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EDITORIAL

ROMANIAN HYDRAULIC POWER IN THE WORLD

We are living in a world in course of globalization, in which who does not comprehend properly the historical trend of nowadays will have to surmount huge difficulties in the daily life. Hydraulics and pneumatics are appropriately framed , according to the new trends of evolution, keeping the right pace both in what regards organizational issues and technical and scientific development. It is unmistakably apparent a regrouping of forces, the smaller specialised companies associating with the bigger ones, ending by a distinct presence of only a few, very representative brands in the field. In what regards technique, pneumatics have already made the qualitative leap up to the future, while hydraulics is still preparing for upgrading its technical and technological level.

In Romania this field is still affected by the economic crisis of the last years and by its ceaseless endeavours to integrate into the world elite of this domain. The number of the employees in the field was reducted over 15 times and production was also cut over 10 times, which led to such an intricate situation which we have not been able to overcome yet. Our chance is represented by the few active national cores from Bucharest, Cluj, Iasi, Ramnicu Valcea, Timisoara or Sibiu which by tremendous efforts have succeded to maintain Romanian hydraulics on the European map of this field.It is worth mentioning that big companies have come on the Romanian market but they have not proved any intention yet of starting any production of equipment, but only of systems and their most important activity is that of sale.

Despite all these facts and improper conditions, we have to mention the successfull association of the companies from the field in FLUIDAS, which has already joined CETOP, the European professional association and succeeded to promote and maintain good relationships with similar associations from other countries like Poland, Italy, Germany or Russia.

Ph.D.Eng. **Petrin DRUMEA**
MANAGER
Hydraulics & Pneumatics Research Institute

It is not negligible the cooperation between certain research and academic centres from our country with the most famous European centres of the like, even if the direct contacts between these have not been very significant.The most important system of connections of the Romanian scientists and professionals with those from other countries is that of direct contacts. It deserves mentioning here the meetings with the specialists from Aachen, Torino, Wroclaw, Cracow, Toulouse, Poitiers, Russe, Chisinau, Prague or Vienna who honoured with their presence the HERVEX annual international scientific reunion. But although the direct scientific contacts and meetings were numerous their concrete relevance to the national research and production is extremely low. The contacts of the last years on FP7 themes or structural funds seem to bring a slight change in what regards international cooperation in the field, with concrete results for Romanian hydraulics.

In the end we remark the tendency of rebuilding international relationships, on a new groundwork, according to the real demands of the national economy and to the common interests in technical and scientific activities of our most important foreign partners and the Romanian representative names in the field.

EDITORIAL

HIDRAULICA ROMANEASCA IN LUME

Ph.D.Eng. **Petrin DRUMEA**
MANAGER
Hydraulics & Pneumatics Research Institute

Traim intr-o lume in curs de globalizare, in care cine nu intelege mersul istoriei va avea mari probleme in viata de zi cu zi. Hidraulica si pneumatica se incadreaza destul de bine in noile tendinte, atat din punct de vedere al organizatorii cat si din punct de vedere al dezvoltarii tehnico-stiintifice. In acest sens se poate usor observa regruparea firmelor de specialitate in jurul celor mai puternice, in final ramanand doar cateva mari grupuri care sa fie reprezentative in domeniu. De asemenea se constata ca tehnic pneumatica a efectuat deja saltul calitativ spre viitor in timp ce hidraulica este inca in etapa pregatirii trecerii spre urmatorul nivel tehnic si tehnologic.

In Romania domeniul inca are de suferit atat de pe urma integrarii la nivel mondial cat si de pe urma crizei economico-financiare a ultimilor ani. Reducerea numarului lucratorilor din domeniu de peste 15 ori, a fabricatiei de peste 10 ori a condus la o situatie din care inca nu reusim sa iesim. Sansa noastra o constituie existenta celor cateva nuclee active la nivel national Bucuresti, Cluj, Iasi, Ramnicu Valcea, Timisoara,Sibiu, care cu eforturi deosebite reusesc sa mentina hidraulica pe harta europeana a domeniului. Este interesant ca marile firme au patruns in Romania, dar deocamdata fara activitatea de fabricatie de echipamente ci doar de sisteme si de vanzare a echipamentelor fabricate in alte tari.

Chiar si in aceste conditii s-a reusit crearea unei asociatii a firmelor cu preocupari in domeniu FLUIDAS care fost integrata la nivel european in CETOP si care a reusit sa asigure legaturi foarte bune, inclusiv la nivel de protocoale directe de cooperare cu asociatiile similare din tari ca Polonia, Italia Germania sau Rusia.

Nu este de neglijat nici sistemul relational al unor centre de cercetare si academice din tara noastra cu cele mai prodigioase centre de expertiza europene, chiar daca pana acum contractele directe intre acestea nu sunt

Cel mai important sistem de legaturi al specialistilor romani cu cei din alte tari il reprezinta cel al legaturilor directe.

Dintre acestea as remarca pe cele cu specialistii din Aachen, Torino, Wroclaw, Cracovia, Toulouse, Poitiers, Russe, Chisinau, Praga si Viena care au fost si la intalnirile anuale realizate sub genericul HERVEX. Consider ca desi numarul contactelor personale este destul de mare, efectul acestora asupra cercetarii si productiei nationale este extrem de scazut. Contactele ultimilor ani pe teme de FP7 sau pe Fonduri Structurale par sa modifice ideea simplista de mobilitati si sa se treaca la cooperarea internationala in domeniu, cu rezultate concrete pentru domeniul hidraulicii romanesti.

In final trebuie remarcata tendinta de reasezare a legaturilor internationale pe directia cerintelor reale ale economiei nationale si primele elemente serioase de activitati tehnico-stiintifice si de productie comune cu principalii actori internationali din domeniu.

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SECTION 4. MODERNIZATION AND NEW PRODUCTS, TECHNOLOGICAL TRANSFER

SECTION 5. LOGISTICS INFRASTRUCTURE FOR DEVELOPMENT OF THE FIELD

MODELLING AND SIMULATION OF THE DRIVING SYSTEM OF THE CATERPILAR CARRIER

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Summary
The use in surface mining of conveyor caterpillars that convey high-weight structural members over roads of various types of sub-grades and slopes requires to determine both the properties and the capacities of the conveyor caterpillar. Due to the missing opportunities to carry out experimental research, upon analysis of the operation of this system, a series of fairly essential simplifying assumptions was adopted – considering the initial nature of the research. On this basis, a mathematical model of the driving system was developed, made up of: a combustion engine, two hydrostatic gears and engines of a variable specific capacity and a driving mechanism of the conveyor caterpillar. The results of the preliminary simulation testing and their study are presented.
Abstract
A conveyor caterpillar used in surface mining faces barriers and limitations in cases of driving over roads laden with significant slopes and different soil types. To overcome these difficulties a mechanical-electronic driving control process should be present in the system to minimize its disadvantages. The realization of this idea requires the knowledge of physical phenomena occurring in such systems. Since there is no possibility to carry out experimental research, a mathematical model of the driving system and then the simulation model were designed. Based on this simulation testing, conclusions were drawn, aiming at the improvement of the driving control system.

1. Introduction

The conveyor caterpillar of a special design is dedicated to move, under difficult ground conditions of a surface mine, the driving stations of band conveyors of a band width up to 2500mm. The driving stations as well as other conveyed constructions are, dimensionally, many times bigger that the construction of conveyors, whereas the load capacity of the conveyor is almost three times higher that the weight of its construction. The view of the conveyor is shown in Fig. 1. The conveyor is provided with two groups of hydraulic drives closely related to the functions being accomplished. These are the drives connected with the caterpillar driving mechanism and the drives of operating movements of the platform on which the driving stations and the structural members of conveyors are transported.

The original source of energy for the hydrostatic drives is the diesel combustion engine that drives, via the distributor gear, the assemblies of hydraulic pumps.

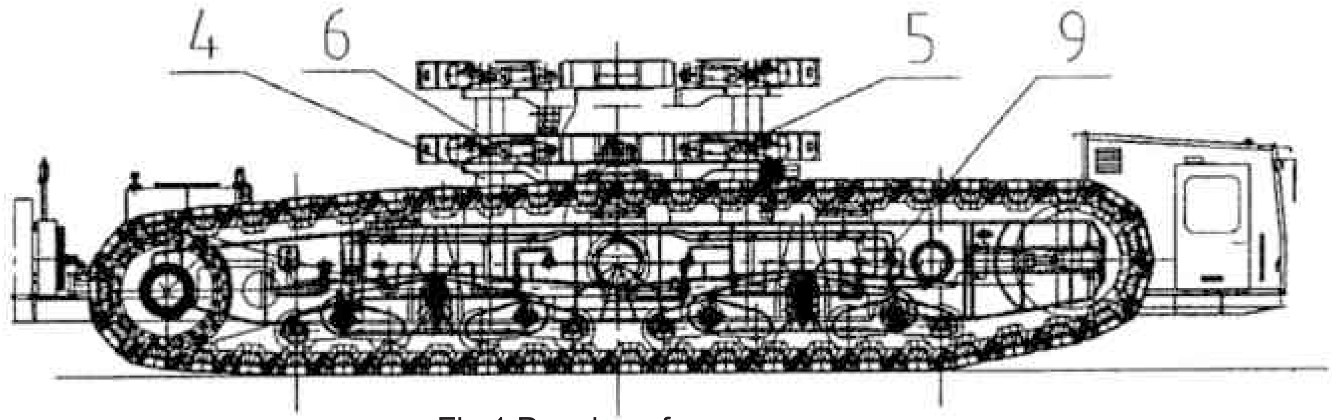


Fig.1 Drawing of a conveyor

Two hydrostatic engines of a variable absorptive capacity were used for the driving system of each caterpillar, mounted on the planetary gear of the driving wheel. The hydrostatic drive is made up of a piston pump of a variable delivery and an alternating pumping direction as well as two hydraulic engines of a variable absorptive capacity, connected in parallel to the power supply line circuit. A change in the delivery and of the flow direction of the pump is made via a proportional valve. The pump is provided with a constant-power regulator. The hydraulic engines are provided with maximum-torque valves.

The hydraulic system of the conveyor caterpillar drive is a typical hydrostatic gear that comprises a pump of a variable delivery and engines of a variable absorptive capacity (Fig. 2).

The gears in which both the pump setting parameter ε_p and the engine setting parameter ε_s can be altered are controlled either sequentially or simultaneously. At the simultaneous control of $\varepsilon_{p,}$ ε_s of both the units, the alteration is made at the same time, according to the pre-determined program. At the sequential control, the variability range of the pump setting ε_p is used first, the engine setting parameter ε_s is used next.

Assuming that the efficiency of the gear cannot drop below η = 0.8, the sequential control system of the gear allows to obtain the widest adjustment range. The obtained span of the dynamic gear ratio i_{rd} and of the kinematic gear ratio i_{rk} is 6 – 7 as opposed to the control solely through the alteration of the pump parameter where the maximum span of the gear ratios is 4.5.

This system allows to obtain 3 speed values of the caterpillar drive. The control distributor set in the position as presented in Figure 2 produces that the engines are switched to the maximum absorptive capacity, thus for the specific value of the pump setting the speed of the engines is the lowest at the maximum torque. The second speed range is obtained when the control distributor is switched to the position corresponding to the parallel flow via the distributor. Then one of the engines is switched to the minimum absorptive capacity.

The third speed range is obtained when both the distributors are switched to the position corresponding to the parallel flow via the distributor, which allows the highest speed of the engines at the lowest torque developed by the engines.

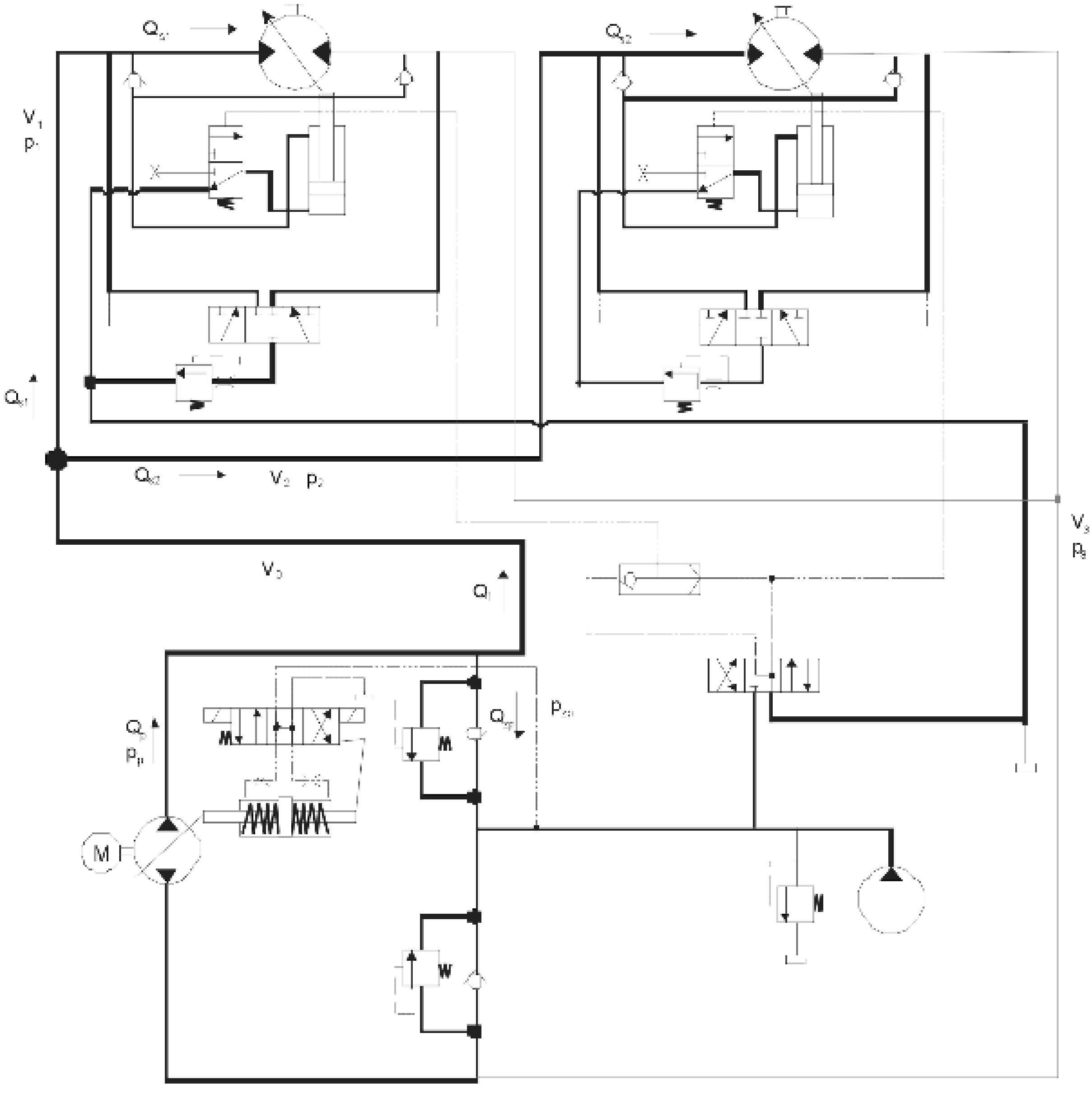


Fig.2 Schematic drawing of the hydraulic system of the driving system

Taking into account the dimensions of the conveyor, its fitness for use in brown coal mines, the knowledge of the dynamic phenomena accompanying the movement of the machines with the load is necessary. On the basis of the results obtained it is possible to impove the algorithms of the conveyor operation control, the more so as the pheonemen of the limited power of the assembly: combustion engine – hydraulic pumps appears. In oder to obtain the intended result, the experimental research should be conducted. The high cost of the experimental research and the technical difficulties to conduct it resulted in the rise in the interest in analytical methods. This paper presents the analytical method to determine the load value of the caterpillar drive basing on a discrete mathematical model.

2. Mathematical model of the hydraulic driving system of the conveyor

2.1. Simplifying assumptions

The mathematical model was created basing on the simplifying assumptions that represent the actual object with required accuracy. For the hydraulic driving system the following simplifying assumptions were adopted:

· the pressure in the system is always higher than atmospheric pressure;
· it was adopetd that the density, viscosity and modulus of elasticity of liquid do not change during the operation of the system;
· it was adopted that there is no dry friction between the movable surfaces;
· it was adopted that there is no cavitation in the system;
· the distortions of the hydraulic pipes and elements were omitted;
· the impact of the limited speed of the propagation of disorders in the system was omitted;
· the efficiency of the drive transmission between he combustion engine and the pump is 100%;
· the pressure in the drain line has a constant value p_3 =const.;
· due to the preliminary and diagnostic nature of the research work constant efficiency values were adopted;
· the movable masses of the conveyor and of the load were reduced to the drive wheel axle.

2.2 Mathematical equations to describe the model adopted

§ Equation of torques: combustion engine - pump

On the basis of the results obtained, the Cummis combustion engine is characterized by the following torque presented in Fig. 3. The engine torque within the speed range n = 700 – 2100 is illustrated by the equation:

$$M_s = \left(9 \cdot 10^{-7} \cdot n^3 - 0{,}0049n^2 + 7{,}7684n - 2154\right)\xi \qquad (1)$$

where: ξ – proportional coefficient decreasing the amount of the fuel fed to the injection pump.

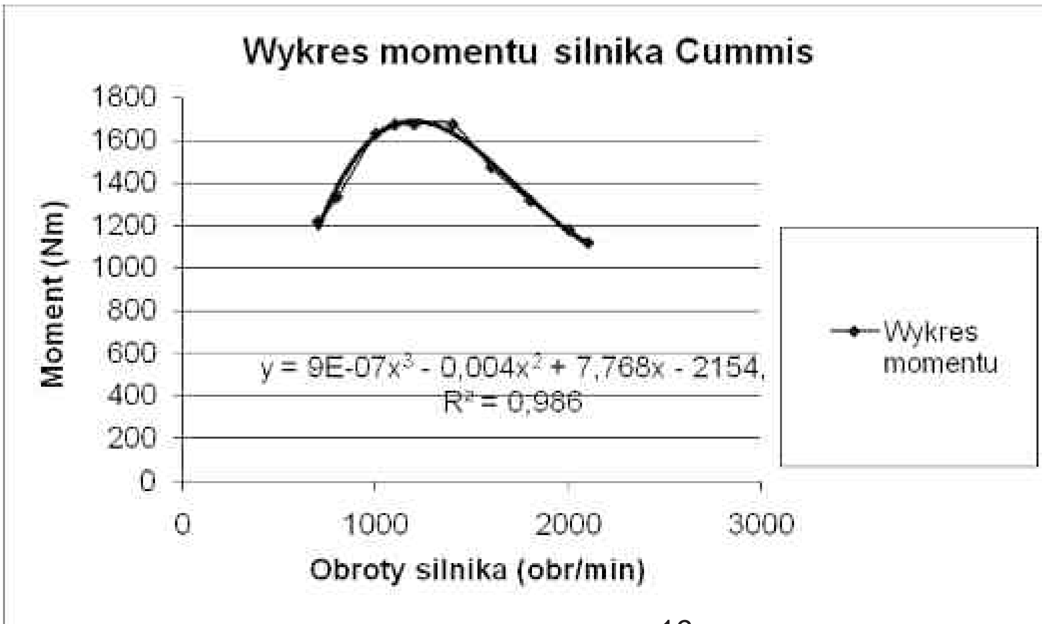


Fig. 3 Graph of the combustion engine torque

The dispositional torque at the outlet from the pump is determined with the following relationship.

$$M_p = \frac{\varepsilon_p \cdot q_p \cdot \Delta p_p}{2\pi} \eta_{vol} \text{ [Nm]} \qquad (2)$$

where:

- ε_p - setting of the pump delivery
- q_p – specific output of the pump, cm^3/revolution
- η_{vol} – volumetric efficiency of the pump
- Δp_p – pressure differential, [MPa]

§ **Equations of the torques of a hydrostatic rotary engine**

The equation of torques adopts the following form:

$$M_s = (M_N + I\frac{d\omega}{dt} + M_{sk} + M_w)/i \qquad (3)$$

where:

- M_s – torque at the outlet from the rotary engine
- M_N – torque resulting from the resistances of the caterpillar movement
- $I\frac{d\omega}{dt}$ moment of inertia of movable elements
- M_w – torque resulting from the wind pressure
- M_{sk} – torque of the caterpillar turning resistance
- i – ratio of the planetary gear

Driving is the typical state of the driving system of the conveyor. In order to reveal all the forces acting on that system, two fragments related to the caterpillar driving wheel and the caterpillar tightening wheel should be separated out of it. During the driving, the active driving force resulting from the operation of the driving system is counterbalanced by the resistances of the movement and the constituents of the force of gravity. If, in addition, the conveyor moves over a sloped ground, then the value of the necessary torque on the mechanism of one caterpillar, reduced to the driving wheel axle, is:

$$M_N = \frac{1}{2}\left[(mg\sin\psi + R_0)\frac{d_1}{2} + M_R\frac{d_1}{d_2}\right] \qquad (4)$$

The force of the movement resistance R_o is calculated as a product of the force of gravity of the conveyor and of the coefficient f of the movement resistance.

$$R_0 = mgf\cos\psi \qquad (5)$$

It is assumed that M_R adopts the value of 10% M_N (on the grounds provided by A. Dudczak).

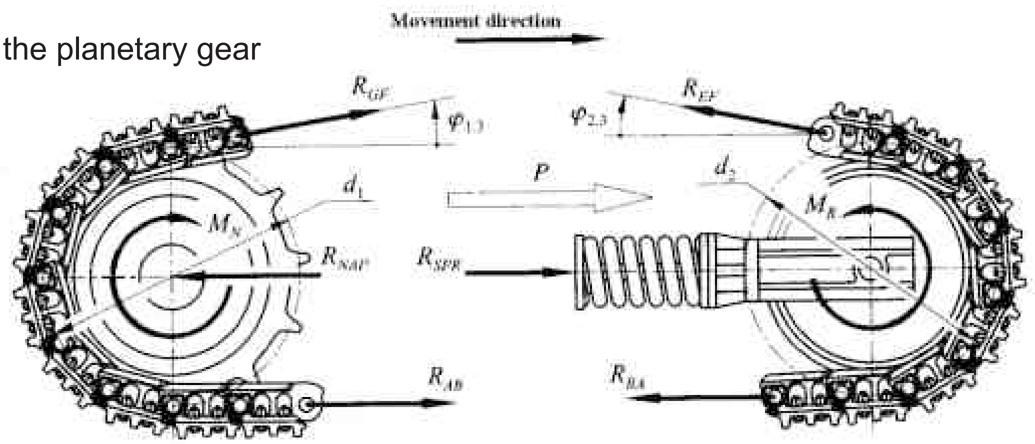


Fig. 4. Forces acting on the caterpillar during the driving

· **Caterpillar turning**

During a change in the longitudinal plane of the caterpillar rolling, e.g.: when driving over a curvilinear path or during a turn on the spot, friction resistances appear at the contact place of the caterpillar with the ground, and on the soft ground, shearing resistances and lateral ground push-off resistances appear as well . These resistances are dependent on the momentary revolution radius, that is the caterpillar turning radius.

In the calculation of the total turning resistance two basic constituents are discriminated: M_t – moment of the caterpillar friction against ground and M_c – shearing moment or crushing moment of the ground with the side edges of the caterpillar, that is

$$M_{sk} = M_t + M_c \tag{6}$$

§ Equations of flow

- pump – tee, in front of hydraulic rotary engines

$$Q_{pn} = Q_{zb} + \frac{V_0}{B}\cdot\frac{dp_p}{dt} + G_p\sqrt{p_p - p_1} \tag{7}$$

where:

- Q_{pn} – pump deliverydtdpBVp×0
- $\frac{V_0}{B}\cdot\frac{dp_p}{dt}$ flow produced by the liquid compressibility
- V_0 – volume of the pipes between the pump and the tee
- B – modulus of cubical elasticity of liquid
- Q_{zb} – amount of liquid flowing out via the overflow valve1.ppGpp-
- $G_p\sqrt{p_p - p_1}$ amount of liquid flowing to the rotary engines

- Equations of flow: tee – hydraulic rotary engines

$$G_p\sqrt{p_p - p_1} = Q_{s1} + Q_{s2} + \frac{V_1}{B}\cdot\frac{dp_1}{dt} + \frac{V_2}{B}\cdot\frac{dp_1}{dt} \tag{8}$$

where:

- Q_{s1} - amount of liquid flowing to engine No. 1
- Q_{s2} - amount of liquid flowing to engine No. 2dtdpBV11×
- $\frac{V_1}{B}\cdot\frac{dp_1}{dt}$ flow produced by the liquid compressibility in the pipe bringing the liquid up to engine No. 1dtdpBV12×
- $\frac{V_2}{B}\cdot\frac{dp_1}{dt}$ flow produced by the liquid compressibility in the pipe bringing the liquid up to engine No. 2.

The absorptive capacity of the rotary engines is described with the following relationships:

$$Q_{s1} = \frac{n_{s1}\cdot q_{s1}\cdot \varepsilon_{s1}}{\eta_{vols1}} \tag{9}$$

$$Q_{s2} = \frac{n_{s1}\cdot q_{s2}\cdot \varepsilon_{s2}}{\eta_{vols2}} \tag{10}$$

where:

- n_{s1}, - sped of the hydraulic engine
- q_{s1}, q_{s2} – specific absorptive capacities of the engines
- ε_1, ε_2 – setting parameters of the engines
- η_{vols1} ,η_{vols2} – volumetric efficiencies of the engines

The speeds of the engines are, respectively:

$$n_{s1} = \frac{\varepsilon_p}{\varepsilon_{s1}}\cdot\frac{q_p}{q_s}\cdot n_g.\eta_{vol1} \tag{11}$$

$$n_{s2} = \frac{\varepsilon_p}{\varepsilon_{s2}}\cdot\frac{q_p}{q_s}\cdot n_g.\eta_{vol2} \tag{12}$$

3. SIMULATION MODEL

To model the equations, the computer software of The MathWorks company was used, bearing the name MATLAB, with the Simulink software package. The Simulink software is an interactive software package used to model, simulate and perform the dynamic analysis of continuous, discrete and mixed systems. The mathematical models are constructed in form of block diagrams, which provides a clear system of the model. An additional advantage of the Simulink software package is a rich set of libraries with mathematic operations, facilitating the work with the model. An essential advantage is the option of presenting the graphs of several relationships in one window, this allows to watch several parameters of the model at one time.

The use of the computer software allows to quickly resolve the differential equations using numerical methods. This significantly shortens the time to resolve the problem and allows to make alterations in order to optimize the model.

The Simulink software package makes available a dozen or so methods of numerical integration.

4. Results of preliminary simulation testing

Figs. 5-8 present some exemplary results of the simulation testing.

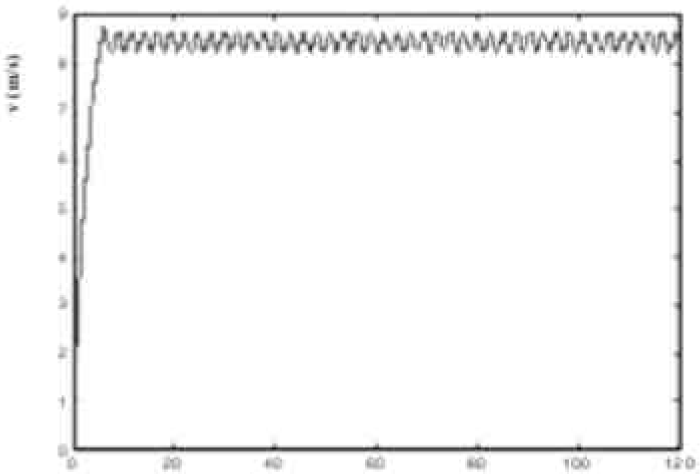


Fig.5. Graph of the speed of the conveyor over a flat ground, laden with a torque Mn=242100Nm

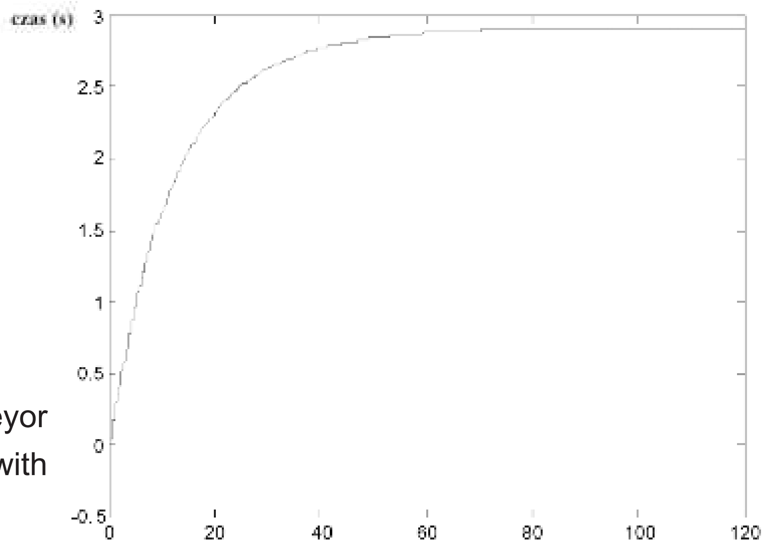
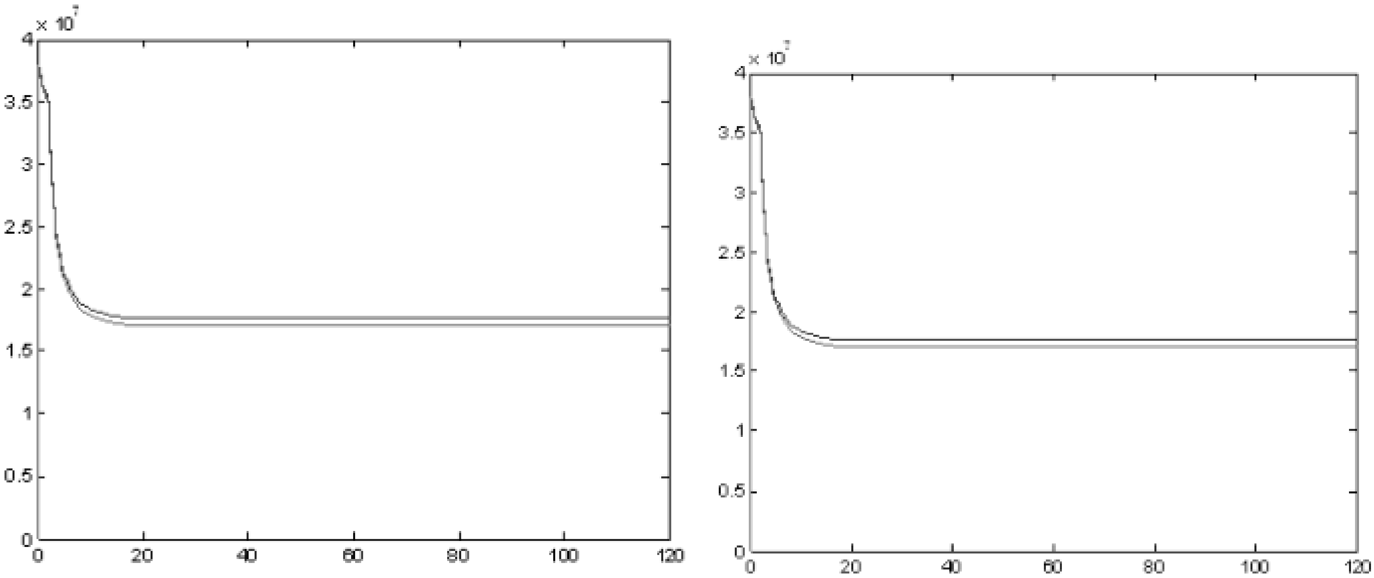


Fig. 6. Graph of the speed of the conveyor (m/min) up-hill of a slope of 11°, laden with the maximum torque Mn = 2128600Nm



Rys. 7. Runs of the pressures p_p and p_s (Pa) for the conveyor driving up-hill

5. Final conclusions

On the basis of the preliminary simulation testing the following conclusions may be drawn:

1) The testing demonstrated that the conveyor can move with two speeds only.

2) When driving up-hill (11° max.), the conveyor can move with one minimum speed only.

3) The fundamental obstacle in obtaining the assumed parameters of the conveyor movement is the wrongly selected combustion engine that has too low a driving torque within the high speed ranges. It seems that the work should be continued, in particular within the scope of the hydrostatic gear control. In the present situation, the pump efficiency is used at 60% only. Therefore a new control algorithm for the gear under discussion should be suggested in order to partially eliminate the imperfection of the drive.

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11.Katalogi firmy REXROTH

MATHEMATICAL MODELS FOR LOOPED PIPES NETWORKS IN STATIONARY AND TRANSIENTS REGIMES

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Abstract:
This paper proposes for the calculus of loop pipes two procedures able to solve the problems connected with their design and operation indifferent of the complexity of the hydraulic system or network. In transient regimes it is used the method of characteristics and in stationary regimes the Hardy Cross method. Both methods are programmable by electronic computer languages. The work offers numerical data obtained through application of the abovementioned methods on particular hydraulic networks.

1. INTRODUCTION

Hydraulic systems are generally composed from hydraulic networks and hydraulic machines. Hydraulic networks consists of : pipes, valves, vessels and basins (reservoirs) connected between through branches, loops or a combination among them. Hydraulic machines may be generators (pumps) or motors (turbines). The working fluid is usually water but may be also other liquids like oil, liquid metal and sometimes air with definite conditions.

The operation researches of hydraulic networks, included in a hydraulic system, are possible through different methods in stationary regimes and in non-stationary and transients regimes.

In stationary regimes to obtain a valid solution for the design and operation of branched hydraulic pipes it is used the Bernoulli equation (energy transfer equation), the continuity equation and hydraulic losses formula. For hydraulic loops in a stationary regime it is used through electro-hydrodynamic analogy Kirchhoff's laws and Hardy Cross method.

In non - stationary regimes for branched hydraulic networks it is proved that the characteristic method is useful. At last the most complex case is to describe in non-stationary regimes looped hydraulic networks. In this situation it is used a combination between the characteristic method and Hardy Cross method.

Finally the established methods will be applied to a hydraulic pumping system provided with a multi loop hydraulic network which extract the liquid (water) from a basin and discharged it in an other reservoir. The system's rate of flow is controlled through a valve. The transient regime considered is the start of the feeding pump of the system. Therefore an exploitation problem of known hydraulic system is considered. For it will be established the variation of the pumping head and pressure in various points (cross sections) of the system together with the flow rate and mean velocity in every section of the network's pipes.

2. MATHEMATICAL MODELS

The method of characteristic applied to a pipe operating in transient regime needs to be divided into N reaches and than used the continuity and motion equations established for one dimensional stream in non-stationary regime. In principle the solution of a system of partial differential equations with distributed parameters may be transformed by the method of characteristics into particular total differential equations.

These latter equations may then be integrated to yield finite difference equations which are conveniently handled numerically along privileged "characteristic" directions in space and time.

The Hardy Cross method utilizes an iterative rapid convergent method to correct the flow rates on every loop of the hydraulic network.

Actually it is used a numerical method to solve a second degree polynomial equation (sometimes it may be used the power 1,85 instead 2) through the tangent method.

A plane loop hydraulic networks an ensemble of pipes under pressure consisting of "n" nodes or joints and "m" branches or pipes, disposed so that in every node to converge at least two branches, two certain nodes to be connected through a pipe and the branches to not be connected in points which are not nodes. The nodes and reaches of a looped network formed in plane "b" loops which are the frontiers of "b" finite domains. Every time there exists the relation

b = m+n+1.

If there are noted with "a_i" the pipes number which are convergent in N_i and \ M_{ij} – the hydraulic modulus introduced by :

$$h_{p_{ij}} = \lambda \cdot \frac{l}{d} \cdot \frac{v^2}{2 \cdot g} = M_{ij} \cdot Q^2$$

of the pipe "j" in node "i"

Q_{ij} – the flow rate of the pipe which connects the points "i" and "j"

Q_i – the feeding (supplying) or consumption from outside of the loop rates of flow and

$$B_{ij} = \frac{c}{g \cdot A}$$

The continuity equation takes the shape:

$$\sum_{i=1}^{a_i} \left(\pm Q_{ij}\right) \pm Q_i = 0$$

in which the income rates of flow in N_i are considered positive and the outcome from N_i are negative.

The calculus of plane loop hydraulic networks is made In the following steps:

- In the case of a design problem, it is adopted on every pipe a stream direction so that the remote consumers to be supplied on the shortest route ;
- After that it is choose the initial guess of the pipes rates of flow $Q_{ij}^{(0)}$ so that to the consumers to be assured the required rates of flow and in the network nodes to be satisfied the continuity equation ; with the initial rates of flow it is choose the diameters of the pipes Dij – based on the technical - economic table : for example D=0,1 m Q=5,4 l/s; D=0,5 m Q=0,2 m3/s; D=1 m Q=1 m3/s. With these diameters it are determined the real rates of flow in the pipes with the Hardy Cross method which will be described further.
- In the case of a exploitation problem namely when it are known the pipes diameters and consumers needs, Q_i (t), it are choose the initial rates of flow $Q_{ij}^{(0)}$ and the stream direction in every loop's branch and is calculated the real rates of flow in all the reaches through Hardy Cross method.

The Hardy Cross method is applied after establishing in all hydraulic network the flow direction, the initial rates of flow and the pipes diameters.

The calculus continue with the following operations :

- of all hydraulic network loops it is adopted a positive traversing direction (par example clockwise direction)
- on every pipe it is calculated Mij with a major hydraulic losses coefficient λ_{ij} (usually for rough turbulence)
- for every loop "k" there are defined the hydraulic losses corresponding to the iteration "p".
- for every loop there are calculated the correction rates of flow corresponding to the iteration :

$$\Delta Q_k^{(p)} = -\frac{\sum_k \left\{\pm M_{ij} \left[Q_{ij}^{(p-1)}\right]^2\right\}}{2 \cdot \sum_k M_{ij} \cdot \left|Q_{ij}^{(p-1)}\right|}$$

- the corrected initial or precedent rates of flow :

$$Q_{ij}^{(1)} = Q_{ij}^{(0)} \pm \Delta Q_k^{(1)}$$

In relation (3) it is introduced + or – in respect of the flow direction in the pipe "ij", if it is the same or against the positive direction adopted for the loop.

With the new rates of flow it are calculated the new hydraulic losses and are introduced together with new rates of flow in relation (2).

The iterative process is stopped if it is fulfilled a chose quality criteria like $\left|h_{p_{rk}}\right| < 0,5$ m

The exact solution corresponds for $h_{p_{rk}} = 0$

Usually the process is rapid convergent especially if the initial rates of flows was elected judiciously.

3. APPLICCATION ON A TYPICAL NETWORK

- It is considered the hydraulic network from Figure 1
- How it can be observed this hydraulic pumping system contains hydraulic network loops of pipes the feeding pump, suction basin, the discharge reservoir and the consumer. The research is focused on the pumps start from rest and provided with a valve in point 9. It is known in different moments (through rates of flow in time) the corresponding consumers rates of flow in the point 6. It is determined the celerity of every pipe reach. Also for every pipe it is known the hydraulic modulus or the unitary hydraulic losses (the losses for unit rate of flow) and the conductance. It is accepted the pump equation namely the pumping head in function of rate of flow for parametric angular velocities of the impeller.
- It is introduced a coding system with purpose of generalization of this application to any geometry of the hydraulic network of pipes. So with the sign “+” and “-“ in four combinations, it are defined :
- \+ + usual node;
- \+ - outlet in the reservoir with the given Q(t) ;
- \- + reservoir

\- - outlet with a valve with a known rate of flow coefficient.

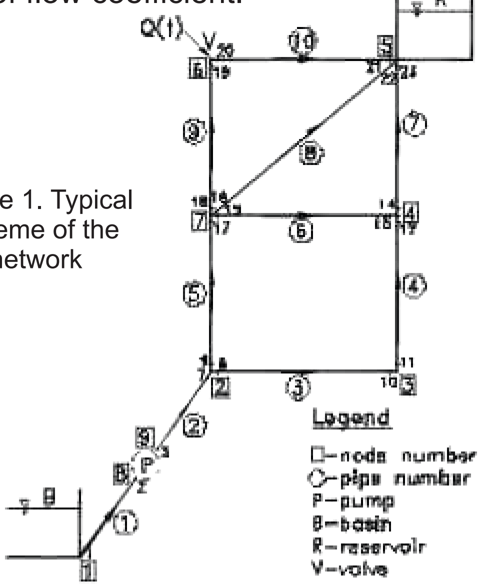

Figure 1. Typical scheme of the network

The flow is considered positive if it enters in a node and negative if it goes out from a node.

Indexing through coding the network with a line matrix which contains successive, indifferent of the order, for every pipe the following : ± the junction number, ± the numbers of pipes which converge in a node, ± the pipe number, the number of the pipe section at the node, repeating this ensemble for every node of the network. “0” means the end of the line matrix (the list).

Based on these assumptions it is erected a program in FORTRAN IV language.

The initial data introduced are :

Mij = 5; 4; 40; 40; 40; 200; 25; 300; 50; 50 <s2/m5>

Bij = 250; 270; 420; 420; 420; 1000; 500; 1000; 500; 500 <s/m2>

Qoutput = 0; 0; 40; 0; 10; 0,2 <m3/s>

CDG = $\mu \cdot A_g \cdot \sqrt{2 \cdot g}$ = 0; 0; 2; 0; 10; 0,06 <m5/2/s>

Outlet points level: z(6) = 20 <m>

Piezometric head: H1 = 0 <m> ; H5 = 40 <m> ; HR = 40 <m>

Pump nominal rate of flow QR = 0,6 <m3/s>

Startup duration Ts = 2 <s>

Pump equation

$$H_p = H_R \cdot \left[1{,}28 \cdot \alpha^2 - 0{,}1 \cdot \alpha \cdot \frac{Q_p}{Q_R} - 0{,}1 \cdot \left(\frac{Q_p}{Q_R} \right)^2 \right]$$

$$\alpha = \frac{T}{T_S} + 0{,}5$$

Time step $\Delta T = 0{,}5 =$ <s>

The program “Non-stationary hydraulic network loops” was computed and there was obtained the following results

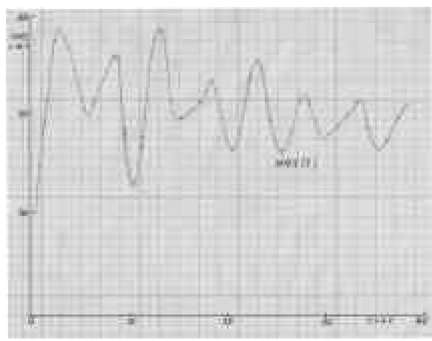

Figure 2. Piezometric head variation, in point 2, during transient pump startup process

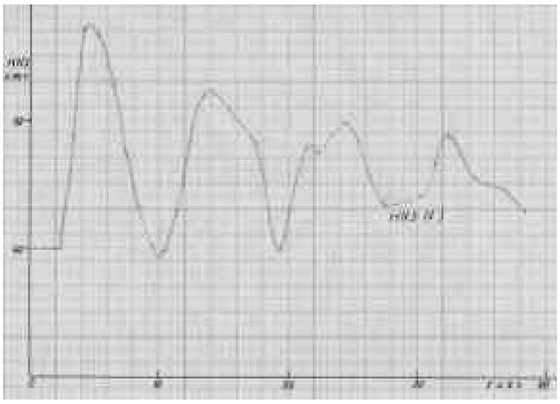

Figure 3. Piezometric head variation, in point 3, during transient pump startup process

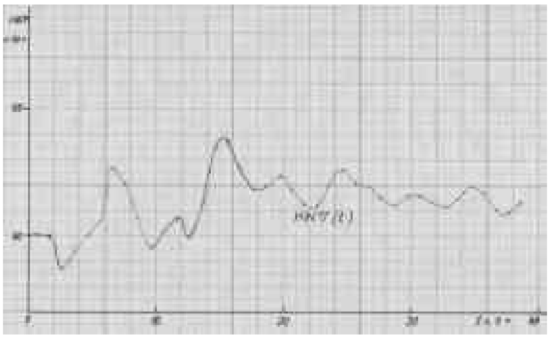

Figure 4. Piezometric head variation, in point 3, during transient pump startup process

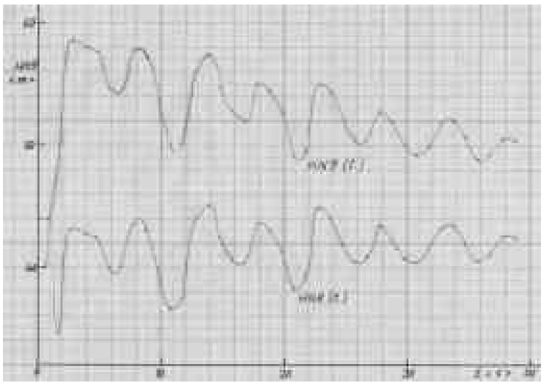

Figure 5. Piezometric head before and after the pump P, respectively in points 8 and 9.

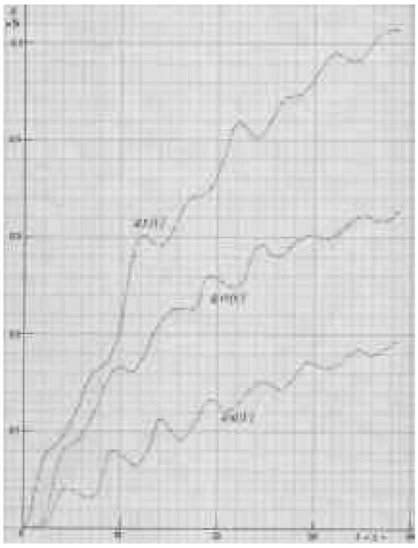

Figure 6. Rate of flow variation in the points 3, 10 and 17 during hydraulic system's pump startup

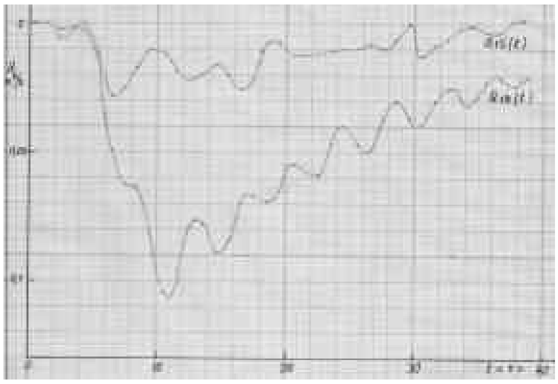

Figure 7. Rate of flow variation in the points 15 and 18 during hydraulic system's pump startup

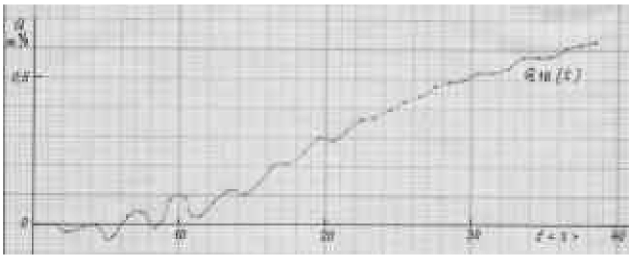

Figure 8. Rate of flow variation in the point 16 during hydraulic system's pump startup

In stationary regime particularizing the formula (1), (2) and (3) it is obtained :

for $p = 2$

$$h_{p1} = \lambda \frac{1}{D} \frac{Q^2}{A^2} \frac{1}{2g}$$

$$h_p = h_{p1} l$$

$$\Delta Q_{ij} = -\frac{\sum h_p}{\sum 2 \frac{h_p}{Q}}$$

The hydraulic system on which are applied the formula is the same. In Fig.9 are given the specific geometric and hydraulic details.
Iterative calculus for every loop are summarized in the following tables :

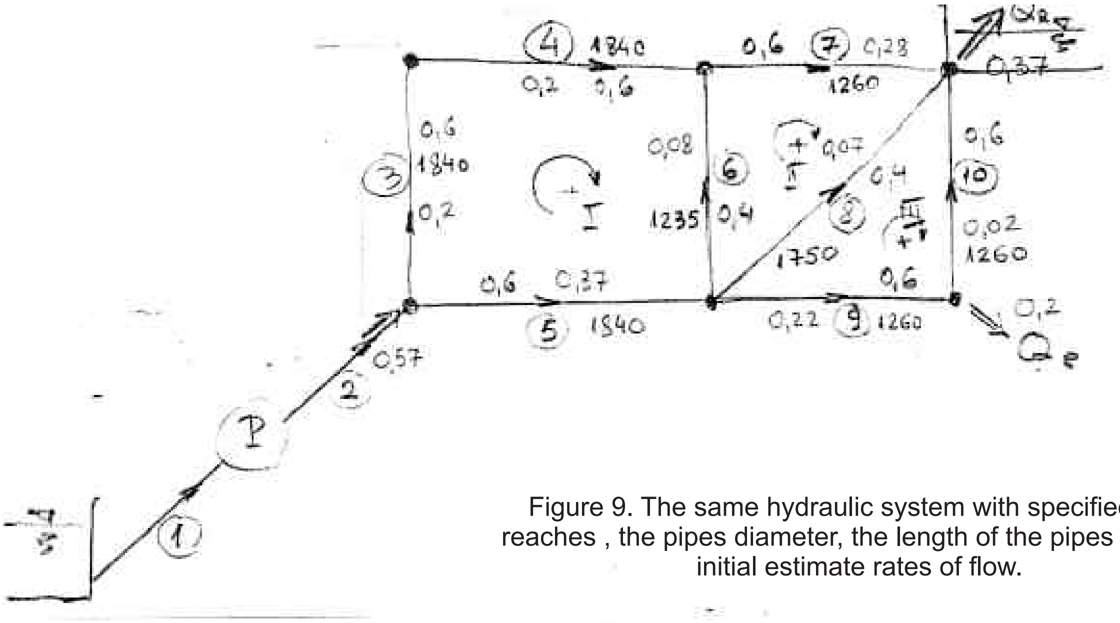

Figure 9. The same hydraulic system with specified pipe reaches , the pipes diameter, the length of the pipes and the initial estimate rates of flow.

ITERATION 1 LOOP I

Nr.	L <m>	D <m>	A <m2>	Q <m3/s>	hp1 < - >	hp <m>	hp/Q <s/m2>
3	1840	0,6	0,2826	0,2	0,0212733	39,142872	195,71436
4	1840	0,6	0,2826	0,2	0,0212733	39,142872	195,71436
6	1235	0,4	0,1256	-0,08	-0,1615449	-199,50795	2493,8493
5	1840	0,6	0,2826	-0,37	-0,0212733	-39,142872	105,79154
						-160,36508	2991,0695

$\Delta Q = -0{,}0268061 < m^3/s$

ITERATION 1 LOOP II

Nr.	L <m>	D <m>	A <m2>	Q <m3/s>	hpl < - >	hp <m>	hp/Q <s/m2>
6	1235	0,4	0,1256	0,08	0,1615449	199,50795	2493,8493
7	1260	0,6	0,2826	0,28	0,0212733	26,804358	95,72985
8	1750	0,4	0,1256	0,07	-0,1615449	-282,70357	4038,6224
						- 56,39169	6628,2015

$\Delta Q = +0{,}00421944626 <m3/s>$

ITERATION 1 LOOP III

Nr.	L <m>	D <m>	A <m2>	Q <m3/s>	hpl < - >	hp <m>	hp/Q <s/m2>
8	1750	0,4	0,1256	0,07	0,1615449	282,70357	4038,6224
10	1260	0,6	0,2826	0,02	-0,0212733	-26,804358	1340,2179
9	1260	0,6	0,2826	0,22	-0,0212733	-26,804358	121,83799
						229,09486	5500,6782

$\Delta Q = -0,020824239 < m^3/s >$

ITERATION 2 LOOP I

Nr.	L <m>	D <m>	A <m2>	Q <m3/s>	hpl < - >	hp <m>	hp/Q <s/m2>
3	1840	0,6	0,2826	0,2268	0,0212733	39,142872	172,58761
4	1840	0,6	0,2826	0,2268	0,0212733	39,142872	172,58761
6	1235	0,4	0,1256	-0,0532 + 0,0843932 =0,03119343	0,1615449	199,50795	5813,1687
5	1840	0,6	0,2826	-0,3432	-0,0212733	-39,142872	114,05265
						238,65082	6172,1627

$\Delta Q = -0,0193328 < m3/s >$

4. CONCLUSIONS

1) The article put in evidence the modeling possibilities, in one-dimensional approximation, of the hydraulic regime from hydraulic systems consisting from loop pipe networks.
2) The mathematical model used for describing the hydraulic network operation in transient regimes is based on an extension of the method of characteristics after a before mentioned definition of local-global topological structure of the network.
3) The mathematical calculus of the network in stationary regimes uses an electro-hydrodynamic analogy from Kirchhoff to Hardy Cross. The process is iterative, and rapid convergent a little bit more complicated like in electricity because of the nonlinear character of hydraulic losses.
4) The particularization for numerical calculus in transient regimes provides interesting excursions of the parameters : rates of flow and piezometric head in respect of the position in the network and the moment of time considered during the transient regime.
5) The results of the application of the Hardy Cross method for the looped network demonstrate the efficiency, precision and convergence of the method and the theoretical foundation of the method through an approximation explained graphic-analytical.

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MECANISMUL PILOTĂRII SUPAPELOR

Mat.ing. Gabriel Radulescu, Dr.ing. Gheorghe Sovaiala, Drd.ing. Radu Radoi,
Ing. Niculaie Mihai - INOE 2000 - IHP, BUCURESTI - ROMANIA

Spre deosebire de supapele comandate direct care la creşterea presiunii de intrare răspund cu o deschidere progresivă (în rampă), supapele pilotate la depăşirea presiunii reglate produc o deschidere totală (în treaptă)

1 <u>Modelul constructiv</u> adoptat este redat de Fig. 1

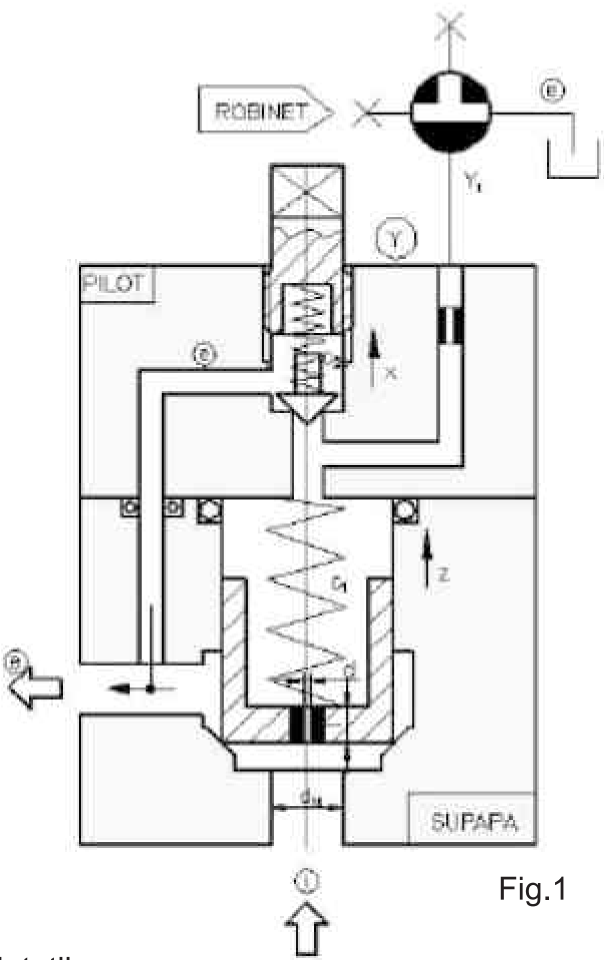

Fig.1

Notaţii:
i: intrarea în supapă conectată în derivaţie cu circuitul de înaltă presiune;
e: ieşirea din supapă şi corectarea cu joasă presiune;
Y: circuitul de pilotare;
x: deplasarea pilotului;
y: deplasarea supapei.

Componenta este evidenţiată de figura 1

- Supapa pilotată într-un corp se poate deplasa *z* contra unui arc nereglabil, izolează circuitul *i* şi *e* în stare închisă şi permite comunicarea circuitului *i* cu *Y* printr-o duză;
- Pilotul aşezat pe un scaun, se poate deplasa *x* contra unui arc reglabil şi închide etanş comunicarea *Y* cu *e* în regim de nefuncţionare

2 Stările funcţionale ale supapei

- Supapă închisă

Când $p_i < p_{nom}$, p_{nom} : presiunea de regim a circuitului

<u>Supapa</u> rămâne închisă cu o forţă de închidere egală cu prestrângerea arcului, forţele de presiune fiind în echilibru ca presiuni egale pe secţiuni egale.

<u>Pilotul</u> nu permite comunicarea între circuitele *Y* şi *e* deoarece forţa de presiune pe pilot rămâne mai mică ca forţa de prestrângere a arcului $A_k \cdot p_i < c_2 \cdot (H_1 - H_2)$

- <u>Supapă pilotată intern</u>

Momentul când $p_i > p_{nom}$ care are ca, consecinţă $A_k \cdot p_i > c_2 \cdot (H_1 - H_2)$ pilotul permite comunicarea *i* – *y* – *e* şi debitul Q_c care curge prin pilot implicit prin duză când produce o cădere de presiune $p_i - p_y = k(d, l, \eta) Q_c$ care deplasează cu z supapa contra arc, permiţând comunicarea directă $i - e$ doarece

$$p_i A_s > p_y A_s$$

-<u>Supapa pilotată extern</u>Dacă în derivaţia pilotului există un circuit Y_1 care printr-un organ de închidere poate stabili comunicarea Y_1 – e succesiunea de fază de la pilotarea internă se produce având ca, consecinţă deplasarea z a supapei iar pilotul rămâne închis, presiunea de deschidere fiind în $p_{min} < p_i < p_{nom}$.

Cu alte cuvinte deschiderea supapei se produce la o comandă externă la orice $p_i < p_{nom}$

3 Descriere constructiv funcţională

a) Modelul fizic al pilotului este redat de Fig 2

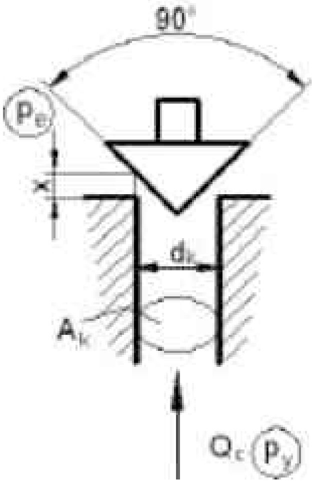

Fig 2

- Relaţiile de legătură între parametrii pilotului [4]

$$p_y - p_e = \xi_c(x)\cdot\frac{1}{2}\rho\left(\frac{Q_c}{S_c}\right)^2$$ căderea de presiune în pilot;

$$p_i - p_y = \frac{188\eta\cdot kQ_c}{\pi d_c^3}$$ căderea de presiune prin duză, în care:

$$\xi_c(x) = 0{,}15 - 4\left(\frac{x}{dk}\right) + 0{,}15\left(\frac{dk}{x}\right)^2$$

coeficientul de pierdere locală prin pilot

$$S_c(x) = (\pi\sin 45\cdot dk)x - (\pi\sin^3 45)x^2$$

secţiunea de trecere prin pilot când acesta este deschis cu deplasarea „*x*” $k = 5...10$, se ia $k = 6$ raportul lungime – diametrul duzei, cu

$$c_2 = \frac{A_k(p_i - p_y)}{x}$$ (c_2 constanta elastică a arcului pilotului).

b) Modelul fizic al supapei este redat de Fig 3

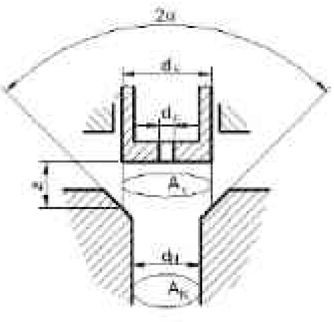

Fig 3

Relaţiile de legătură între parametrii supapei:

$$p_i - p_e = \xi_L(z)\frac{1}{2}\rho\left(\frac{Q_L}{S_L}\right)^2$$ căderea de presiune în supapă, în care:

$$\xi_L = 0{,}5 + 0{,}15\left(\frac{A_N}{A_z}\right)^2$$ coeficientul de pierdere prin supapă;

$$S_L = \pi z\sin\alpha\left(d_L + z\cos\alpha\sin\alpha\right)$$

secţiunea de trecere prin supapă când aceasta este deschisă cu deplasarea „z”

$$c_1 = \frac{A_s(p_i - p_e)}{z}$$ constanta elastică a arcului supapei

4 Evaluări cantitative asupra parametrilor constructivi şi funcţionali

Parametrii anticipaţi trebuie aleşi astfel ca c_2 să fie egal

a)Se anticipează următoarele dimensiuni şi parametrii

- Deschiderea nominală a supapei $d_N = 20\ mm$ valoare care reprezintă media valorilor în seria de supape de uz general cuprinsă între 10 şi 32 mm;
- Diametrul duzei d_c = 0,5 mm valoare ce reprezintă minimul domeniului de valori $d_c \cong 0{,}4...0{,}8mm$
- Căderea de presiune care produce deschiderea supapei se admit $\Delta p_L = p_i - p_e \cong 5bar$
-d_k = *1 mm* diametrul de închidere al pilotului;
- Vâscozitatea, respectiv densitatea mediului fluid sunt:

$$\eta = 0{,}0342\left(\frac{Kg}{m\cdot s}\right)\ ;\ \rho = 855\frac{Kg}{m^3}$$

b) Evaluări numerice au ca scop evidenţierea ordinelor de mărime al principalelor parametrii constructivi:

b1) Pilotul:

- Debitul ce trece prin duza supapei:

$$Q_c = \frac{\pi d_c^3\Delta p}{128\eta k} = \frac{\pi\cdot(0{,}5\cdot10^{-3})^3\cdot5\cdot10^5}{128\cdot0{,}0342\cdot6} = 7{,}47\cdot10^{-6}\left(\frac{m^3}{s}\right)\left(448\frac{cm^3}{min}\right)$$

- Coeficientul de pierderi de sarcină prin pilot:

$$\xi_c = 0{,}15 - 4\left(\frac{x}{dk}\right) + 0{,}15\left(\frac{d_k}{x}\right)^2$$

în care x ~ 10^{-5} m (x ~ 0,02 mm) iar d_k ~ 10^{-3} m, se observă că:

$$4\left(\frac{x}{d_k}\right) \sim 4\frac{10^{-5}}{10^{-3}} \sim 4\cdot 10^{-2} \quad ;$$

$$0{,}15\left(\frac{dk}{x}\right)^2 \sim 0{,}15\left(\frac{10^{-3}}{10^{-5}}\right)^2 \sim 10^{-1}\cdot 10^{4} \sim 10^{3}$$ deci:

$$\xi_c(x) \cong 0{,}15 + 0{,}15\left(\frac{dk}{x}\right)^2$$ în care d_k ~ 10^{-3} *(m)* în final:

$$\xi_c(x) = 0{,}15\left(1 + \frac{10^{-6}}{x^2}\right)$$

* Secţiunea de trecere prin pilot

$$d_k = 1\cdot 10^{-3} m \quad A_k = 7{,}8\cdot 10^{-7} m^2$$

$$S_c(x) = (\pi d_k \sin 45)x + (\pi \sin^2 45)x^2 = 2{,}22\cdot 10^{-3} x - 1{,}11 x^2$$

- Înlocuind în expresia căderii de presiune $p_y - p_e$ rezultă ecuaţia în x:

$$E(x) = \frac{\xi_c(x)}{S_c^2(x)} = \frac{2(p_y - p_e)}{\rho Q_c^2} = \frac{2\cdot 100\cdot 10^5}{855\cdot (7{,}47\cdot 10^{-6})^2} = 4{,}19\cdot 10^{14}\left(\frac{1}{m^4}\right)$$

Ecuaţia:

$E(x) = 4{,}2\cdot 10^4$ este verificată de x ~ 10^{-5} m

Coeficientul elastic al arcului pilotului pentru

$$\Delta p \sim 10^7 \frac{Kg}{m\cdot s^2}(100 bar)$$

$$c_2 = \frac{A_k\cdot \Delta p}{x} \sim \frac{10^{-7}\cdot 10^7}{10^{-5}} \sim 10^5\left(\frac{Kg}{s^2}\right) \rightarrow \left(10\frac{daN}{mm}\right)$$

b2) <u>Supapa</u>

- Constructor $d_s = 1{,}15 d_N = 1{,}15\cdot 20 = 23\,mm$

Dacă supapa este deschisă la nominalul secţiunii şi dacă $\alpha = 45^0$:

$$z = \frac{\sqrt{d_s^2 + d_N^2 \cos\alpha} - d_s}{\sin 2\alpha} = \frac{\sqrt{23^2 + 20^2 \cos 45}}{\sin 2\cdot 45} = 5{,}4$$

si

$$\begin{cases} A_L = A_N = \dfrac{\pi\cdot 2^2}{4} = 3{,}14 cm^2 \rightarrow (3{,}14\cdot 10^{-4} m^2) \\ \xi_L = 0{,}5 + 0{,}15\left(\dfrac{A_N}{A_L}\right)^2 = 0{,}5 + 0{,}15 = 0{,}65 \end{cases}$$

Pierderea de sarcină prin supapă admisă

$$p_i - p_e \cong 2 bar$$

rezultă debitul maxim prin supapă:

$$Q_s \cong A_s\sqrt{\frac{2(p_i - p_e)}{\rho\xi_L}} = 3{,}14\cdot 10^{-4}\sqrt{\frac{2\cdot 2\cdot 10^5}{855\cdot 0{,}65}} = 8{,}42\cdot 10^{-3}\left(\frac{m^3}{s}\right)\left(505\ \frac{l}{\min}\right)$$

Constanta arcului $A_s = \dfrac{\pi\cdot d_s^2}{4} = \dfrac{\pi\cdot 2{,}3^2}{4} = 4{,}15 cm^2$

iar $p_i - p_e = 2\ bar$

$$c_1 = \frac{A_s(p_i - p_e)}{z} = \frac{4{,}15\cdot 2}{0{,}54} = 15{,}3\frac{daN}{cm}\left(1{,}53\frac{\text{daN}}{\text{mm}}\right)$$

În concluzie, din evaluări ordinele de mărime la presiunea de funcţionare *100 bar* sunt redate în Fig 4:

Fig 4

Dimensiunea	UM	Pilot	Supapa
Deschidere nominală	mm	10^0	10^1
Constanta arcului	daN/mm	10^1	10^0
Deplasarea funcţională	mm	$x \sim 10^{-2}$	$z \sim 10^0$
Duză	mm	-	10^{-2}
Debite vehiculate	dm^3/min	10^{-1}	10^2

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DATA MEASUREMENT AND NEW STRATEGIES FOR WAVEFORMS ANALYSIS USING FFT

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Abstract
The paper presents a new method for the analysis of the number of harmonics that must be considered in order to respect the European standards. One intends to verify if the limitations are correct for a series of real cases. Some characteristic features of the data acquisition system along with the most important principles of numerical analysis are provided. The initial signals are sampled in agreement to their particularities. Numerical interpolation is used in order to provide a higher accuracy. The presented solution removes the limits imposed by the industrial power analyzers with respect to the evaluation of powers flow over harmonics and to some global quality parameters computation. The analysis was made at some power sources terminals. The analysis accuracy was verified through signals re-composition.

I. INTRODUCTION

The specialty literature and the existing standards imposed both by E.U. member states and by IEEE organization restrict the number of harmonic components from the distorted waves decomposition, limiting the number of harmonics to the first 40 or 50 harmonics.

For this aim dedicated soft products were designed. They use the FFT transform or other decomposition methods but do not mention if the number of harmonic components is equal to 40, to 50 or if it is higher. In any of the cases only the first 40 (50) components are considered [14], [16], [17], [18].

Because the Fourier series practically have an infinite number of terms, one must determine an optimum with respect to the number of harmonics that must be considered. Also one must make a compromise between the modern computer time-response and the driving time of certain types of modern compensators for distorting consumers in dynamic or static regimes [5], [6], [7].

Major consequences can occur in what is concerning the electromagnetic compatibility of various equipment influenced by the proximity of others [1], [3], [8].

The non-sinusoidal periodic stable states are generated by: the equipment supplying with non-sinusoidal periodic sources; the existence of some distorting consumers; the loosing of equilibrium of phase impedances at consumers from three-phase systems, a. o. [2], [4], [9].

All these causes lead to unpleasant effects over other consumers and over the transmission lines due to their own technological losses produced by the currents flowing through them.

In the same context one must consider the harmonic analysis techniques with or without the presence of certain types of compensators for distorting regimes [13], [18], [20] or the powers circulation within an electric network considering it as a whole and respectively for individual harmonics [19]

Figure 1. Modular portable data acquisition system

II. TECHNICAL FEATURES OF DATA ACQUISITION SYSTEM AND DEDICATED SOFTWARE

A. General Description of Equipment

In order to determine some of the electric energy quality parameters and also to achieve a complex equipment that must be able to determine some other quantities and to detect unpleasant phenomena, a modular portable system was conceived (Fig. 1).

The main functions provided by it are:

· The determination of electric energy quality parameters that should consequently result in measures for the improving of qualitative and quantitative efficiency of energetic consumptions.

· Events recording, in order to detect the faults' causes and the repeated connection and disconnection of electric lines.

The equipment modular design makes possible the realization of a family of fixed and portable systems for tests and data acquisitions.

B. Functions of Equipment

The equipment family provides the following functions:

Ø Test and acquisition of analogue data (voltages, currents and powers) and respectively of numeric data (switching apparatus state) for nodes of the power system where the distorting regimes occur.

Ø The numeric processing of data, in order to determine the power parameters, the performance indices concerning the electric energy quality.

Ø The recording, evaluation, managing and displaying along periods of the consumptions and events concerning the deviations from the quality of the used electric energy.

Ø The permanent monitoring of the power systems parameters.

Ø Ø Faults detection and localization.

Ø Signalization when some quality indices standardized values are exceeded.

A series of facilities are provided, as follows:

· The determination of data for voltages and currents corresponding to phases and null wire.

The apparatus input voltages are supplied either by some voltage transformers from secondary windings with a rated value of 100 V ac, or by sensitive instant values transducers. The apparatus input currents supplied either by some current transformers from secondary windings with a rated value of 1 A ac, or by instant values transducers.

· Consumptions evaluation.

· Displaying of the time variations of currents, voltages etc. and of the states of the switches from the distribution utilities.

· Real time clock, non-volatile memory, graphical display of extended sizes 75 x 140 mm.

· Analysis and determination in the three-phase network of the following parameters:

- Phases and neutral impedances.
- Positive, negative and zero components of the unbalanced systems of voltages/currents.
- Determination of the survived element's operation regime (load, idle, voltage lack, fault, a.o.).

C. Technical Features

The equipment presents the following characteristics:

Ø Number of monitored and evaluated lines: 3 (for the test variant with 3 voltages and 2 currents) ; 2 (for the test variant with 3 voltages and 3 currents) ;

Ø Tests accuracy:

§ U, I..........0,5%

§ Frequency…0,05%

§ Active/reactive power: according class 2 IEC1268

§ Total Harmonic Distortion (THD) for voltages and currents… 2%

Ø Storage capacity: 256 KB ... 8 MB (depending on variant)

Ø Period of recording: 3 sec - 12 min, equivalent of maximum 240 events, each of 3 seconds; the records are non volatile.

D. Software Packages

The estimated and recorded data are processed by means of a soft package that allows:

- ü The harmonic analysis of measured quantities (voltages and currents) up to the 18-th harmonic.
- ü Evaluation of analogue quantities, separately for each phase (RMS values, initial phases of currents and voltages harmonics, spectral analysis) based on the decomposition up to the 18-th harmonic.
- ü Computation of electric power quality indices based on a unitary theory.
- ü Displaying, on request, of some electric parameters: active reactive and distorting powers, power factor, currents, voltages, frequency.
- ü Displaying on request of superior harmonics weights for voltages and / or currents.
- ü Detection of normal fast variations and of accidental unbalances from the three-phase systems of voltages and currents.
- ü Monthly recording, evaluation and displaying of the events corresponding to electric power quality deviations.

Prescription of limit values both for the quantities estimated in the system and respectively for the estimated quantities; when the respective values are reached, sound and optic alarms are generated.

The initial software package ("PDMWin") is integrated to the data acquisition system from fig.1, making possible the real time processing and a preliminary analysis that also includes the evaluation of some quality parameters for the voltage and current waveforms. The system and its corresponding software package make possible the realization of analysis up to the 18-th harmonic. The use of 18 harmonics resulted in unexpected greater errors. When a number of 12 harmonics is used, the error is lower than 2.5%.

For the detailed analysis of the waveforms and in order to be able to perform a complete analysis from the powers point of view, the data recorded with the presented data acquisition system were transferred through a serial interface to a desktop or laptop.

. On the target computer other numerical processing are to be done. For this aim we realized a software package dedicated to applications in three-phase systems, using MATLAB. It uses the fast Fourier transform (FFT). In order to make an evaluation as accurate as possible of the distorting operating regime at the level of power sources or at the level of consumers from the three-phase system, the software package was provided with a series of tools. They make possible the realization of some polynomial interpolation or the employing of spline functions in order to extend the applications range toward the industrial domain and to increase the number of harmonics used for the harmonic decomposition. Basically the program allows experimental determinations and numerical processing for any standard that must be implemented (national, European, US etc.). The software package relies on the existing national and European standards and takes into account the correlations between both standards. The considered standards are: PE 143/94 (Romanian Standard), IEC 60664 (European Standard), ANSI-IEEE 519, CEI 1000-2-4, IEEE 1459-2000.

Any modification of the used standard that affect the total number of harmonics considered during the analysis can be very easily implemented through the realized interface and the designed algorithms.

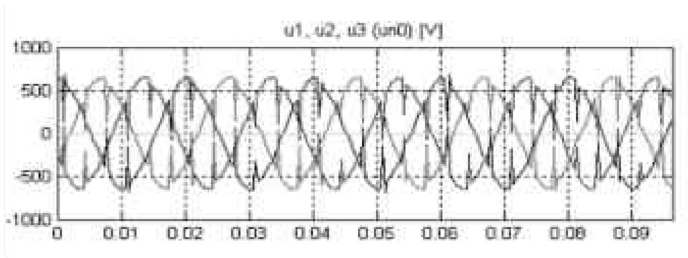
The results generated using the software packages realized for the numerical processing concerning the quality factors of the waveforms are in a good agreement with the number of harmonics and with their initial magnitudes and phases. Also, in order to determine the powers for the distorting regimes that occur in the three-phase networks one can implement various theories: Budeanu's theory, Akagi's theory of instantaneous (re)active powers a.o. [10], [13], [11], [15].

III. IS IT NECESSARILY TO DETERMINE THE NUMBER OF HARMONICS FROM THE FOURIER SERIES ?

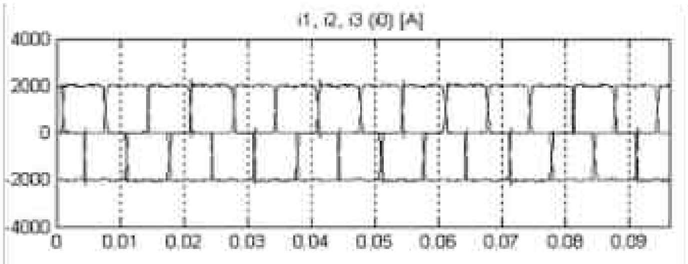
One performed the analysis of some distorted waveforms recorded for some electric power sources and distorting consumers of type.

For this aim an original algorithm was designed in order to perform a decomposition of voltages and currents. It was implemented using MATLAB. For consequent interpolations this number can be increased. This thing was performed using interpolation polynomials in the cases when the waveforms presented short-lasting, non-periodical variations. The extension for the FFT-based analysis concerning the harmonics number was realized using spline functions.The processing of several distorted waveforms recorded for various distorting sources and consumers at the Faculty of Electrotechnics Laboratory or at a Power Plant. Fig. 2 depicts the voltage and current waveforms for a distorting three-phase power source from a Power Plant (auxiliary generator's stator). The waveforms corresponding to voltages and currents from the stator phases were decomposed into 40 harmonics (according to European norms). Fig. 3 depicts the harmonic content of the voltage from phase no. 1 and Fig. 4 depicts the harmonic content of the current through the same phase (in both cases for the first 20 harmonics). In both cases the initially decomposed signal was reconstructed using its harmonics up to the 40-th order.

The number of harmonic components used to decompose an experimentally determined periodical signal cannot exceed the number of sampling points along a period.



(a) Phase voltages



(b) Phase currents

Fig. 2. Measured quantities for auxiliary generator's stator

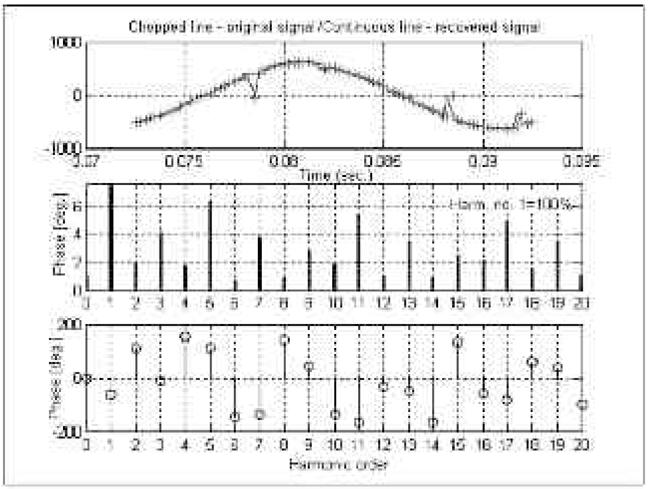


Figure. 3. Harmonic content of voltage u_1 for auxilliary generator

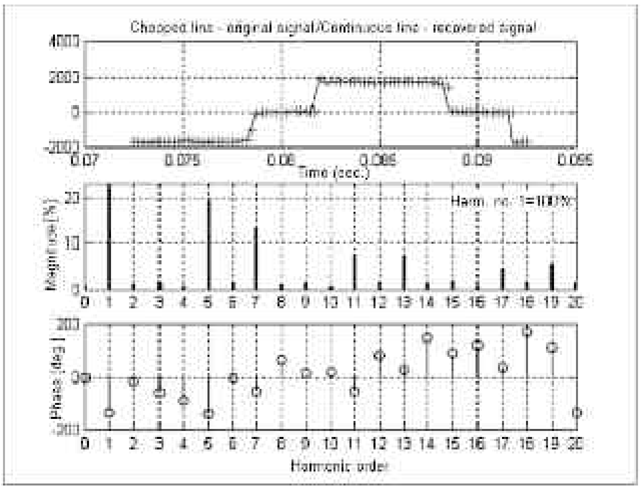


Figure. 4. Harmonic content of current i_1 for auxilliary generator

If one needs a decomposition in a higher number of harmonic components, the waveform can be locally approximated through a spline interpolation (cubic polynomials) in order to determine intermediate points.

For the results validation the signal is restored through the harmonics composition and then one must compute the percent relative deviation from the original signal.

The analysis performed directly with the data acquisition system, using its integrated software (PDMWin package), resulted in an error lower than 2.5% between the recorded signal and the signal obtained through the recomposing of 12 harmonics. The error generated by the difference between the signal recorded initially and the signal reconstructed through the recomposing of the 40 harmonics was computed.

In all the analyzed cases the error did not exceed 1%.

Therefore one can conclude that a significantly greater number of harmonics is required only in some particular situations (e.g. the maintaining of the operating regime for a long time, the instantaneous compensations for slow load variations.

TABLE I

SIGNIFICANT INITIAL PHASES, MAGNITUDES AND WEIGHTS RELATIVE TO THE FUNDAMENTAL COMPONENT OF PHASE VOLTAGES

	U1			U2			U3		
Harmonic Order	Magn. [V]	Initial Phase [deg]	Weight [%]	Magn. [V]	Initial Phase [deg]	Weight [%]	Magn. [V]	Initial Phase [deg]	Weight [%]
1	376.38	169.24	100	337.34	-71	100	371.9	47.26	100
3	26.03	30.26	4.32	11.37	13.40	2.04	38.37	-71.9	6.74
5	34.13	-163	3.92	33.86	73.69	9.66	46.63	-71.2	8.149
7	26.09	-3.32	4.32	49.39	119.08	8.83	41.17	-89.81	7.18
9	19.30	63.83	3.38	7.07	169.14	1.26	30.08	-83.78	3.26
11	32.26	-130	3.39	46.36	86.36	8.31	37.46	-33.81	6.33
13	22.08	12.80	3.83	49.47	133.21	8.87	42.81	-72.2	7.48
15	21.76	68.02	3.77	11.90	-172.3	2.13	23.74	-86.14	4.3
17	32.31	-134	3.64	41.38	98.23	7.42	31.03	-33.18	3.43
19	19.11	30.38	3.31	46.39	146.1	8.33	41.96	-36.71	7.33
21	23.37	68.41	4.03	14.48	-133	2.39	21.66	-84.31	3.78
23	32.84	-120.	3.69	37.10	108.46	6.63	26.36	-13.31	4.6
25	19.03	47.46	3.30	47.00	138.48	8.43	42.89	-43.63	7.3
27	21.42	78.17	3.71	17.12	-139.2	3.07	16.63	-93.30	2.91
29	33.22	-108	3.76	30.43	112.74	3.46	22.33	14.11	3.94
31	11.83	61.60	2.03	33.33	169.17	6.37	34.34	-27.32	6.04
33	23.93	78.66	4.13	14.06	-119.3	2.32	11.48	-83.6	2.07
34	26.01	-102	4.31	14.60	72.66	2.62	13.32	90.97	2.36
35	32.24	-98.28	3.39	24.83	116.67	4.43	19.20	36.89	3.33
36	20.68	80.93	3.38	12.43	-103.3	2.23	7.18	-70.2	1.23
39	23.07	87.60	4.00	13.72	-99.4	2.46	8.79	-93.18	1.33
40	29.39	-93.00	3.09	18.69	64.03	3.33	16.47	116.38	2.88

TABLE II

SIGNIFICANT INITIAL PHASES, MAGNITUDES AND WEIGHTS RELATIVE TO THE FUNDAMENTAL COMPONENT OF PHASE CURRENTS

	I1			I2			I3		
Harmonic Order	Magn. [A]	Initial Phase [deg]	Weight [%]	Magn. [A]	Initial Phase [deg]	Weight [%]	Magn. [A]	Initial Phase [deg]	Weight [%]
1	1781.61	92.44	100	1763.84	-147.9	100	1753.96	-28.31	100
5	348.48	-76.3	19.56	368.37	160.38	20.89	331.21	40.918	20.02
7	240.77	103.13	13.51	203.03	-139.9	11.59	223.62	-24.26	12.74
11	141.74	-63.28	7.95	150.23	168.98	8.51	146.18	51.42	8.33
13	141.19	11.81	7.92	93.83	-128.1	5.32	117.73	-20.35	6.71
17	80.93	-34.84	4.54	87.23	173.39	4.94	82.80	61.98	4.72
19	99.58	130.64	5.58	48.12	-112.2	2.72	77.73	-20.96	4.43
23	51.17	-45.03	2.87	53.88	-175.6	3.05	53.86	73.51	3.07
25	80.71	145.39	4.53	23.03	-88.87	1.37	56.48	-24.64	3.22
29	36.43	-34.43	2.04	34.88	-174.4	1.97	37.37	88.42	2.13
31	67.71	158.96	3.80	32.39	55.64	1.83	50.23	-26.43	2.86
35	26.20	-28.46	1.47	19.03	-175.2	1.07	44.1578	-118.2	2.51
37	56.11	169.61	3.14	16.03	55.23	0.97	44.2223	-31.21	2.52

This proves that the software packages realized by the authors of this paper using interpolating polynomials or spline functions generate more accurate results from the harmonic decomposition point of view and moreover they provide the user with the facility of use any standard (like EC-60664 or IEEE-ANSI 519, etc.) during the analysis and decomposition of waveforms.

The realized algorithm, based on FFT, allowed the determination of the harmonics that appear in the waveforms of phase voltages and currents. These are depicted by tables I and II.

Using these results one can determine a series of quality parameters for the distorted waveforms of the phase voltages and currents. In the tables III and IV one can see the RMS values and the total harmonic distortions of phase voltages and currents, determined from the realized harmonic decompositions.

The performed analysis reveals a regime that causes strong distortions in the case of auxiliary generator. Significant harmonics can be noticed in the waveforms of phase voltages and currents. The THD for the phase voltages is great (higher than 20% for every phase) and its values vary significantly between phases ($UTHD_{min}$ =21.51% - phase 1, $UTHD_{max}$ =27.82% for phase 3). These values reveal a unbalanced operating regime of the auxiliary generator. The great values of THD for the phase currents emphasize their significant distortions.

Generally the significant harmonics have indices of the form (6p1). They are characteristic for sources of this type that supply rectifiers controlled with thyristors – as in the analyzed case. The weight of the significant harmonics (mainly of orders 5 and 7) leads to the conclusion that filters must be used to compensate their effect.

The above analysis also emphasized that, owing to the fully controlled rectifier with thyristors, one can notice a reversed flow of active power along the higher harmonics as compared to the initial flow of power corresponding to the fundamental harmonic provided by the auxiliary generator.

This fact is reflected by the analysis of the regime of d.c. current after the rectifier. It resulted into the conclusions that the power generated by the d.c. component, which is afterward delivered toward the main generator of the power group had a value of 304 kW. Meanwhile the total active power before the rectifier had a value of 316 kW. The difference between powers represents a reversed flow of active power along the harmonics (from the rectifier toward the auxiliary generator).

TABLE III
QUALITY PARAMETERS FOR PHASE VOLTAGES OF AUXILIARY GENERATOR STATOR

Quality parameter	Phase 1	Phase 2	Phase 3
RMS value [V]	417.34	410.43	417.97
UTHD	21.51	27.82	25.27

TABLE IV
QUALITY PARAMETERS FOR PHASE CURRENTS OF AUXILIARY GENERATOR STATOR

Quality parameter	Phase 1	Phase 2	Phase 3
RMS value [A]	1313.8	1293.3	1291.4
ITHD	28.27	27.04	27.84

IV. CONCLUSIONS

The relative deviations of the decomposition that uses 40 components with respect to the one that uses 500 or 1000 components emphasizes a relative low variation, fact that seems to be correct from the European standards point of view, which is limited to the first 40 harmonics. We still consider that in practice one must provide individual data for every type of sources or for power systems in order to certify this assumption. A similar problem can be considered for any type of (groups of) consumers.

The original algorithm can be successfully used in harmonic analysis problems within networks that contain one or more distorting consumers.

This analysis presents a case of a harmonic source from a power system. The presented case was selected from a significant number of determinations performed at a power group. Separate or simultaneous analysis of the auxiliary generator and of the fully controlled rectifier were also made for various loads of the main generator (including the idle running) and for various operating regimes (inductive, resistive or capacitive).

The analysis presented by this paper emphasizes the clear advantages of the data acquisition system and the possibility to use the elaborated software. This software practically extends the harmonic analysis for a number of harmonics imposed by the (inter)national standards. Its specific features makes possible the implementing of various theories concerning the powers/energies for the three-phase systems, the adapting to particular cases (power sources, auxiliary equipment from three-phase power plants, significant industrial consumers etc.)

The correct interpretation of the recorded and processed data can be used consequently for the correct management of powers/energies and of their flow and in the same time can provide indices for the diagnose and control methods [12].

The analysis accomplished at certain consumers validated the conclusions concerning the data acquisition system and the original software packages.

The harmonic analysis presented here can be useful for distorting consumers compensated with active or passive harmonic filters in both cases: before and after the compensators installation [20].

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CONDIȚIILE DE DIMENSIONARE ALE ARCURILOR SUPAPELOR CU COMANDĂ DIRECTĂ

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1 Condițiile de limitare a parametrilor arcurilor spirale cilindrice

Literatura indică pe baza unor criterii limitele în care trebuie dimensionate arcurile

- Raportul (*i*) dintre spirei (*D*) şi diametrul sârmei (*d*) respectă relația: $4 \le i \le 12$

-Stabilitatea transfersală a arcului (λ) este raportul dintre lungimea netensionată (H_0) şi diametrul spirei (*D*) şi trebuie să fie mai mică ca un λ_{critic}

$$\lambda = \frac{H_0}{D} < \lambda_{critic}$$

În cazul supapelor în care când împingătorul arcului este ghidat $\lambda_{critic} \cong 5,34$

Funcție de modul de ghidare valorile lui λ sunt $1,31 < \lambda < 5,34$ şi se poate calcula cu relația: $\lambda_c = \frac{2,62}{\beta_c}$ pentru care $0,6 < \beta_c < 2$

- Sârma rotundă de arc utilizată în mod curent are în principal două caracteristici importante: Efortul tangențial maxim: $\tau_a \le 70 \frac{daN}{mm^2}$

- Modulul de elasticitate tranversală:

$$G \le 8100 \frac{dan}{mm^2}$$

Unghiul de înfăşurare al spirei se recomandă a fi:

$$6^0 < \alpha < 15^0$$

Coeficientul de formă al arcului are ca formă aproximativă:

$$i \cong 1 + \frac{1,6}{i}$$

Variația raportului $i = \frac{D}{d}$ funcție de diametrul (d) al sârmei este redat de diagrama Fig 1

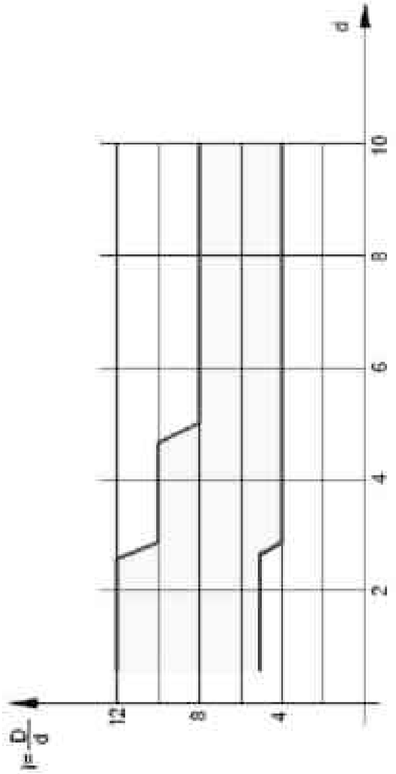

Fig 1

2 Modelul fizic al supapei şi arcului

Explicitarea dimensiunilor ansamblului supapă – arc este ilustrată de Fig 2

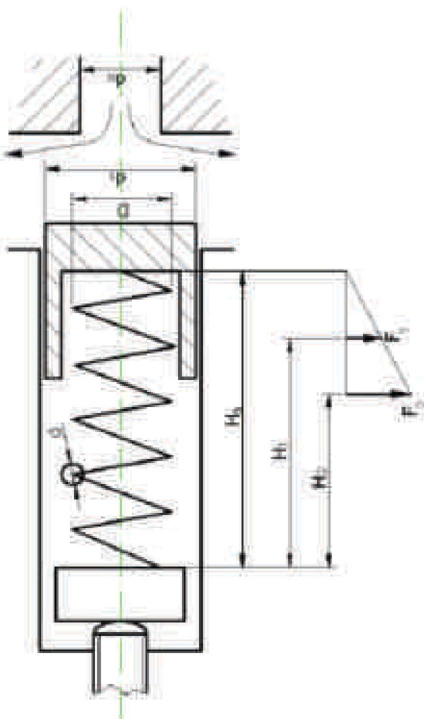

Fig 2

În care: d diametrul sârmei, D diametrul spirei, d_S diametrul supapei, d_N diametrul nominal, H_0 lungimea destinsă a arcului, H_1 lungimea prestrânsă, H_2 lungimea de comprimare a arcului la deschiderea nominală a supapei.

3 Setul de relații utilizate în dimensionarea arcului:

$$(I)\begin{cases} n=\dfrac{Gd^4}{8CD^3} \text{ Numarul de spire active;} \\ C=\dfrac{F_2-F_1}{f} \text{ Constanta elastica;} \\ \tau_a=\dfrac{8K}{\pi}\cdot\dfrac{D}{d^3}F_2 \text{ Efortul tangential;} \\ H_0=f_0+f+0{,}14nd+(n+n_r)d \text{ in care} \begin{cases} f_0=\dfrac{F_1}{C} \\ f=\dfrac{F_2-F_1}{C} \\ n_r=1{,}5...2 \end{cases} \end{cases}$$

4 Aprecieri constructive:
Se apreciază constructiv că $d_S = 1{,}25\ d_N$ iar

$D\cong 0{,}8\cdot d_S$ rezulta $D\cong d_N$

Se aproximează că $f\cong h$ deschiderea nominală a supapei

$$h=\frac{d_N^2}{4d_S};\quad f\cong 0{,}25\cdot d_N$$

Se impune ca $F_2\le 1{,}25\cdot F_1$ în care:

$$F_1=p\frac{\pi\cdot d_N^2}{4}=0{,}785pd_N^2$$

5 Elementele de predimensionare ale arcului utilizând mărimele de temă şi constantele materialului

a) Constanta elastică, rezultă succesiv:

$$C=\frac{F_2-F_1}{f}=\frac{0{,}25\cdot F_1}{f}=\frac{0{,}25\cdot 0{,}785\cdot pd_N^2}{0{,}25\cdot d_N}=0{,}785\cdot d_N p$$

Exprimarea lui F_2:

$$F_2=1{,}25\cdot F_1=1{,}25\cdot 0{,}785\cdot pd_N^2$$

b) Diametrul sârmei se obține succesiv:

$$\tau_a=\frac{8K}{\pi}\cdot\frac{D}{d^3}\cdot F_2=\frac{8}{\pi}\cdot\frac{i+1{,}6}{i}\cdot\frac{i}{d^2}\cdot F_2\ ;$$

$$d=\sqrt{\frac{8(i+1{,}6)\cdot F_2}{\pi\tau_a}}$$

Explicitând „d” obținem:

$$d\sqrt{\frac{8(i+1{,}6)}{\pi\tau_a}\cdot 0{,}981\cdot pd_N^2}$$

$$(II)\ d=1{,}581d_N\cdot\sqrt{(i+1{,}6)\cdot\frac{p}{\tau_a}}$$

c) Numărul de spire active se obține succesiv:

$$n=\frac{Gd^4}{8CD^3}=\frac{Gd}{8Ci^3}=\frac{G}{8i^3}\cdot\frac{1{,}581d_N\sqrt{(i+1{,}6)\cdot\frac{p}{\tau_a}}}{0{,}785pd_N}$$

$$(III)\ n=0{,}252\cdot\frac{G}{p}\cdot\frac{1}{i^3}\sqrt{(i+1{,}6)\frac{p}{\tau_a}}$$

d) Lungimea netensionată a arcului

Exprimarea diferitelor stadii de comprimare sunt redate de relațiile (IV).

Lungimele corespund astfel:

$$(IV)\begin{cases} H_3=(n+n_r)d\ \ n_r=1{,}5...2 \text{ comprimare spira pe spira;} \\ H_2=H_3+0{,}14nd \text{ comprimarea de forta maxima;} \\ H_1=H_2+f \text{ prestrangerea;} \\ H_0=H_1+f_0 \text{ netensionat } f_0=\dfrac{F_1}{C} \end{cases}$$

- Lungimea netensionată

$$(V)\ H_0=f_0+f+0{,}14nd+(n+n_r)d$$

$$H_0=f_0+f+1{,}14nd+2d$$

- Evaluarea termenilor:

$$(VI)\begin{cases} f_0=\dfrac{F_1}{C}=\dfrac{0{,}785\cdot pd_N^2}{0{,}785\cdot pd_N}=d_N \\ f=0{,}25\cdot d_N \\ n=0{,}252\cdot\dfrac{G}{p}\cdot\dfrac{1}{i^3}\cdot\sqrt{(i+1{,}6)\cdot\dfrac{p}{\tau_a}} \\ d=1{,}581\cdot d_N\cdot\sqrt{(i+1{,}6)\cdot\dfrac{p}{\tau_a}} \end{cases}$$

Înlocuind (IV) cu (V) se obtine :

$$(VII)\ H_0 = d_N \cdot \left[1,25+0,454\cdot\frac{G}{p}\cdot\frac{1}{i^3}(i+1,6)\frac{p}{\tau_a}+3,162\sqrt{(i+1,6)\frac{p}{\tau_a}}\right]$$

e) Exprimarea stabilității

$$\lambda = \frac{H_0}{D} = \frac{H_0}{d_N},$$

$$\lambda = 1,25+0,454\cdot\frac{G}{p}\cdot\frac{1}{i^2}(i+1,6)\frac{p}{\tau_a}+ 3,162\sqrt{(i+1,6)\frac{p}{\tau_a}};$$

$$(VIII)\ \lambda = 1,25+0,454\cdot\frac{G}{i^2}\cdot\frac{i+1,6}{\tau_a}+ 3,162\sqrt{(i+1,6)\frac{p}{\tau_a}}$$

în care:

$G = 810.000\frac{daN}{cm^2};\qquad 4 < i < 12;$

$\tau_a = 7000\frac{daN}{cm^2};$ iar $\lambda_{crit} = 5,34$

Fig 3 prezintă modul de variație a lui λ funcție de „p” la $i = ct$.

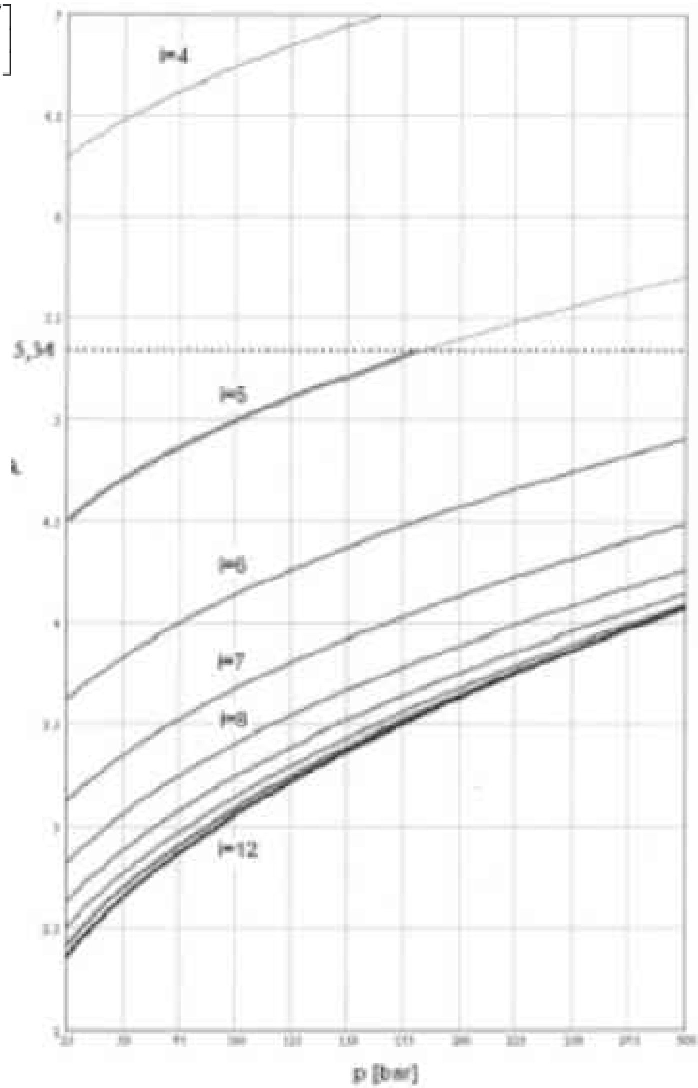

Fig 3

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SONIC TRANSMISSION ON WIND TURBINES

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Abstract: *The European Community is fully involved in the energy production sector. Major efforts are made for abandoning the traditional paradigms and working with new modalities for producing energy. In this framework they pay more attention on ensuring funds for development of new technologies that can increase the total production of the European Union. A solution based on the theory of Sonics, can satisfy this need. This solution refers to the power transfer from the turret to the base of the tower or elsewhere where it is needed. This leads to significant savings, from all points of view, especially in labour protection. This solution offers more efficient wind power plants at much lower costs.*

Abstract: *Comunitatea Europeană, este implicată în totalitate în sectorul producţiei de energie. Se fac eforturi majore pentru abandonarea paradigmelor tradiţionale şi abordarea unor noi modalităţi de producere a energiei. În acest cadru se acordă o atenţie deosebită în asigurarea de fonduri pentru dezvoltarea de noi tehnologii care să crească producţia totală a Uniunii Europene. O solutie, bazată pe teoria sonicităţii, poate satisface această nevoie. Aceasta se referă la transferul puterii obținute în turelă, la baza turnurilor eoliene sau în altă parte. Aceasta duce la economii importante din toate punctele de vedere, implicit din cel al protecţiei muncii. Această soluţie oferă posibilitatea eficientizării centralelor electrice eoliene, la costuri mult mai scazute.*

Keywords: energy, wind turbine, mechanical transmission, sonic transmission

1. INTRODUCTION

Industrial wind turbines are massive building, producing high power. The wind turbine in itself is an entire “factory” that transforms the rotation movement of the rotor into electrical energy. Its turret contains gears, brakes, electrical generators, control panels, power cables, etc.

This means that the assembly, operation and maintenance are more difficult. It should be noted that usually a daily inspection of equipment in the turret is made and annually all assemblies and equipment are remove and inspected, including the rotor blades. All these operations are dangerous, because everything is done at heights of about 60-90 m and are expensive too.

This paper presents a solution based on the theory of Sonics. This solution refers to the power transfer from the turret to the base of the tower or elsewhere, where it is needed. This leads to significant savings from all points of view, especially in labour protection.

In principle, the resulting motion from the turbine blades is converted into sonic pressure waves, bi- or multi-phase by the sonic generator and then transferred to the base of the wind tower, through a suitable number of pipelines equivalent to the number of phases. The pressure wave is then converted to rotary movement by a sonic motor usually having the same construction as the sonic generator from the turret. The mechanical energy is then transformed into electrical energy by conventional means. The converters can be located at the base of the tower or elsewhere.

This method also makes possible a resizing of the wind tower, making them lighter and easier to maintain.

2. CHARACTERISTIC CURVES FOR THREE-PHASE SONIC SYSTEMS

One of the advantages of the three-phasic transmission is that it can transmit the same quantity of motion at any point in time. From the structure and the design of the motion converting mechanism and the phases of the pistons that are part of this mechanism, shown in *Figure 3*, one can see that the motion is generated only by the maximum flow of the phases, when Q_R is between π/6 and 5π/6. The speed and the load are represented in *Figure 1*, taking into account the above mentioned conditions.

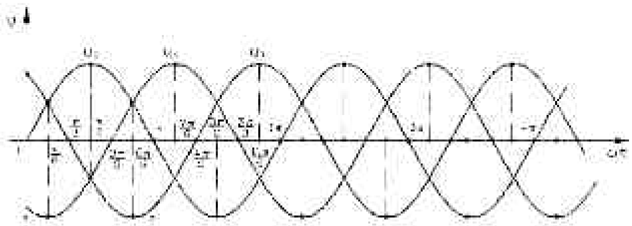

Figure 1. *Flow diagram-phase sinusoidal*

2. THE SPEED OF THE THREE-PHASE SONIC ENGINE

Phase movement is always generated at the moment with the maximum instantaneous flow. *Figure 1* shows that for each phase there's an interval with the length of 2π/3 radians where the flow for this phase is greater than the flow of the other phases.

We will calculate the average flow rate, Q_m, in this period, after which it will be used to determine the speed.

The instantaneous flow given by a phase generator is:

$$Q_i = A_g \cdot e_g \cdot \omega_g \cdot \sin(\omega_g \cdot t) = A_g \cdot e_g \cdot \omega_g \cdot \sin\varphi_g \tag{1}$$

where:

$$\omega_g \cdot t = \varphi_g \tag{2}$$

The average instantaneous flow due to the first phase, active between π/6 and 5π/6, generated by motion, is:

$$Q_{g_{1im}} = \frac{1}{\frac{2\pi}{3}} \cdot \int_{\frac{\pi}{6}}^{\frac{5\pi}{6}} A_g \cdot e_g \cdot \omega_g \cdot \sin\varphi_g \cdot d\varphi_g \tag{3}$$

so:

$$Q_{g_{1im}} = 0{,}83 \cdot A_g \cdot e_g \cdot \omega_g \tag{4}$$

The speed of the hydraulic piston motor phase is:

$$v_{m_1} = \omega_m \cdot R_m = \frac{\pi \cdot n_{m_{n1}}}{30} \cdot R_m \tag{5}$$

but:

$$v_{m_1} = \frac{Q_{g_{1m}}}{A_m} \tag{6}$$

From Equation (5) results that:

$$n_{m_{f1}} = \frac{30 \cdot 0{,}83 \cdot A_g \cdot e_g \cdot \omega_g}{\pi \cdot R_m \cdot A_m} \tag{7}$$

where:

$$K_g = e_g \cdot A_g \qquad K_m = R_m \cdot A_m \tag{8}$$

Equation (8) becomes:

$$n_{m_{f1}} = \frac{30 \cdot 0{,}83 \cdot K_g \cdot \omega_g}{\pi \cdot K_m} \tag{9}$$

but:

$$\omega_g = \pi \cdot \frac{n_g}{30}$$

Substituting in (9) we get:

$$n_{m_{f1}} = \frac{30 \cdot 0{,}83 \cdot K_g \cdot \pi \cdot n_g}{30\pi \cdot K_m} \tag{10}$$

so:

$$n_{m_{f1}} = 0{,}83 \cdot \frac{K_g}{K_m} \cdot n_g \tag{11}$$

Comparing the speed of the three-phase hydraulic transmission with the speed of the two-phase hydraulic transmission, we can conclude that when K_g, n_g, and K_m are identical, the speed of the three-phase transmissions is 30% greater than the speed of the two-phase transmission. By increasing the number of phases, the constant from the speed formula tends to become unitary.

4. THE SPEED OF THE THREE-PHASE SONIC MOTOR UNDER LOAD

The speed is determined like in the case of the two-phase transmission with the single difference that the limits of integration are between π/6 and 5π/6. (See Figures 1 and 2)

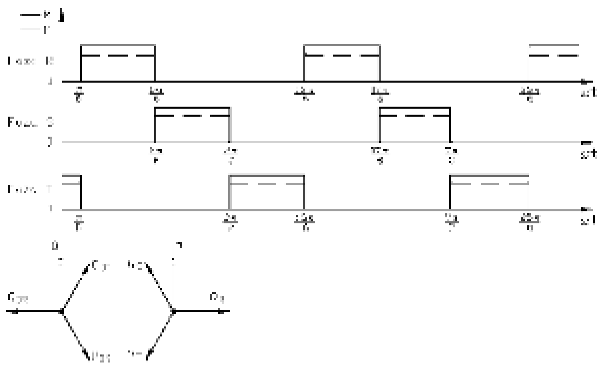

Figure 2. *Phase diagram of tasks depending on cylinder angular frequency*

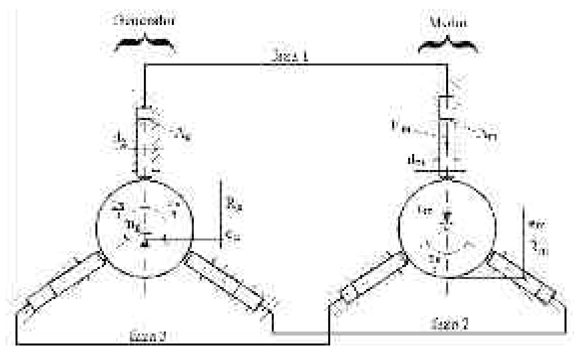

Figure 3. *Diagram of a system design phase, radial piston*

If we consider a three-phase system like the ones shown in Figures 3 and 4, the phasic flow of the hydraulic generator under load is diminished by the inductive (Q_{Li}) and capacitive (Q_{Ci}) flows.

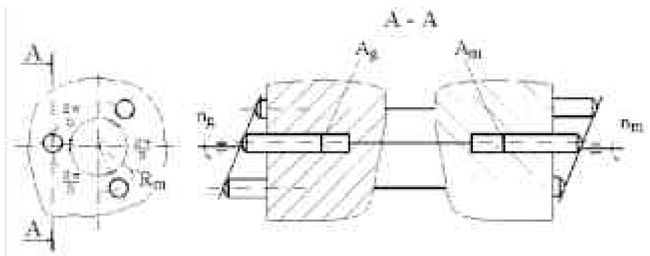

Figure 4. *Axial piston-phase system*

Thus the real flow Q_{ef} will have the value:

$$Q_{ef} = Q_f - Q_{Li} - Q_{Ci} \qquad (12)$$

Their effect is shown in Figure 5.

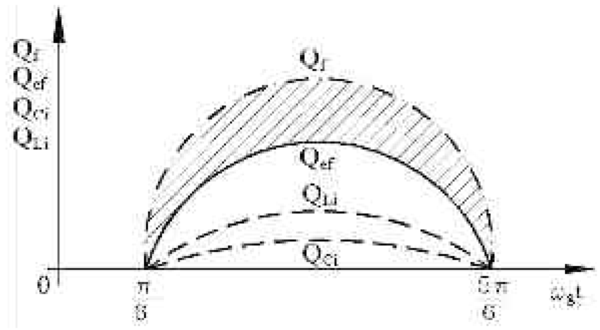

Figure 5. *The effect of inductive and capacitive discharges*

If the mass of the phase pistons and the angular frequency generate significant inertial forces, one must consider both their inductive and capacitive flows. Furthermore, to simplify the calculation, we consider them constant.

- **THE CAPACITIVE FLOW(Q_{Ci})**

From the relation (4.90) in [1] we obtain:

$$dV_{Ci} = \frac{V_0}{E} \cdot dp_{Ci} \qquad (13)$$

From:

$$Q_{Ci} = \frac{dV_{Ci}}{dt} \qquad (14)$$

results that:

$$dV_{Ci} = Q_{Ci} \cdot dt \qquad (15)$$

respectively, after replacing in (13) :

$$Q_{Ci} \cdot dt = C_S \cdot dp_{Ci} \qquad (16)$$

or:

$$Q_{Ci} = \frac{C_S \cdot dp_{Ci}}{dt} \qquad (17)$$

but dp_{Ci} it can be written as:

$$dp_{Ci} = \frac{F_m}{A_m} \qquad (18)$$

Substituting (18) in (17), we obtain the expression of the capacitive flow:

$$Q_{Ci} = C_S \cdot \frac{d}{dt}\left(\frac{F_m}{A_m}\right) \qquad (19)$$

- **THE INDUCTIVE FLOW Q_{Li}**

The equation (4.80) from [1] can be written as:

$$\Delta p_{Li} = L_S \cdot \frac{dQ_{Li}}{dt} \qquad (20)$$

or:

$$dQ_{Li} = \frac{\Delta p_{Li} \cdot dt}{L_S} \qquad (21)$$

but:

$$\Delta p_{Li} = \frac{F_m}{A_m} \qquad (22)$$

accordingly:

$$dQ_{Li} = \frac{F_m}{A_m \cdot L_S} \cdot dt \qquad (23)$$

Substituting in (12) Q_f and Q_{Ci} and considering Q_{Li} null, we obtain:

$$Q_{ef} = A_g \cdot \omega_g \cdot e_g \cdot \sin(\omega_g \cdot t) - C_S \cdot \frac{d}{dt}\left(\frac{F_m}{A_m}\right) \qquad (24)$$

The average real flow rate is given by:

$$Q_{efm} = \frac{1}{T} \cdot \int_0^T Q_{ef}(t) \cdot dt \qquad (25)$$

In our case, the average real flow rate will be calculated in the interval $\omega_g \cdot t \in \left[\frac{\pi}{6}; \frac{5\pi}{6}\right]$

shown in *Figure 1* and *2*, as follows:

$$Q_{efm} = \frac{1}{\frac{2\pi}{3}} \cdot \left[\int_{\frac{\pi}{6}}^{\frac{5\pi}{6}} A_g \cdot \omega_g \cdot e_g \cdot \sin(\omega_g \cdot t) \cdot dt\right] - \frac{1}{\frac{2\pi}{3}} \left[C_S \cdot \frac{d}{dt} \cdot \int_{\frac{\pi}{6}}^{\frac{5\pi}{6}} \frac{F_m}{A_m} \cdot dt\right] \qquad (26)$$

$$= 0{,}83 \cdot A_g \cdot e_g \cdot \omega_g - \frac{3}{2\pi} \cdot C_S \cdot \frac{F_m}{A_m}$$

$$= 0{,}83 \cdot A_g \cdot e_g \cdot \omega_g - 0{,}48 \cdot C_S \cdot \frac{F_m}{A_m}$$

The average speed of the engine's phase piston will be obtained from the relation (8.21) in [1] and results:

$$v_{m_m} = \frac{Q_{efm}}{A_m} \qquad (27)$$

Then:

$$v_{m_m} = \frac{0{,}83 \cdot A_g \cdot e_g}{A_m} \cdot \frac{\pi \cdot n_g}{30} - 0{,}48 \cdot C_S \cdot \frac{F_m}{A_m^2} \qquad (28)$$

where: $\omega_g = \frac{\pi \cdot n_g}{30}$ (29)

The torque M_m must overcome the resistant torque produced by the lever mmmsine bj×= of the force F_m (that must be defeated by the pistons in their active stages), *Figure 6*. Thus:

$$F_m = \frac{M_m}{b_m} \qquad (30)$$

or:

$$b_m = e_m \cdot \sin\varphi_m \qquad (31)$$

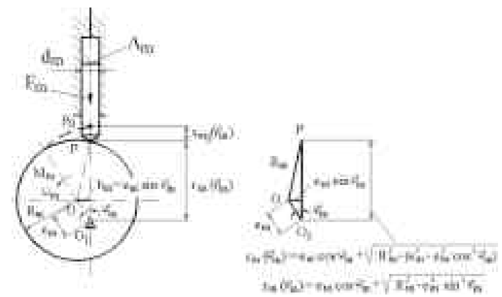

Figure 6. *Making the phase torque*

We will consider an average value of the lever b_m, noted with b_{mm}, during the active phase of the moving piston $\left[\varphi_m \in \left(\frac{\pi}{6}; \frac{5\pi}{6}\right)\right]$

It is calculated similar to equation (8.18) from [1] from which:

$$b_{mm} = \frac{1}{\frac{5\pi}{6} - \frac{\pi}{6}} \cdot \int_{\frac{\pi}{6}}^{\frac{5\pi}{6}} e_m \cdot \sin\varphi_m \cdot d\varphi_m \qquad (32)$$

$$F_m = \frac{M_m}{b_{mm}} = \frac{M_m}{0{,}83 \cdot e_m} \tag{33}$$

and (28) has the form:

$$v_{mm} = \frac{0{,}83 \cdot A_g \cdot e_g}{A_m} \cdot \frac{\pi \cdot n_g}{30} - -0{,}48 \cdot C_S \cdot \frac{M_m}{0{,}83 \cdot e_m \cdot A_m^2} \tag{34}$$

Equation (27) can be written as:

$$v_{mm} = \frac{Q_{ef_m}}{A_m} = r_m(\varphi_m) \cdot \omega_{m_m} \tag{35}$$

$$v_{mm} = \omega_{m_m} e_m \cdot \cos\varphi_m + \omega_{m_m} \sqrt{R_m^2 - e_m^2 \cdot \sin^2 \varphi_m} \tag{36}$$

Since the terms $e_m^2 \cdot \sin^2 \varphi_m << R_m$ and $e_m \cdot \cos\varphi_m << R_m$

are negligible, (36) becomes:

$$v_{mm} \cong R_m \cdot \omega_{mm} \tag{37}$$

Equalling (37) with (34) we obtain:

$$\frac{0{,}83 \cdot A_g \cdot e_g}{A_m} \cdot \frac{\pi \cdot n_g}{30} - -0{,}48 \cdot C_S \cdot \frac{M_m}{0{,}83 \cdot e_m \cdot A_m^2} = = R_m \cdot \omega_{m_m} \tag{38}$$

but:

$$\omega_{mm} = \frac{\pi \cdot n_m}{30} \tag{39}$$

so:

$$n_m = \frac{0{,}83 \cdot A_g \cdot e_g}{A_m \cdot R_m} \cdot n_g - -\frac{1}{\pi} \cdot 17{,}35 \cdot \frac{C_S \cdot M_m}{e_m \cdot A_m^2 \cdot R_m} \tag{40}$$

but: $K_g = e_g \cdot A_g$

$$K_m = R_m \cdot A_m$$

$$n_m = \frac{0{,}83 \cdot K_g \cdot e_g}{K_m} \cdot n_g - \frac{1}{\pi} \cdot \frac{17{,}35 \cdot C_h \cdot M_m}{e_m \cdot A_m \cdot K_m} \tag{41}$$

$$n_m = 0{,}83 \cdot n_g \cdot e_g \cdot \frac{K_g}{K_m} - \frac{17{,}35}{\pi} \cdot \frac{C_h \cdot M_m}{e_m \cdot A_m \cdot K_m}$$

Using the theoretical rotation speed relationship (11):

$$n_{mf1} = 0{,}83 \cdot \frac{K_g}{K_m} \cdot n_g \tag{42}$$

relation (41) becomes:

$$n_m = n_{mf1} \cdot e_g - \frac{17{,}35}{\pi} \cdot \frac{C_S \cdot M_m}{e_m \cdot K_m \cdot A_m} \tag{43}$$

or:

$$n_{mf1} \cdot e_g - n_m = \frac{17{,}35}{\pi} \cdot \frac{C_S \cdot M_m}{e_m \cdot K_m \cdot A_m} \tag{44}$$

From (44) we can determine the torque transmitted by one phase:

$$M_m = \frac{(n_{mf1} \cdot e_g - n_m) \cdot e_m \cdot K_m \cdot A_m \cdot \pi}{17{,}35 \cdot C_S} \tag{45}$$

The maximum torque is reached when the second term of the Equation (8.89) is zero. This occurs when $n_m = 0$

In this case for each phase there is a purely capacitive load $Q_f = Q_C$

$$\frac{n_m \cdot e_m \cdot K_m \cdot A_m \cdot \pi}{17{,}35 \cdot C_S} = 0 \tag{46}$$

(for $n_m = 0$)

then:

$$M_{\max} = \frac{n_{mf1} \cdot \pi \cdot e_g \cdot e_m \cdot K_m \cdot A_m}{17{,}35 \cdot C_S} \tag{47}$$

From the relation (17), written for the three phases, one can determine the phase pressures in relation to the capacitive flow as follows:

$$p_{C1} = \frac{1}{C_S} \cdot \int_0^T Q_{C1} \cdot dt \qquad (48)$$

$$p_{C2} = \frac{1}{C_S} \cdot \int_0^T Q_{C2} \cdot dt \qquad (49)$$

$$p_{C3} = \frac{1}{C_S} \cdot \int_0^T Q_{C3} \cdot dt \qquad (50)$$

The torque of the drive shaft is produced by the sum of the three pressures:

$$p_m = p_{C1} + p_{C2} + p_{C3} \qquad (51)$$

or:

$$p_m = \frac{1}{C_S} \cdot \int_0^T (Q_{C1} + Q_{C2} + Q_{C3}) \cdot dt \qquad (52)$$

5. Conclusions

This solution, by which the classical mechanical transmission is replaced with the sonic three-phasic transmission, brings a lot of improvements regarding the construction, use and maintenance of the wind power plant.

Beside the advantage of moving the equipment at the base of the tower, the sonic transmission systems offer the possibility of centralization of the wind power from multiple wind turbines and converting the mechanical energy into electrical energy using only one conversion unit.

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RHEOLOGICAL RESEARCHES CONCERNING THE THERMAL BEHAVIOR OF THE LUBRICATING GREASES

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ABSTRACT
The paper presents the studies for the thermal behavior of the lubricating greases, using a plastometer with a capillary tube.
The plastometer was specially designed in order to be capable to determine the variation of the yield stress versus temperature. The experimental results have been numerically treated and a regression relation was obtained, similar to the relation between viscosity and temperature.
As a final conclusion, the results were compared with those published in the literature.

NOMENCLATURE

t	- temperature;
t_0	- reference temperature;
u	- velocity along Oy axis;
y	- cartesian coordinate;
α	- coefficient;
η	- viscosity;
τ	- shear stress;
τ_0	- shear yield stress;
$\tau_{0,t}$	- shear yield stress corresponding to the temperature t;
τ_{0,t_0}	- shear yield stress corresponding to the reference temperature t_0;

I. INTRODUCTION

The classical hydrodynamic lubrication theory in its original form can be applied only if the lubricant behaves as a linearly viscous fluid (Newtonian) with negligible temperature rise, /1/. Applications involving non-Newtonian fluids require appropriate formulation. A class of non-Newtonian fluid utilizes a so-called Bingham model in some tribological applications to describe the flow characteristics of some lubricants, such as grease or fine suspensions, /2/. The constitutive equation for an ideal Bingham plastic model is:

$$\tau = \tau_0 + \eta \frac{du}{dy} \qquad (1)$$

Two parameters, which characterize Bingham plastic models, are the shear yield stress and the viscosity. When the magnitude of the stress tensor is less than the shear yield stress, the behavior of the fluid is akin to that of a rigid solid. When the shear yield stress is exceeded, an ideal Bingham plastic fluid commences to flow as a linear viscous (Newtonian) liquid.
The purpose of this paper is to study the thermal behavior of the lubricating greases, using a plastometer with a capillary tube.

II. EXPERIMENTAL STAND

The experimental stand was a plastometer with a capillary tube, which permits the direct measurement of the yield stress and also its variation with the temperature. The plastometer is similar to GOST 7143-73, but with the loading system modified (Figure 1), /3/.

The components elements are:
1 – Thread tube M5 x 0.8 filled with grease;
2 – Thermostatic precincts (20 ... 80)^{0}C;
3 – Hydraulic pipe;
4 – Gauge (0,05 ... 1) bar;
5 – Hydraulic loading system with piston (0,05 ... 0,55) bar;
6 – Tap;
7 – Oil reservoir.

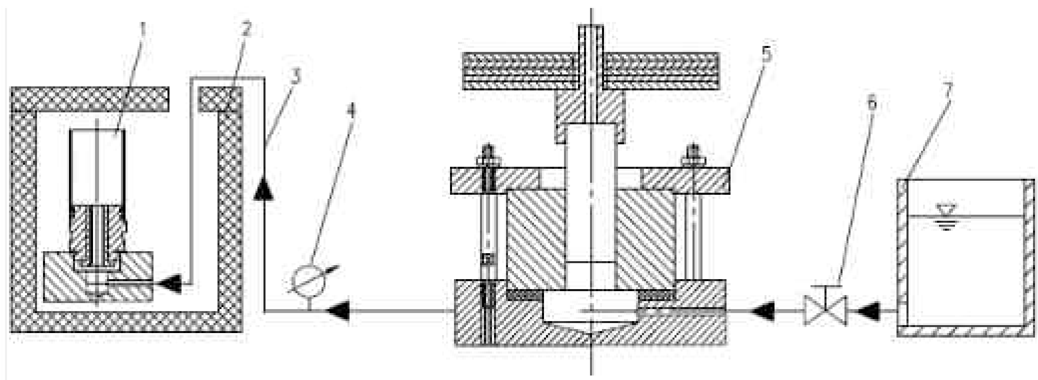

Figure 1 *Schematic diagram of the plastometer*

III. RESULTS

The experiments were carried out on a group of 4 Romanian greases (UM165LiCa1, L90Ca1G, Rul145Na3 and UM185Li2) and 2 foreign greases (Shellalvania2 and MobiluxEP2). The temperature field variation was between 20^{0}C - 60^{0}C, the results being comparatively presented with some values obtained by other authors (see Table 1) /4/, /5/, /6/.
The first 6 experimental results from Table 1 have been statistically processed, by using the regression analysis method, searching an exponential relationship between shear yield stress and temperature, as follow:

$$\tau_{0,t} = \tau_{0,t_0} e^{-\alpha(t-t_0)} \quad (2)$$

In Table 2 are presented the values of coefficient for all the greases which were studied and also the comparison between the theoretical and experimental values for the yield stress.
Also, in Figures 2, a and b, the regression curves and the experimental points have presented.

Table 1 Experimental results for the variation of the shear yield stress versus temperature

No.	Grease type	t, ^{0}C	-15	-10	0	10	20	30	40	50	60	70	80	100
1	UM 165 Li Ca 1						269	227	186	124	115			
2	L 90 Ca 1 G						248	213	175	161	103			
3	Rul 145 Na 3						341	247	203	189	163			
4	UM 185 Li 2						413	385	323	294	244			
5	Shellalvania 2						558	434	340	287	263			
6	Mobilux EP 2	τ_0,					517	420	383	317	265			
7	STP, /4/	Pa						457	291	230	216		116	
8	Aliten U2, /4/							205	174	149	146	128		
9	Bentor 2, /4/						453		403		455		421	362
10	Lt - 43, /4/							1150	1106	922	835	740	593	
11	Alvania EP2, /5/		1102	793	631	618	543		344		281		224	164
12	Aeroshell 6, /6/				700		725	750	825					
13	Termalene, /6/				900		800		700					

Table 2 The values of coefficient for all the greases (No. 1 to 6, Table 1)

No.	Grease type	α, °C^{-1}	Comparison between the theoretical and experimental values for the yield stress						Correlation coefficient
			t, °C	20	30	40	50	60	
1	UM 165 Li Ca 1	0.0230	$\tau_{0,t\ exp}$	269	227	186	124	115	0.9633
			$\tau_{0,t\ regress}$	269	213	170	135	107	
2	L 90 Ca 1 G	0.0204	$\tau_{0,t\ exp}$	248	213	175	161	103	0.9282
			$\tau_{0,t\ regress}$	248	202	165	134	110	
3	Rul 145 Na 3	0.0174	$\tau_{0,t\ exp}$	341	247	203	189	163	0.9362
			$\tau_{0,t\ regress}$	341	286	241	202	170	
4	UM 185 Li 2	0.0132	$\tau_{0,t\ exp}$	413	385	323	294	244	0.9803
			$\tau_{0,t\ regress}$	413	362	317	278	243	
5	Shellalvania 2	0.0192	$\tau_{0,t\ exp}$	558	434	340	287	263	0.9679
			$\tau_{0,t\ regress}$	558	461	380	314	259	
6	Mobilux EP 2	0.0161	$\tau_{0,t\ exp}$	517	420	383	317	265	0.9898
			$\tau_{0,t\ regress}$	517	440	375	319	272	

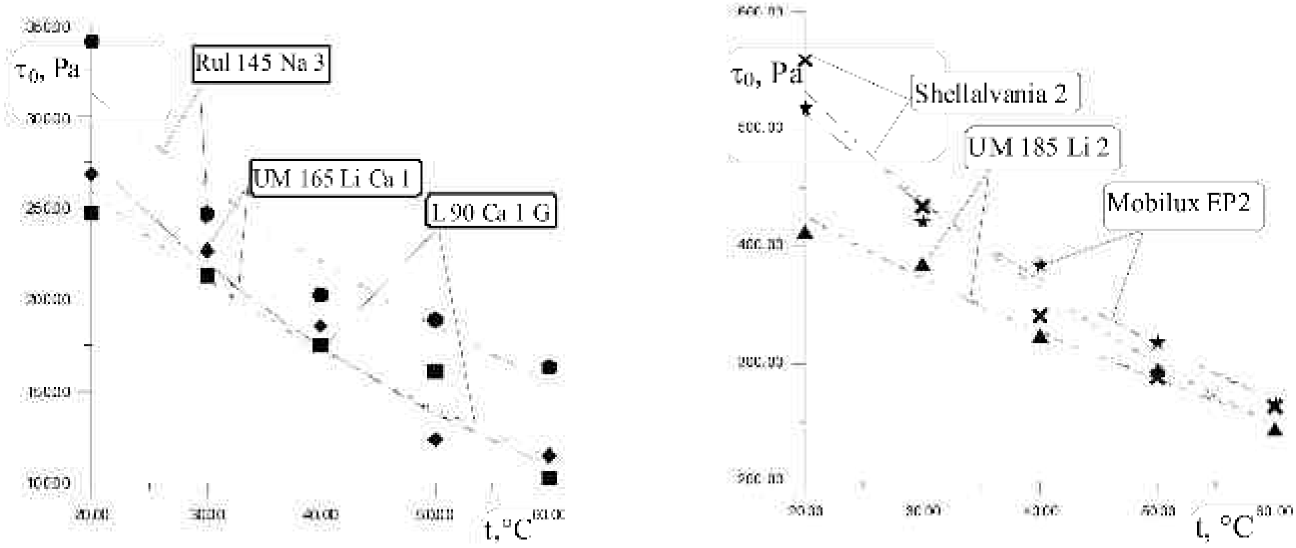

Figure 2 *The variation of the shear yield stress versus the temperature for the experimented greases*

IV. CONCLUSIONS

1. There is a direct relation between the shear yield stress and the temperature; the exponential dependence is very appropriate for approximate this relation.
2. It is very important to intensify the research in order to obtain more information for a large class of greases.

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First Order Virtual Prototype for Analysis of Complex Interactions between Hydrostatic Driving System, Wheel and Irregular Road at Construction Equipments

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Abstract
Main subject of this paper is a virtual prototype for numerical simulations of dynamics of construction equipment with fully hydrostatic driving system. This virtual prototype, named SYMTRAX-I, was developed based on the classical single degree of freedom model. It is a new complete and serviceable simulation instrument for the technological equipments with integral hydrostatic driving system. With the help of this model it was simulated the kinematical excitation phenomenon generated by the road irregularities. The complexity of this analysis results from evaluation of the specific dynamic phenomenon which appears at interaction between the main parts of the construction machine and the road. It was supposed the complex connections between tire wheels drive devices with the equipment insulated on these, the rolling system, the traction transmission and the engine from the base machine. This paper presents mainly the SYMTRAX-I numeric simulator, the computational initial hypothesis and final results, and the comparative discussion between the instrumental tests and the numerical results.

Keywords: hydrostatic driving system, wheel-road interaction, dynamic analysis, virtual prototype.

Introductive Remarks

The driving systems of the construction equipments have a complex configuration based on the mechanical and/or hydraulically ensembles. Hereby, it can be classified into the three main classes, taking into consideration the structural composition, such as follows: full mechanic, full hydraulic and combined hydro-mechanic driving systems. Supposing these, the traction system of certain technological equipment acquires a specifically dynamic behavior under the kinematical excitations generated by the road irregularities. This fact can lead to the resonance phenomenon with speedy propagation and harmful effects into the entire structure of the driving system.

The complexity of this analysis is sustained by the innovative evaluation method of the specific dynamic phenomenon which appears at the interaction between the main parts of the construction machine and the road. It was supposed the complex connections between tire wheels drive devices with full equipment insulated inside these, the rolling system, full traction transmission structure and the main engine from the base machine.

The entire dynamic process have the common element and this is the rolling drive system, related to dynamic characteristics of tires, which include both the vertical direction movement phenomenon of the equipment with respect to kinematical excitation, and the tensional dynamic charges of driving system.

According with previous briefly argumentation, this research deals with virtual prototype for construction equipments with integral hydrostatic driving system. Major objective of this numerical simulator consist by complete analysis of the complex phenomenon generated into the machine system by the road irregularities, for a normal working cycle. Based on the single degree of freedom model, it was developed a new practical simulation model named SYMTRAX-I. This paper presents mainly the SYMTRAX-I numeric simulator, the computational initial hypothesis and final results, and the comparative discussion between the instrumental tests and the numerical results.

In Figure 1 is depicted the basic diagram of the SYMTRAX-I numerical model. This is the core of the virtual prototype for proposed dynamic analysis. The motion equations results easily thus that the dynamic's system for the proposed model is

$$\begin{cases} J_{SP}\dot{\omega}_S + (\chi_P q_P \delta_f + \beta_S)\omega_S + \chi_P q_P p = \alpha_S \\ (q_M - k^*)\omega_R + \alpha_M p^2 + \alpha_P p + (\beta_P + \beta_M)\dot{p} = \chi_P q \\ J_{MR}\dot{\omega}_R - (q_M - k^*)\delta_M(\omega_R - \omega_r)^2 - (q_M - k^*)p = \\ J_T \ddot{\varphi}_U - c_\varphi(\dot{\varphi}_R - \dot{\varphi}_U) - k_\varphi(\varphi_R - \varphi_U) = 0 \\ M\ddot{z} + c_z\dot{z} + k_z z = c_z\dot{u} + k_z u \\ u = u_0 \sin(\omega_0 t) \\ M_R = r_D f.M.(g + \ddot{z}) \\ \omega_R = \dot{\varphi}_R \end{cases} \quad (1)$$

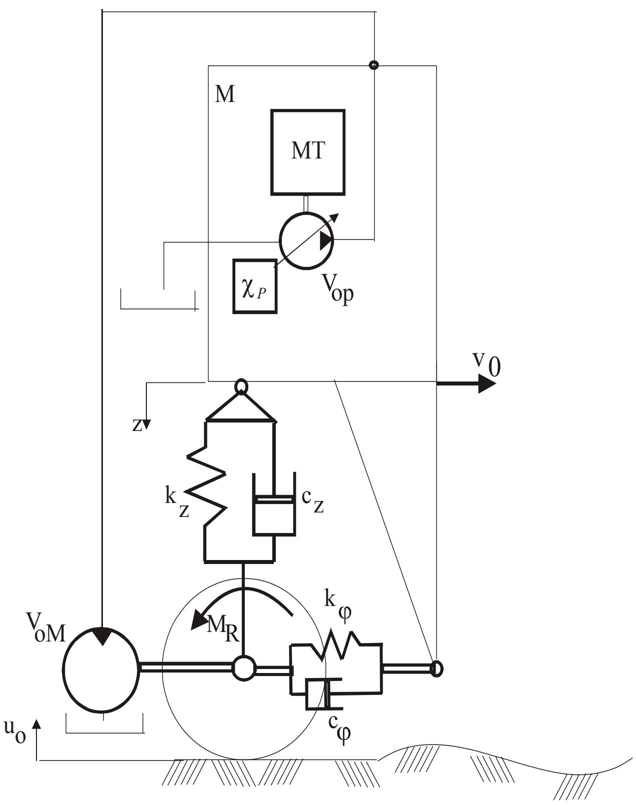


Figure 1. The basic schematic diagram of SYMTRAX-I virtual prototype

The main parameters of the virtual prototype (which appears in Figure 1 schematics) have the meanings and formulations such as follows

The Basics of SYMTRAX-I Numerical Model

i) The adjustment characteristic of the hydrostatic pumps is

$$\chi_P^* = \frac{N_n}{q_{0P}.\omega_S.p} \quad (2)$$

with basic restrictions given by

$$\chi_P = \begin{cases} 1 \ \text{if} \ \chi_P^* \geq 1 \\ \chi_P^* \ \text{if} \ \chi_P^* < 1 \ \text{and} \ p \leq 2{,}8.10^7 N/m^2 \\ \chi_{P\min}^* \ \text{if} \ p > 2{,}8.10^7 N/m^2 \end{cases} \quad (3)$$

ii) The irregularities pulsation of the road profile is

$$\omega_0 = v_0 / r_D \quad (4)$$

iii) The rolling resistance coefficients have the values presented in Table 1.

Table 1. The rolling resistance coefficients

Rolling resistance coefficient for		
puddle ground	moisten sand	asphalt or concrete track
0.03	*0.16*	*0.02*

iv) The moment of adherence between the tire and the road wearing out surface is given by the expression

$$M_A = r_D \varphi_a.M(g + \ddot{z}) \quad (5)$$

v) The main condition for the adherence limit is given by the next expression

$$M_R < M_A \quad (6)$$

Computational analysis on virtual prototype

From the previous paragraph results that the mathematical formulation of the SYMTRAX-I core model have the expressions given by (1) containing five differential equations. These enable computing of the five unknown independent parameters of the model, namely such as follows

- z means the displacement of the equipment on vertical direction;
- p means the pressure into the hydrostatic driving system;
- ω_S, ω_R, ω_U means the instantaneous angular velocities at engine axis, tire wheel, and respectively, of the whole equipment reduced at the wheel axis.

The expression (2), with restrictions given by (3), framed the adjustment characteristic of the hydrostatic pump regulator. The adjustment factor of the pump displacement flow χ_P result from these equations, respecting the instantaneous pressure into the driving system. Hereby it will be able to evaluate the instantaneous flow rate value of the pump.

From the numerical simulation results the dynamic characteristics of the traction system. Among these results, it will be assumed the pressure variation into the driving system, because these data was acquired also from the real model.

A wheel frontal loader with full hydrostatic driving system was the real model used for the comparative analysis with the numerical simulation. Actually, this was the MMT-45 frontal loader, made by PROMEX SA factory in Braila, Romania. This construction equipment is presented in Figure 2 (general view and details of the hydrostatic driving system for the front wheels).

Figure 2. The MMT-45 frontal wheel loader. General view with hydraulic system and wheel driving unit details.

In Figures 3 and 4 was depicted the diagrams related to the simulation results for some movement analysis cases of the construction equipment.

The longitudinal profile of the road which was supposed for numerical simulations depicted in Figure 3 is given by the next expression

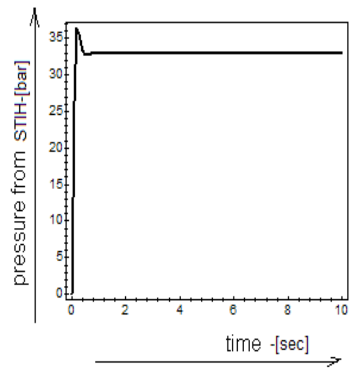
$$u = u_{elev} \sin(3.488\, t) \tag{7}$$

where u_{elev} denote the elevation of the road potential irregularities.

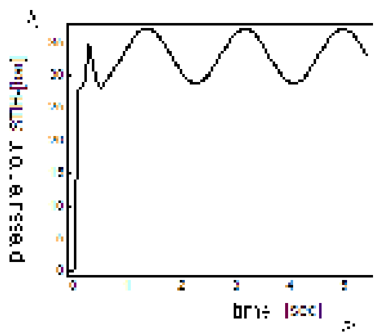
As well, for simulations results depicted in Figure 4, the longitudinal profile of the road is given by the expression

$$u = 10\sin(6.976t) + 5\sin(5\cdot 6.976t) + 5\sin(10\cdot 6.976t)$$

Diagrams in Figure 5 shown two main cases of comparative evolution of the instantaneous pressure into the hydraulic driving system, between the instrumental tests, the numerical simulations and the theoretical movement for a direct and flat road surface without irregularities.



a)



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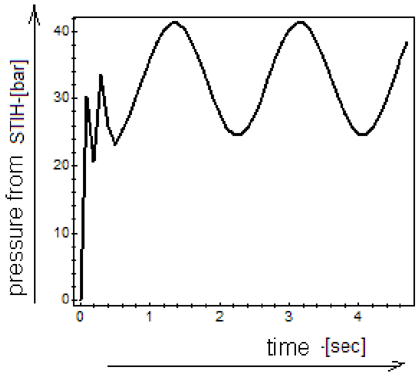

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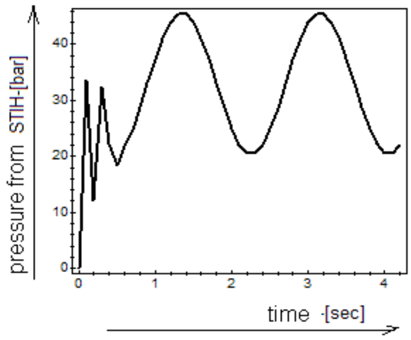

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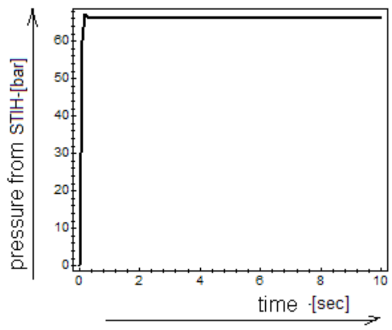
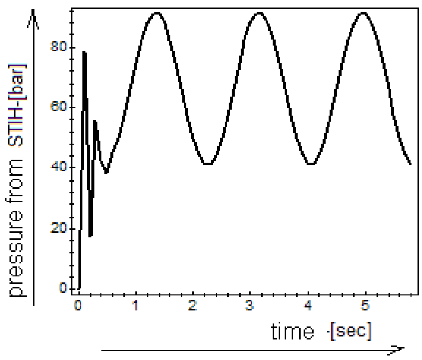


e)



f)

Figure 3. First case results of SYMTRAX-I numerical simulations for the equipment ovement with harmonically irregularities on the road and 1.5 m/s (5.4 km/h) speed.
(a) no road irregularities, concrete or asphalt track with $f = 0.02$
(b) harmonically irregularities with 0.1 m elevation, concrete track with $f = 0.02$
(c) harmonically irregularities with 0.2 m elevation, concrete track with $f = 0.02$
(d) harmonically irregularities with 0.3 m elevation, concrete track with $f = 0.02$
(e) no road irregularities, puddle clay track with $f = 0.03$
(f) harmonically irregularities with 0.3 m elevation, puddle clay track with $f = 0.03$

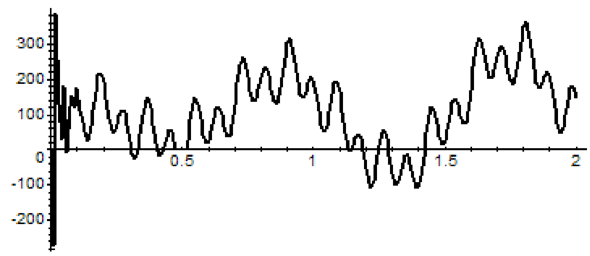
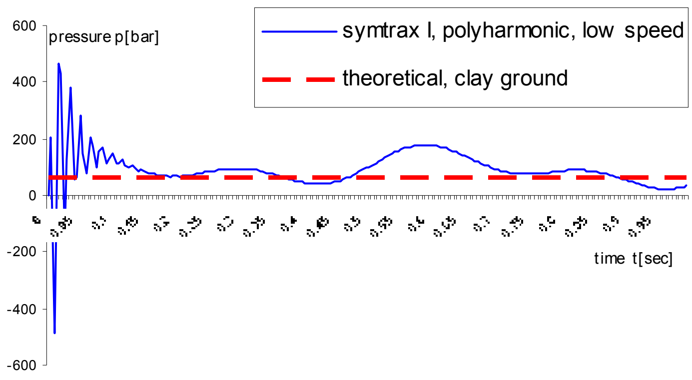
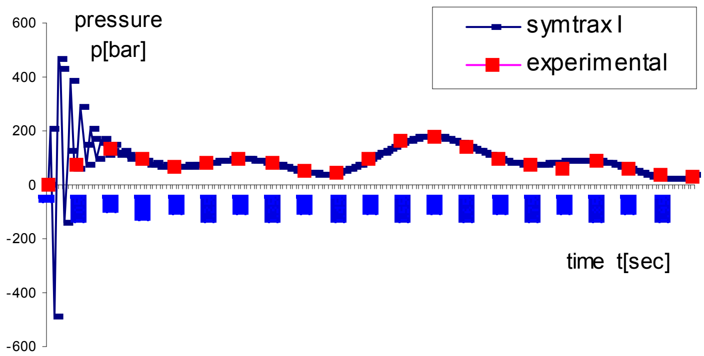


Figure 4. Second case results of SYMTRAX-I numerical simulations for the equipment evolution with periodical irregularities on the road and 3 m/s (10.8 km/h) speed.



(a)



(b)

Figure 5. Comparative analysis for MMT-45 equipment movement over the puddle clay track with periodical irregularities.

(a) Comparison between the theoretical movement for direct and flat road surface without irregularities (red dashed line), and simulated movement for road with polyharmonical irregularities (thick blue continuous line);

(b) Comparison between simulated movement for road with polyharmonical irregularities (thick black continuous line) and instrumental measurements for MMT-45 equipment (red square dots).

Discussions and conclusions

Numerical computations and simulations developed on SYMTRAX-I model reveal deep and cross correlation of the pressure with effective rolling conditions of the construction equipment, such as: type of the road, elevation and type of the track irregularities, equipment velocity. It was dignified that the instantaneous pressure into the equipment driving system follows up the road irregularities profile. It was observed that for the specific conditions supposed for the SYMTRAX-I virtual prototype simulations, even the pressure follows up the irregularities with enough accuracy, it does not accomplish the resonance conditions in the hydrostatic driving system. This is due to the fact that natural frequencies range of hydraulic driving system are enough shifted relative that of the road irregularities profile.

A very important conclusion related with these simulations refer that was not identified the resonance phenomenon, whichever the irregular road profile and the speed range was adopted. It had to be mentioned that the speed range was between 0 and 5.5 km/h. These were happened even for the cases when the magnitude and the phase of the instantaneous pressure into the driving circuit had acquired comparative evolution with the kinematical excitation.

In case of periodical kinematical excitation with polyharmonical signals, the pressure follows up the road irregularities, but appears breaks on linkage with rolling way. This means losses of the adherence and was observed especially for high speed movements, with values over the technological limit speed.

In case of singular irregularities, the pressure leaps appears rigorously at the subside attack. After this moment, the dynamic phenomenon decreases speedy due to the damping around the value that corresponds to the movement over a flat road (see Figure 5).

With this research it was proved that the resonance phenomenon, supposed as very imminent at construction equipments with fully hydrostatic driving systems, it is possible to appear only when natural frequencies domain of the driving system (resulted form designing and manufacturing processes) are situated nearby the excitation frequencies area of the irregular road profile (which statistically denote a potential road profile for an effective study case).

Acknowledgement
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at the *Research Center for Mechanics of the Machines and Technological Equipments at "Dunarea de Jos" University of Galati, Engineering Faculty in Braila, Romania*. The instrumental tests have been performed at the *Research Institute for Construction Equipments and Technologies* - ICECON SA - *Bucharest, Romania*.

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Second Order Virtual Prototype for Analysis of Complex Interactions between Hydrostatic Driving System, Wheel and Irregular Road at Construction Equipments

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Abstract

This paper is a part of a large study deals with numerical simulation of complex dynamics of construction equipment with full hydrostatic driving system. The objective of this paper is a virtual prototype, named SYMTRAX-II, which was developed from the first order virtual prototype SYMTRAX-I in addition with classical two degree of freedom dynamic model. SYMTRAX-II becomes a powerful virtual instrument for complex simulation of dynamics generated by the irregular road profiles and induced into the equipment on the whole. The complexity of this analysis results from the evaluation of the specific dynamic phenomenon which appears at interaction between the main parts of the construction machine and the road. This means a complex connection between tire wheels drive devices with the equipment insulated on these, the rolling system, the traction transmission and the engine from the base machine. In this paper was described the SYMTRAX-II numeric simulator, the computational initial hypothesis and final results, and comparative discussions between the two virtual prototypes developed until now: SYMTRAX-I and SYMTRAX-II.

Keywords: *hydrostatic driving system, wheel-road interaction, dynamic analysis, virtual prototype.*

Introductive Remarks

The driving systems of the construction equipments have a complex configuration based on the mechanical and/or hydraulically ensembles. Hereby, it can be classified into the three main classes, taking into consideration the structural composition, such as follows: full mechanic, full hydraulic and combined hydro-mechanic driving systems. Supposing these, the traction system of certain technological equipment acquires a specifically dynamic behavior under the kinematical excitations generated by the road irregularities. This fact can lead to the resonance phenomenon with speedy propagation and harmful effects into the entire structure of the driving system.

The complexity of this analysis is sustained by the innovative evaluation method of the specific dynamic phenomenon which appears at the interaction between the main parts of the construction machine and the road. It was supposed the complex connections between tire wheels drive devices with full equipment insulated inside these, the rolling system, full traction transmission structure and the main engine from the base machine. The entire dynamic process have the common element and this is the rolling drive system, related to dynamic characteristics of tires, which include both the vertical direction movement phenomenon of the equipment with respect to kinematical excitation, and the tensional dynamic charges of driving system.

According with previous briefly argumentation, this research deals with virtual prototypes for construction equipments with full hydrostatic driving system. Major objective of these numerical simulators was to supply a complete analysis of the complex phenomenon generated into the machine system by the road irregularities. Based on the first order virtual prototype (SYMTRAX-I), in addition with two degree of freedom dynamical model, it was developed a new serviceable numeric simulator which is SYMTRAX-II. This paper briefly presents the SYMTRAX-II simulator, the computational initial hypothesis and final results, and a comparative discussion between numerical results. Also, the concluding remarks paragraph presents the advantages and the disadvantages of SYMTRAX - II comparative with the base SYMTRAX - I virtual prototype.

The Basics of SYMTRAX-II Numerical Model

In Figure 1 is depicted the basic schematic diagram of the SYMTRAX-II numerical model. This is the core of the proposed virtual prototype for dynamic analysis. The motion equations results easily thus that the dynamic's system for the proposed model is

$$\begin{cases} J_{SP}\dot{\omega}_S + (\chi_P q_P \delta_f + \beta_S)\omega_S + \chi_P q_P (p_1 + p_2) = \alpha_S \\ (q_M - k^*)\omega_{R1} + \alpha_M p_1^2 + \alpha_P p_1 + (\beta_P + \beta_M)\dot{p}_1 = \chi_P q_P \omega_S \\ (q_M - k^*)\omega_{R2} + \alpha_M p_2^2 + \alpha_P p_2 + (\beta_P + \beta_M)\dot{p}_2 = \chi_P q_P \omega_S \\ J_{MR}\dot{\omega}_{R1} - (q_M - k^*)\delta_M(\omega_{R1} - \omega_r)^2 - (q_M - k^*)p_1 = -M_{R1} \\ J_{MR}\dot{\omega}_{R2} - (q_M = k^*)\delta_M(\omega_{R2} - \omega_r)^2 - (q_M - k^*)p_2 = -M_{R2} \\ (J_{T1} - J_{T2})\ddot{\varphi}_U - c_\varphi(\dot{\varphi}_{R1} - \dot{\varphi}_U) - k_\varphi(\varphi_{R1} - \varphi_U) + c_\varphi(\dot{\varphi}_{R2} - \dot{\varphi}_U) + k_\varphi(\varphi_{R2} - \varphi_U) = 0 \\ M\ddot{z} + c_z[(\dot{z} - a_1\dot{\varphi}) + (\dot{z} - a_2\dot{\varphi})] + k_z[(z - a_1\varphi) + (z - a_2\varphi)] = c_z(\dot{u}_1 + \dot{u}_2) + k_z(u_1 + u_2) \\ J_{Cy}\ddot{\varphi} + c_z[(a_1\dot{\varphi} - \dot{z})a_1 + (a_2\dot{\varphi} - \dot{z})a_2] + k_z[(a_1\varphi - z)a_1 + (a_2\varphi - z)a_2] = \\ \quad = c_z(a_1\dot{u}_1 + a_2\dot{u}_2) + k_z(a_1u_1 + a_2u_2) \\ u_1 = u_{01}\sin(\omega_0 t) \\ u_2 = u_{02}\sin(\omega_0 t + \theta_0) \\ M_{R1} = r_D f.M.(g + \ddot{z} - a_1\ddot{\varphi}) \\ M_{R2} = r_D f.M.(g + \ddot{z} - a_2\ddot{\varphi}) \\ \omega_{R1} = \dot{\varphi}_{R1} \\ \omega_{R2} = \dot{\varphi}_{R2} \end{cases} \tag{1}$$

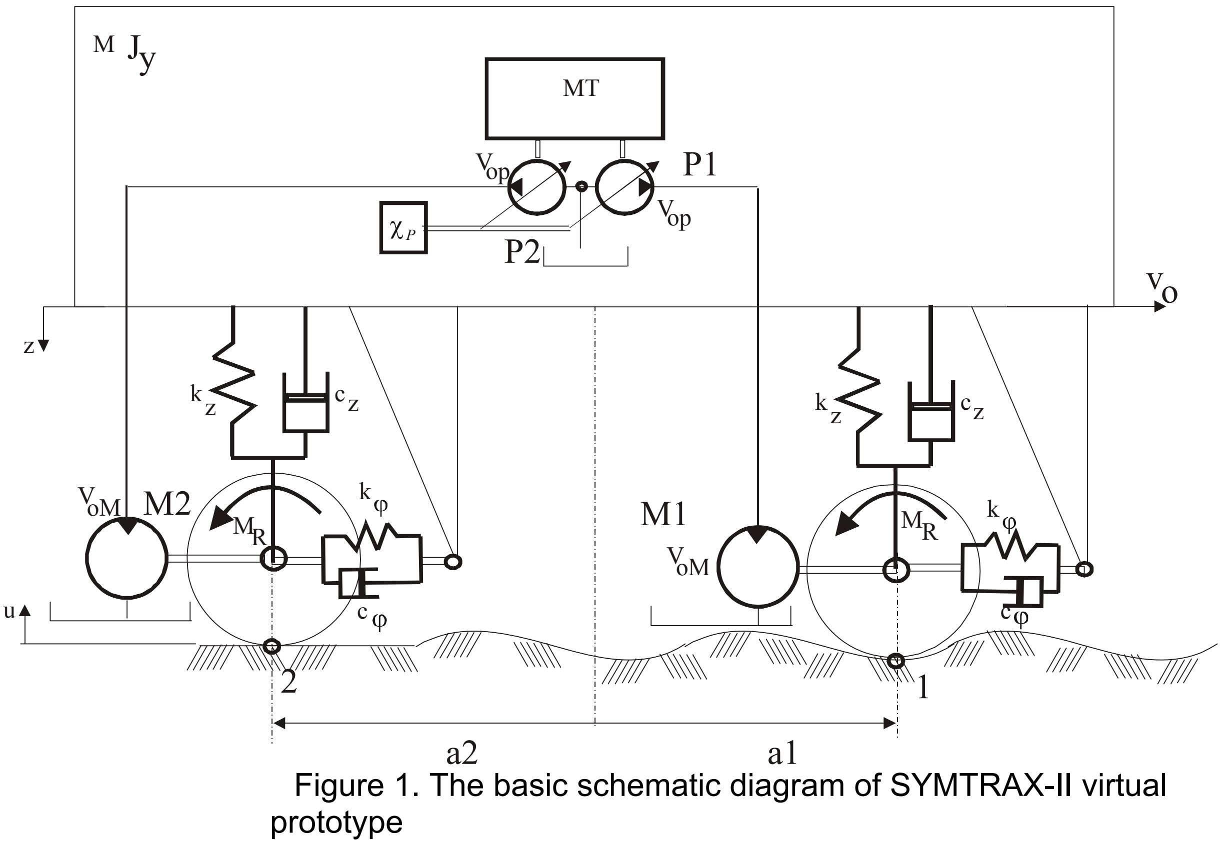


Figure 1. The basic schematic diagram of SYMTRAX-II virtual prototype

The main parameters of the virtual prototype (which also appears in Figure 1 schematics) have the meanings and formulations such as follows:

i) The adjustment characteristic of the hydrostatic pump is

$$\chi_P^* = \frac{N_n}{q_{0P}.\omega_S.(p_1+p_2)} \qquad (2)$$

with basic restrictions given by

$$\chi_P = \begin{cases} 1 \ if \ \chi_P^* \geq 1 \\ \chi_P^* \ if \ \chi_P^* < 1 \ and \\ \quad (p_1+p_2) \leq 5{,}6.10^7 N/m^2 \\ \chi_{P\min}^* \ if \ (p_1+p_2) > 5{,}6.10^7 N/m^2 \end{cases} \qquad (3)$$

ii) The irregularities pulsation on the rolling way (the pulsation of the irregular road profile) is

$$\omega_0 = v_0 / r_D \qquad (4)$$

iii) The rolling resistance coefficients have the values presented in Table 1.

Table 1. The rolling resistance coefficients

Rolling resistance coefficient for		
puddle ground	moisten sand	asphalt or concrete track
0.03	*0.16*	*0.02*

iv) The moments of adherence between each tire and the road wearing out surface are given by the expressions

$$M_{A1} = r_D\varphi_a.M(g+\ddot{z}-a_1\ddot{\varphi})$$

$$M_{A2} = r_D\varphi_a.M(g+\ddot{z}-a_2\ddot{\varphi}) \qquad (5)$$

v) The main conditions for the adherence limit are given by the next expressions

$$M_{R1} < M_{A1}$$

$$M_{R2} < M_{A2} \qquad (6)$$

Computational Analysis on SYMTRAX-II Virtual Prototype

From the previous paragraphs result that the SYMTRAX-II core model have the mathematical formulation given by expression (1) containing eight differential equations. These enable computing of the eight unknown independent parameters of the model, namely such as follows

- *z* means the linear displacement of the equipment on vertical direction (jumping movement);
- φ means the angular displacement of the equipment on vertical plane (rocking movement);
- p_1, p_2 means the pressures for the two energetically lines of the hydrostatic driving system;
- ω_S, ω_{R1}, ω_{R2}, ω_U means the instantaneous angular velocities at engine axis, front and rear tire wheels, and respectively, of the whole equipment reduced at the wheel axis.

The expression (2), with restrictions given by (3), framed the adjustment characteristic of the hydrostatic pump regulator. The adjustment factor of the pump displacement flow χ_P result from these equations, with respect to instantaneous pressure into the driving system. Hereby it will be able to evaluate the instantaneous flow rate value of the pump.

From the numerical simulation results the dynamic characteristics of the traction system. Among these results, it will be assumed the pressures p_1 and p_2 and the flows Q_1 and Q_2 variations into the driving system, because these data was acquired also from the real model.

A wheel frontal loader with full hydrostatic driving system was the real model used for the comparative analysis with the numerical simulation. Actually, this was the MMT-45 frontal loader, made by PROMEX SA factory in Braila, Romania. A general view of this construction equipment is presented in Figure 2. Also, in Figure 2 were provided details of hydraulic driving system.

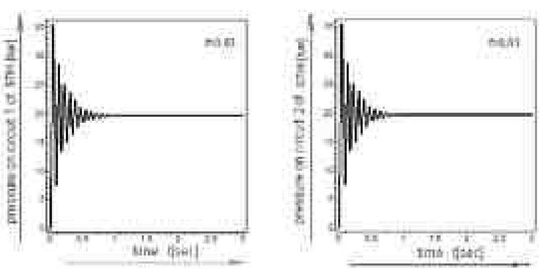
Figure 2. The MMT-45 frontal wheel loader. Generall view with hydraulic system and wheel driving unit details.

In Figure 3 is depicted the diagrams concordant with the simulation results for some movement analysis cases of the construction equipment.

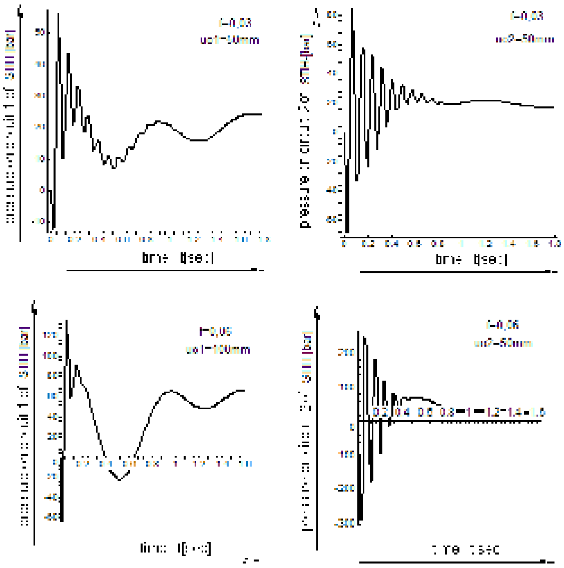
In Figure 4 is depicted the diagrams of pressure variation in hydrostatic driving system circuits, as follows: p_1 into the front circuit and p_2 into the rear circuit, both acquired on real model.

Comparing the simulations with experimental data results a good approximation of the numerical computations with the reality.

On the other hand, comparing the SYMTRAX-I simulations with the SYMTAX-II, result clearly that the second order simulator do not bring any useful additional information regarding the first order model. Particularly, the second model complicates the methods and the procedures for numerical computations.



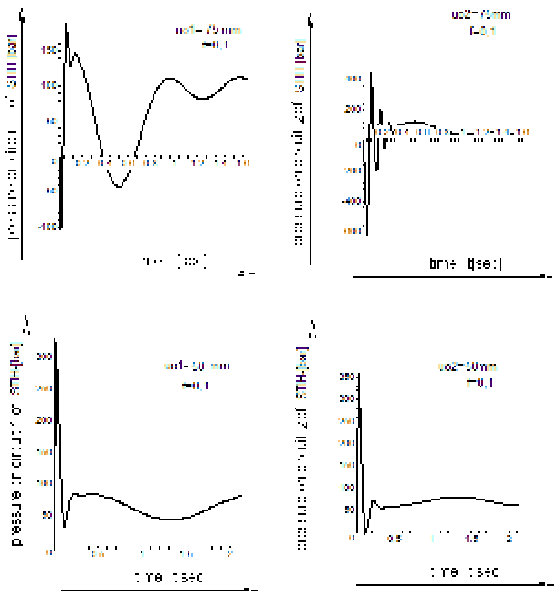
(a)



(b)

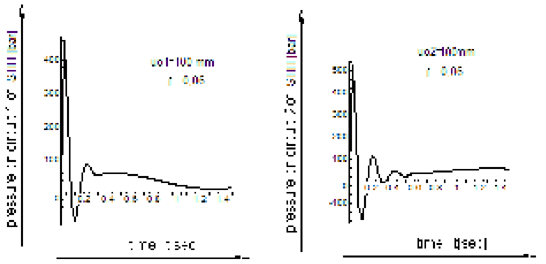
(c)

Figure 3. Simulations with SYMTRAX-II. The equipment movement for harmonically irregular road profile; puddle clay track with *f* = 0.03; left side - pressure into the circuit 1; right side - pressure into the circuit 2;
(a) no irregularities on road, 1.0 m/s (3.6 km/h) speed, bucket loaded;
(b) harmonically irregularities with 0.05 m elevation, 1.0 m/s (3.6 km/h) speed, bucket loaded;
(c) harmonically irregularities with 0.1 m elevation, 1.5 m/s (5.4 km/h) speed, bucket loaded;



(d)

(e)



(f)

Figure 3. Simulations with SYMTRAX-II. (continuation)

The equipment movement for harmonically irregular road profile; puddle clay track with *f* = 0.03; left side - pressure into the circuit 1; right side - pressure into the circuit 2;

(d) harmonically irregularities with 0.75 m elevation, 1.5 m/s (5.4 km/h) speed, bucket loaded;

(e) harmonically irregularities with 0.05 m elevation, 1.5 m/s (5.4 km/h) speed, empty bucket;

(f) harmonically irregularities with 0.1 m elevation, 1.5 m/s (5.4 km/h) speed, empty bucket.

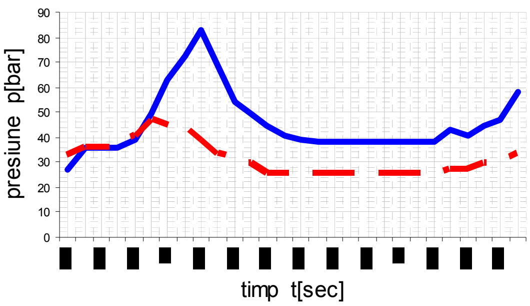


Figure 4. Pressure evolution for machine movement over a real track with unique irregularity; pressure in circuit 1 drawn with blue continuous line; pressure in circuit 2 drawn with red dashed line.

Discussions and Conclusions

SYMTRAX-II virtual prototype do not bring any useful or essential additional information, comparative with SYMTRAX - I, regarding the response of the hydraulic driving system at the kinematical excitation generated by the road profile irregularities. The second order simulator has more complicated motion differential equations, and of course, needs more computing resources. Because the SYMTRAX-II high complexity, and from the dynamic analysis viewpoint, this virtual prototype was not allowed to obtain a new relevant concluding remarks, than about the balanced loaded of the two bridges of the construction equipment. And this was a function of longitudinal position of centre of gravity, and of equipment position and stability versus base machine, on movement process.

From the results analysis of the numerical simulation, developed on SYMTRAX-II simulator, it was dignified the dependences of the pressure with the movement and working conditions of the equipment, as follows: the type of the road wearing out surface, the elevation and the type of road profile irregularities, the equipment velocity. It was marked out that the instantaneous pressure into the hydraulic driving system follows up the road irregularities. It was observed that for the specific conditions supposed for the SYMTRAX-II virtual prototype simulations, even the pressure follows up the irregularities with enough accuracy, it does not accomplish the resonance conditions in the hydrostatic driving system. A very important conclusion related with these simulations refer that was not identified the resonance phenomenon, whichever the irregular road profile and the speed range was adopted. These were happened even for the cases when the magnitude and the phase of the instantaneous pressure into the driving circuit had acquired comparative evolution with the kinematical excitation. This is due to the fact that natural frequencies range of hydraulic driving system are enough shifted relative that of the road irregularities profile.

In case of singular irregularities, the pressure leaps appears rigorously at the subside attack. After this moment, the dynamic phenomenon decreases speedy due to the damping around the value that corresponds to the movement over a flat road (see Figure 4).

With this research it was proved that the resonance phenomenon, supposed as very imminent at construction equipments with fully hydrostatic driving systems, it is possible to appear only when natural frequencies domain of the driving system (resulted form designing and manufacturing processes) are situated nearby the excitation frequencies area of the irregular road profile (which statistically denote a potential road profile for an effective study case).

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DETERMINAREA CONFIGURAȚIEI GEOMETRICE OPTIME A SUPAPEI

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- Se consideră optimă configurația geometrică care provoacă turbulență minimă la trecerea prin supapă admițând, însă că viteza de trecere prin supapă este mai mare ca, circulația prin restul circuitului;
- Configurația adoptată este redată de figura 1 ce corespunde piloților şi supapelor directe.

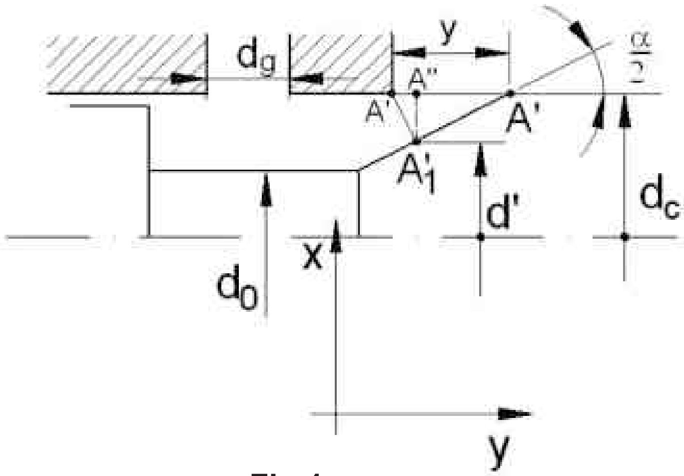


Fig 1
d_g : gaura de intrare;
y : cursa supaei;
d_c : diametrul exterior;
d_0 : diametrul interior.

Dacă se consideră că în restul circuitului circulația se caracterizează de $\mathrm{Re} = \frac{v_1 d_N}{\nu}$, iar prin supapă se poate considera că trecerea se face înmulțind Re cu un factor şi se poate scrie:

$$(I)\ \xi \mathrm{Re} = \frac{v_S d_E}{\nu} \text{ in care } \begin{cases} \xi \text{ coeficient ce multiplica Re;} \\ v_S \text{ viteza de circulatie prin supapa;} \\ d_E \text{ diametrul echivalent deschiderii} \end{cases}$$

Formând sistemul:

$$(II) \begin{cases} \left.\begin{aligned} \mathrm{Re} &= \frac{v_1 d_N}{\nu} \\ \xi\ \mathrm{Re} &= \frac{v_S d_E}{\nu} \end{aligned}\right\} \frac{1}{\xi} = \frac{v_1 d_N}{v_S d_E} = \left(\frac{d_E}{d_N}\right)^2 \cdot \frac{d_N}{d_E} \Rightarrow \frac{1}{\xi} = \frac{d_E}{d_N} \\ d_E = 2\sqrt{\frac{S(y)}{\pi}} \\ v_1 d_N^2 = v_S d_E^2 \end{cases}$$

În care S poate fi considerat funcție de α şi y
Utilizând Fig 1 se exprimă S(y, α)

$$(IV)\ S(y,\alpha) = \frac{\pi}{4}\left[2d_C^2 + \left(2\sin\frac{\alpha}{2} - \sin\alpha\right)\left(2d_C y - y^2 \sin\alpha\right)\right]$$

$$(III)\ \xi(y) = \frac{d_N\sqrt{\pi}}{2} \cdot \frac{1}{\sqrt{S(y)}}$$

Din condiția ca turbulența în supapă să fie minimă este necesar ca ξ să fie minim. Punând formal condiția de minim a lui ξ rezultă condițiile necesare:

$$(V)\begin{cases}\dfrac{\partial\xi}{\partial y}=0\\[2mm] \dfrac{\partial\xi}{\partial\alpha}=0\end{cases}\quad \text{si conditiile suficiente}\begin{cases}\dfrac{\partial^2\xi}{\partial y^2}>0\\[2mm] \dfrac{\partial^2\xi}{\partial y}\cdot\dfrac{\partial^2\xi}{\partial\alpha}-\left(\dfrac{\partial^2\xi}{\partial y\partial\alpha}\right)^2>0\end{cases}$$

Transpunând condițiile necesare pentru ξ rezultă:

$$(VI)\begin{cases}\dfrac{\partial\xi}{\partial y}=-\dfrac{1}{2\sqrt{S^3}}\cdot\dfrac{\partial S}{\partial y}=0\\[2mm] \dfrac{\partial\xi}{\partial\alpha}=-\dfrac{1}{2\sqrt{S^3}}\cdot\dfrac{\partial S}{\partial\alpha}=0\end{cases}\quad \text{dar } S(\alpha,y)\neq 0 \text{ iar } S^3(\alpha,y)\neq 0$$

Condițiile necesare devin:

$$(VII)\ \frac{\partial S}{\partial y}\sim d_C\left(2\sin\frac{\alpha}{2}-\sin\alpha\right)-\sin\alpha\left(2\sin\frac{\alpha}{2}-\sin\alpha\right)y=0$$

$$(VIII)\ \frac{\partial S}{\partial\alpha}\sim 2d_C\left(\cos\frac{\alpha}{2}-\cos\alpha\right)y-\left[\cos\alpha\left(2\sin\frac{\alpha}{2}-\sin\alpha\right)-\sin\alpha\left(\cos\frac{\alpha}{2}-\cos\alpha\right)\right]y^2=0$$

din (VII) rezulta $y=\dfrac{d_C}{\sin\alpha}$ (IX)

din $(VIII)$ rezulta $y=0$ solutie banala

Inlocuind (IX) în (VIII)rezultă ecuația:

$$(X)\ 8\sin^3\frac{\alpha}{2}-2\sin^2\frac{\alpha}{2}+7\sin\frac{\alpha}{2}+3=0$$

care prin transformarea Tschirnhaus:

$$(XI)\ \sin\frac{\alpha}{2}=r+\frac{1}{12}\ \text{ devine }\ r^3+\frac{41}{48}r+\frac{121}{288}=0\quad r\in R$$

şi care are două rădăcini complex conjugate şi una reală:

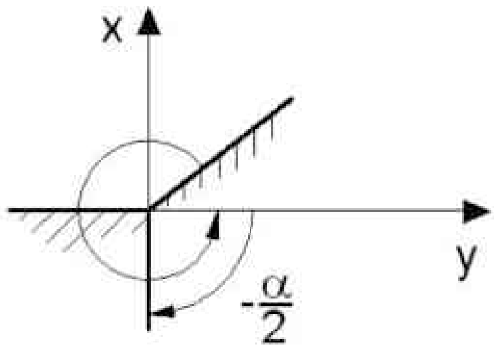
$r=-0{,}41074$ deci

$$\sin\frac{\alpha}{2}=-0{,}41074+\frac{1}{12}=-0{,}3274$$

rezultă semiunghiul supapei:

$\dfrac{\overline{\alpha}}{2}=-19^0$ (minusul derivă din modul de alegere al sistemului de referință)

Deci în mod absolut $\overline{\alpha}=38^0$



Înlocuind α în (IV) rezultă relația din secțiunea de trecere *S(y)* şi deschiderea *y*

Se demonstrează că ξ(*y*) are un minim:

$$\frac{\partial S}{\partial y}=\pi\sin\frac{\alpha}{2}\left(1-\cos\frac{\alpha}{2}\right)\left(d_C-y\sin\alpha\right)>0$$

$$\frac{\partial^2 S}{\partial y^2}=-\pi\sin\alpha\sin\frac{\alpha}{2}\left(1-\cos\frac{\alpha}{2}\right)<0\quad\forall\alpha<90^0$$

dacă:

$$\frac{\partial\xi}{\partial y}=\frac{d_N\sqrt{\pi}}{2}\cdot\frac{\partial}{2y}\left(\frac{1}{\sqrt{S}}\right)=-\frac{d_N\sqrt{\pi}}{4}\cdot\frac{1}{\sqrt[2]{S^3}}\cdot\frac{\partial S}{\partial y}<0$$

$$\frac{\partial^2\xi}{\partial y^2}=-\frac{d_N\sqrt{\pi}}{2}\cdot\frac{\dfrac{\partial^2 S}{\partial y^2}S^2+\dfrac{3}{2}\left(\dfrac{\partial S}{\partial y}\right)^2}{S^4\sqrt{S}}<0$$

Coeficientul de pierderi prin supapă se obține înlocuind (*III*) în (*XII*)

$$(XIII)\ \xi(y)=\frac{d_N}{\sqrt{2d_C^2+0{,}07d_Cy-0{,}021y^2}}$$

Concluzie

Configurația determinată reduce turbulența la un minim dacă α = 38^{o}, ceace conduce la o cădere nominală de presiune minimă la trecerea prin supapă, deoarece:

$$\Delta p = \xi \, \frac{1}{2} \, \rho \, \frac{Q^2}{A^2} \quad \text{in care} \begin{cases} \rho, \mathrm{Q} \text{ constante} \\ \mathrm{A}[\mathrm{S}(\mathrm{y})] \text{si } \xi = \dfrac{\mathrm{d_N}\sqrt{\pi}}{2} \cdot \dfrac{1}{\sqrt{S(y)}} \end{cases}$$

deci: $$\Delta p \sim \frac{K}{A^2(y)\sqrt{S(y)}}$$

din care la $Q = ct$ Δp scade când ”y„ creşte în care $K = ct$.

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DEFINING THE WORK OF DEFORMING WEAR-PROOF IRON-NICKEL PLATING IN MICROSQUEEGING

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Abstract: *The research done elastic, plastic and total volume of deformed volume in micropressing, and the work, expended in deformation and dynamic micro hardness.*

Keywords*:* continuous pressing, micro hardness deformed volumes, springy elastic and total deformed volume.

1. Introduction

The actual problems of studying physical and mechanical characteristics of materials in near – surface layers are caused by the fact that all the modern methods of processing, ruggedizing and coupling metals are connected with contact deformations.
Kinetic micro hardness and hardness tests open up new possibilities for determining physical and mechanical properties and destructions viscosity of wear-proof coverings [1]. The potentialities of defining elastically plastic characteristics, deformation work (A_y, A_n, A_p, A), the relationship among micro hardnesses (H/H_h, H/H_d) of wear-proof iron-nickel coverings have been expended in [2, 3].

2. Information

Kinetic micro hardness and hardness tests open up new possibilities for determining physical and mechanical properties and destructions viscosity of wear-proof coverings.
The study on the deformation of deep and superficial layers of material under indentor by putting the grid in the plane of the meridian section of the model showed that the deformation of the deep layers of material when pressing in the pyramid for the metals is qualitatively identical. Deformations are maximal along the axis of pressing in at the point of maximum shearing stresses. On the surface of the imprint deformations grow from the center to the outline, they decrease near the outline and the direction changes beyond its limits.
The inversion of the direction of deformation occurs in the consequence of the fact that in the imprint and at a certain depth under it the material experiences axial compression and broadening in the radial direction. Beyond the outline of imprint extension of material to the surface occurs, which is accompanied by axial broadening and contraction in the radial direction. In the intermediate directions the components of axial deformation smoothly change from the compression along the axis of pressing in to broadening on the outline of imprint.
The potentialities of defining elastically plastic characteristics, deformation work (A_y, A_n, A_p, A), the relationship among micro hardnesses (H/H_h, H/H_d) of wear-proof iron-nickel coverings have been expended in [2,4].
Iron-nickel plating form electrolytes (tab. 6] were under investigation by the procedure described in the work [2]. As specimens, were studied rollers of 30mm in diameter, with plating 0.5 mm thick and 100 mm in length, which were treated in optimal polishing modes.
The depth of elastic restoration (h_y), of plastic and general squeezing (h_h, h) were defined by

the diagram of pressing indentor of springy (V_y), plastic (V_n), and total (V) deformed for elastic (A_y), plastic (A_n) and total elastic (A) deformed volumes (kgf·mm) were determined for one depth of pressing in (h = 2 μm) by the well-known methods [2,3]. The dynamic hardness elastic (H_d = A/V) was specified as the ratio of complete work of deforming (A) to the expelled material volume elastic (V), i.e. as an average specific work of deformation.

3. The experimental studies

The experimental studies carried out by us have shown that the dependence of dynamic micro hardness elastic (H_d) upon the current density of iron-nickel coverings is of extreme character (fig.1). With the increase of current density from 5 A/dm^2 to 50 A/dm^2, the dynamic micro hardness rose from 6540 (H/mm^2) to 9460 (H/mm^2). Of the current density is increased further from 50 A/dm^2 to 80 A/dm^2, the dynamic micro hardness (H_d) will decrease from 9460 H/mm^2 to 6120 (H/mm^2).

On the entire range of increasing current densities (from 5 A/dm^2 to 80 A/dm^2) the volume of elastic deformation of iron-nickel coverings (V_y) rose from $2.08x10^{-2}$ mm^3 up to 3.02×10^{-2}mm^3 and the work expended on plastic deforming of these volumes (A_y) increased from $7.37x10^{-1}$kgf·cm to $26.13x10^{-1}$kgf·cm.

The above data are in good agreement with the previous studies [2] and show that with rise of current density from 5 A/dm^2 to 80 A/dm^2, has increased the depth of the restored imprint from 0.24 μm to 0.374 μm in the process of micro identification of iron-nickel coverings.

The dependence of dynamic micro hardness (H_d) and work expended on plastic deforming of iron-nickel coverings with the increase of current densities from 5 A/dm^2 to 80 A/dm^2 is of extreme character (fig.2).

Of the current densities are increased from 5 A/dm^2 to 50 A/dm^2, the work of plastic deformation (A_n) will increase from $29.10x10^{-1}$kgf·cm to $33.09x10^{-1}$kgf·cm. With further increase of current densities from 50 A/dm^2 to 80 A/dm^2 the work expended for plastic deformation would decrease from $33.09x10^{-1}$kgf·cm to $21.49x10^{-1}$kgf·cm. With the rise of current densities from 5 A/dm^2 to 80 A/dm^2 the deformed plastic volume (V_n) was reduced from $4.45x10^{-2}$ kgf·cm^3 to $3.51x10^{-2}$ kgf·cm^3. These data have shown that with the increase of current densities from 5 A/dm^2 to 80 A/dm^2 the depth of plastic imprint (h_n) was decreased from 1.760 μm to 1.626 μm in micro identifying iron-nickel coverings.

4. Total work consumed

The dynamic micro hardness dependence (H_d) and total work consumed on iron-nickel plating deformation with the increase of current density from 5A/dm^2 to 80A/dm^2 are of extreme character and the total volume of plastic deformation (V) impressing at the same value (h = 2 μm) was a constant quantity (V = $6.53x10^{-2}$ mm^3) (fig.3).

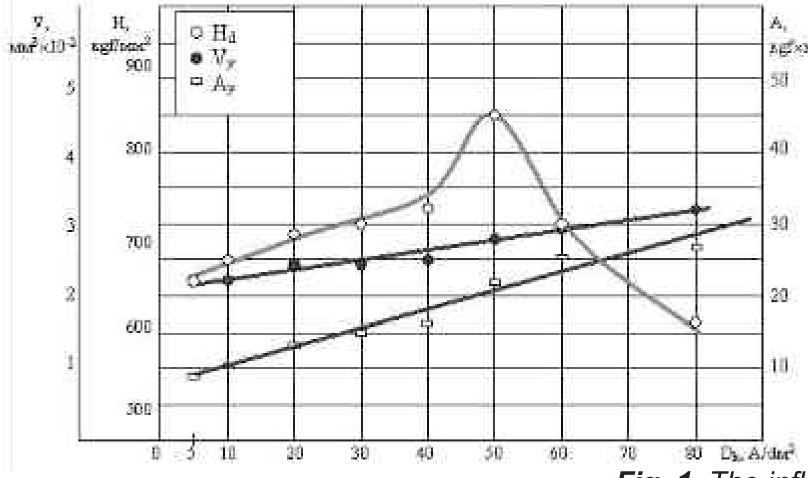

Fig. 1. The influence of current density on elastic characteristics of iron – nickel coverings.

When raised current density from 5 to 50 A/dm^2, the sum total deformation work increased from 42.72 kgf·mm to 55.26 kgf·mm. With the further increase of current density from 50 A/dm^2 to 80 A/dm^2, the sum total deformation work decreased from 55.26 kgf·mm to 39.98 kgf·mm.

With the temperature of electrolyte from 20 °C to 40 °C, the dynamic micro hardness (H_d) grew up from 5780 H/mm^2 to 8460 H/mm^2 and the work expended for plastic deformation rose from 19.99 kgf·mm to 33.09 kgf·mm. The sum total work (A) consumed on deforming the total volume increased from 37.72 kgf·mm to 55.26 kgf·mm. The work for fragile destruction (A_p) grew up from 15.15 kgf·mm to 20.01 kgf·mm.

In spite of an increase in the dynamic microhardness, the work, spent on general, plastic and brittle failure of iron-nickel coatings with an increase in the temperature of electrolyte from 20 °C to 40 °C works spent on the elastic deformation of iron-nickel sediments decreases from 2.582 to 2.157 kgf·mm.

Of the temperature is further increased from 40 °C to 60 °C, the dynamic micro hardness (H_d) will drop from 8460 H/mm^2 to 6540 H/mm^2. The sun total work (A) expended for deforming the general volume was decreased from 55.26 kgf·mm to 42.72 kgf·mm. The work for fragile destruction did not practically change. The work for plastic deformation reduced from 33.09 kgf·mm to 26.33 kgf·mm and work spent on elastic deformation decreased from 2.157 to 1.415 kgf·mm.

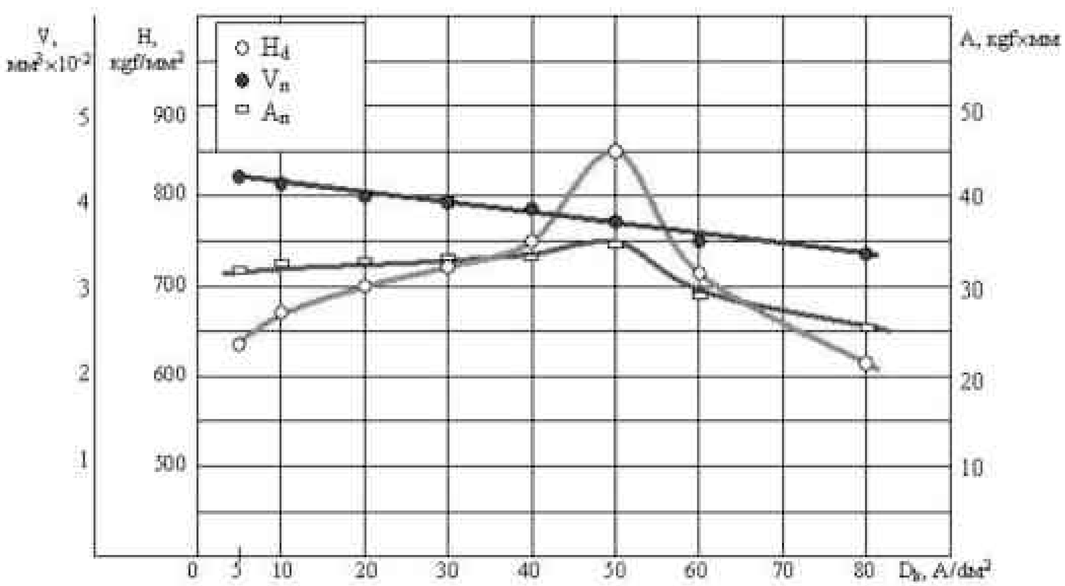

Fig. 2. *The influence of current density on plastic properties of iron – nickel coverings.*

It should be pointed put that with the increase of electrolyte temperature from 20 °C to 60 °C, the depth of plastic pressing decreased (h_y) from 0.390 µm to 0.298 µm; the work expended for plastic deformation (A_y) reduced from 2.582 kgf·mm to 1.415 kgf·mm and the depth of plastic pressing (h_n) rose from 1.620 µm to 1.702 µm.

The studies undertaken have shown that the dynamic micro hardness (H_d), the work for plastic and general deformation (A_n, A) and the work for fragile destruction (A_p) are of extreme character with the change of current density from 5 A/dm^2 to 80 A/dm^2 and electrolyte temperature from 20°C to 60°C.

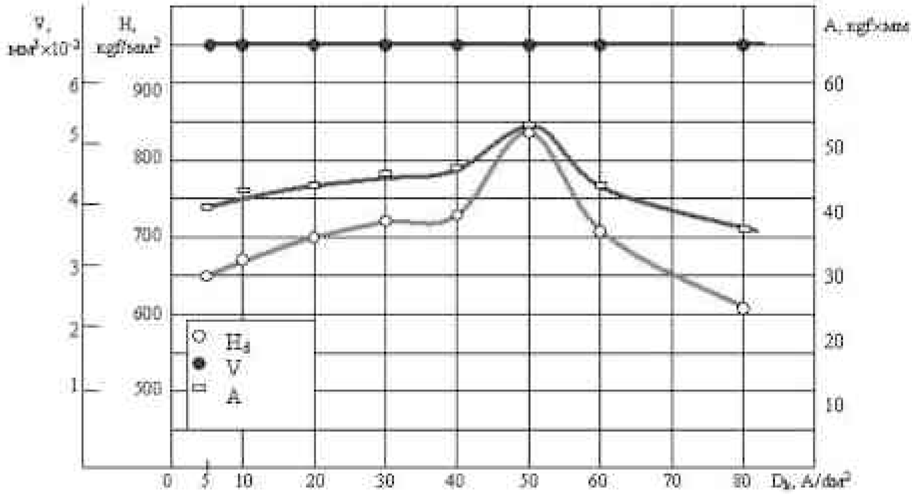

Fig. 3. *The influence of current density on dynamic micro hardness (Hd) and the work expended on deforming Fe-Ni plating in micro squeezing.*

Extreme quantities of the above values (H_d, A_n, A_p, A) coincide with the recommendations obtained earlier for iron-nickel plating from the viewpoint of their optimal wear resistance. The greatest dynamic micro hardness (H_d), the most value of the work expended for springy, plastic and general deformations of iron-nickel coverings of iron density of 50 A/dm^2 and temperature (T) of 40°C.

5. The possibility of evaluating fragility of coverings

The possibility of evaluating fragility of coverings by pressing indentor is of great importance as in defining by means of other methods some difficulties arise connected with plating peeling off the base and their testing because of low hardness [2].

The increase of current density assists in fragile destruction of coverings at smaller critical loads regardless of the solution where plating occurred which agrees with the available published data on determining fragility of coverings by means of flexible cathode.

This regularity can be explained by the fact that increasing current density leads to increasing the number of micro cracks and decreasing the plating density. The plating destruction may arise only after some preliminary deformation. The intensity of this accumulation depends on the type of interatomic bonds, material structure and deformation conditions.

With the change of conditions of electroplating the deposit structure and deformation condition will change either [2]. Pores and cracks concentrate tensions and reduce plastic properties of plating raising their tendency to fragile destruction. The sum total material porosity is defined by means of elasticity module E and H/H_d ratio [4]. The work is consumed on the plastic deformation connected with the preparation of destruction [1].

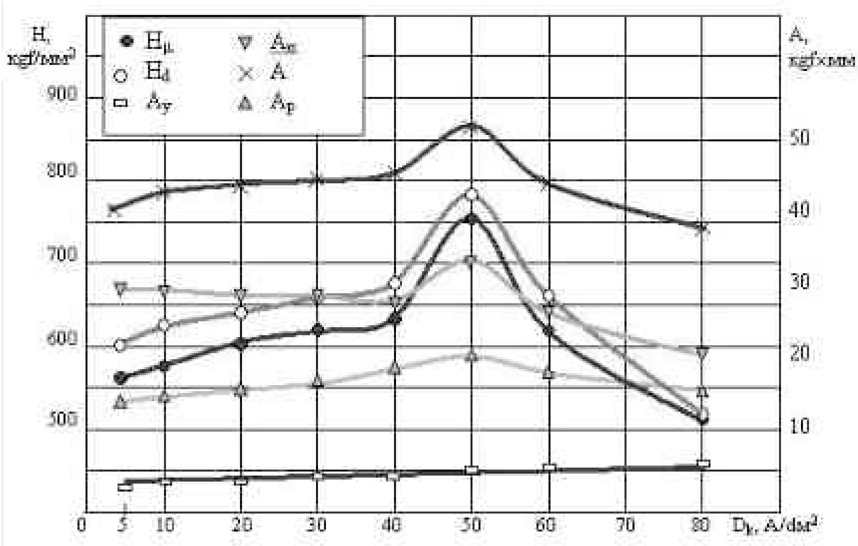

Fig. 4. *The effect of current density on unrestored and dynamic micro hardness (H_h, H_d), on springy plastic destruction fragility and on sum total work (A_s, A_p, A_d, A) in micro squeezing of Fe-Ni.*

6. Final recommendations

On relation with the statements mentioned above, it should be noted that the work connected with energy expenses on springy and plastic deformation of the volume (V) will always be more than the sun total of works connected with springy (A_s) and plastic (A_p) deformations in pressing iron-nickel coverings.

This gives grounds to assume that the difference of this work [$A_d = A - (A_s + A_p)$] is the work (A_d) expended on the fragile destruction of plating in squeezing.

Thus, the obtained results have given possibility for the first time to determine deformed volumes of iron-nickel plating (V_s, V_p, V), the work expended for the plastic deforming of these volumes (A_s, A_p, A) and the work consumed has frail destruction.

These supplementary and very important data allow explaining the mechanism and nature of springy and plastic deformations as well as frail destruction of iron-nickel plating.

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DEVELOPING A POWERFUL, INNOVATIVE HYDRAULIC SYSTEM OF TECHNOLOGICAL EQUIPMENTS FOR MODERNIZING THE PRE-STRESSING AND THE TENSION RELEASE OF THE STRANDS IN THE STRUCTURES OF PRE-STRESSED CONCRETE

Andrei Grama, Dumitru Zetu, Constantin Chiriţă, Adrian Constantin Hanganu

Abstract: *The need to tensioning the structural concrete is determined by the fact that the simple concrete or even reinforced concrete is characterized by resistance at stretching much smaller than the resistance at compression. The rise of resistance at stretching of reinforced concrete is obtained by prestressing it. The authors of the paper have made and have experimented a hydraulic equipment of high pressure to stress and release the prestressed concrete structures presented in this paper.*

Keywords: prestressed concrete, reinforcement, prestressing, posttensioning, hydraulic equipment of high pressure, release, wire, tendon

1. Introduction

Stuctural concrete or even reinforced concrete is characterised by reduced resistance at stretching in contrast with the resistance at compression. This means that these kinds of concrete should be used only for building foundations, foundations for heavy machine tools, foundations for heavy tanks etc. The concrete structures subjected to very powerful stretching loading need the stressing of the reinforcement, producing the prestressing of the concrete and finally the growth of resistance at streching. This solution is necessary for the execution of big roofs for large industrial assembly rooms, concrete bridges, platforms of multistoried parking lots, etc

The structure of uncompressed reinforced concrete subjected to strong stretching behaves as in Fig. 1a, where we can notice that under the action of the loading, cracks appear in the beams or the plates simply suported or in console, which can have an unfavourable evolution. In Fig. 1.b, the shape of the compressed structure is noticed, and in Fig. 1.c, the situation of beams or plates under the loading pressure is shown, a situation in which the lack of cracks is noticed even if the loading has much higher values.

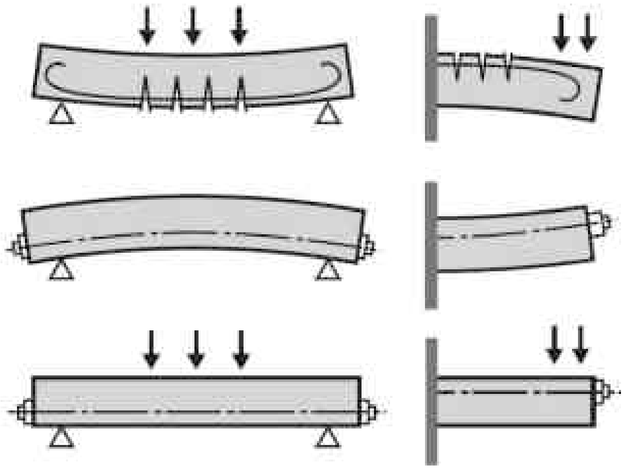


Fig.1- Behaviour of beams/plates of reinforced concrete and prestressed under load
a - reinforced concrete; *b* – prestressed reinforced concrete without load. *c* – prestressed reinforced concrete under load;

An intermediate solution which bridges the gap between the reinforced concrete and the prestressed one, can be obtained through a partial prestressing of the concrete structure. If the reinforced concrete is expected to crack when the loading is applied and the prestressed concrete doesn't crack, the partially prestressed concrete can crack by the amplification of the loading at the value that surpasses “the decompression moment”, moment when the tension in the extreme fibres of the concrete structure surpasses the resistance to stretching.

Prestressing can be achieved by using steel strands and products of steel strand: bars, strands and cables, which are greffered to in general steel „tendons”. In most of the applications, these tendons aren't covered for the protection to corrosion, but there are also solutions of strands covered with epoxy resin. In other cases, other materials can be used, having in their composition non-metal fibres with high level of resistance at stretching and which are stable in alkaline environment.

The prestressing of reinforced concrete structure can be achieved in two ways:

· by pretensioning
· by posttensioning

In the case of prestressed structures, which normally are achieved in industrial rooms, reinforcement strands are subjected to stretching against a retention head before casting the concrete. After the concrete has been casted, it is left to strengthen and to reach the necessary resistance, then the release of strands from the wires is produced and their force is transferred to the concrete structure, compressing it.

The posttensioning is especially achieved, “in situ”, involving the installation and the tensioning of the wire strand or of some tendons under the shape of bars only after the concrete has been cast, has solidified and has reached a minimum resistance to compression.

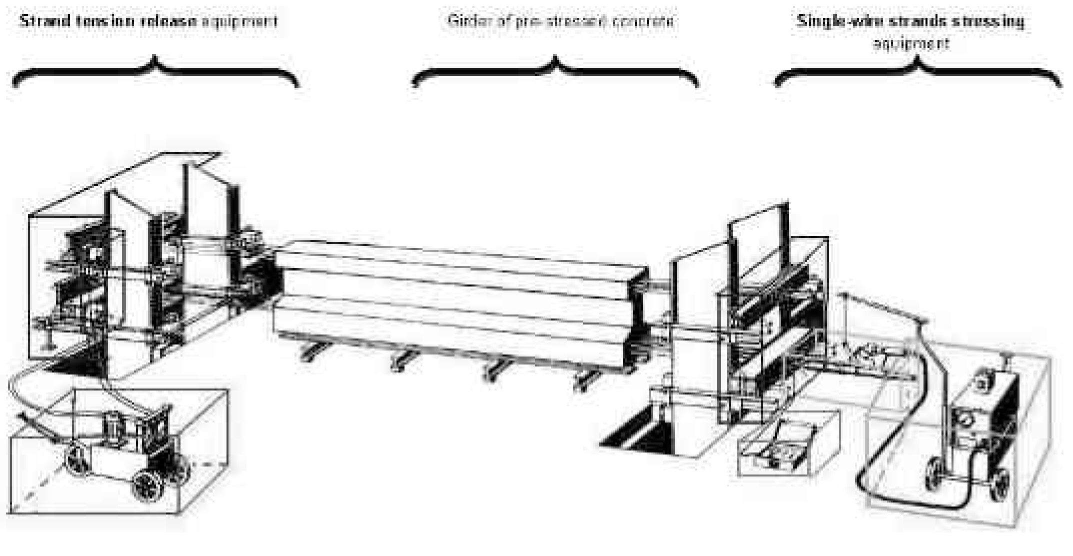
he plates and beams precompressed through prestressing are used almost exclusively for building industrial assembly rooms or storied parking lots, while posttensioning is especially used for building „ in situ”, of concrete bridges and viaducts; the stressing of anchorage systems is exclusively achieved through posttensioning.

2. The structure of hydraulic equipments in order to obtain prestressed concrete

Producing structures of pre-stressed concrete by pre-stressing and post-stressing with equipments made in Romania represents a problem. Such structures were obtained with imported structures with reliability problems that led to the necessity of producing modular equipments TENSRELAX.

TENSRELAX project oriented to the development of a category of new products, complex, innovative, high technology, made up of a system of modular hydraulic equipments, for pre-stressing and strand tension release on the structures of pre-stressed concrete.

First, through a technical study concerning force hydraulic technological equipments realized in Romania and abroad, there were identified the locations, activities and technical specifications for these equipments. (fig.2):



Legend

Electro-hydraulic source of energy for stressing, with pressures of 700 bar

Stressing jacks for mono-strands made up of wires / strands / bars (metallic, polymeric, armed with carbon fibre, of polymer armed with fibre glass), with forces of 16 – 25 tf

Abutment span (fixed + mobile), according to girder section, proportioned at the forces form the stressed strands.

Electro-hydraulic source of energy for the stand of tension release, with pressures of 700 bar

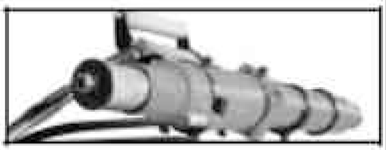
Stand of controlled tension release, for slow transfer of pre-stressing force to concrete, with rollers of 600 – 1000 tf and command installation of the process, when working at 700 bar

Computerized system of acquisition, measuring, digital display and registering of the parameters of the effective service of tension release of the strand from the pre-stressed structure.

Fig. 2 Stand for producing girders of pre-stressed concrete by pre-stressing and the equipments associated with it

TENSRELAX project led to the production of two new prototypes of modular equipments, flexible, with hydraulic operation, in order to manufacture structures of pre-stressed concrete, made up of 7 new products (tab. 1), innovative, with functional and technical traits at European and national level (tab. 2):

Table 1

Equipment		Modular product			
No.	Name	Nr.	Name/ code	Prototype 's Photo	Technical traits
1	TENSRELAX for pre-stressing equipment	P1	Hydraulic panel for stressing PHT 1,5-A		- Maximum pressure ... 700 [bar] - High pressure output ....0,8 [l/min] - Low pressure output......6 [l/min] - Oil capacity. .... 22 [dm ^{3}] - Installed power .... 1,5 [kW] - Network voltage .... 220 [V ca] - frequency .... 50 [Hz] - net weight ....90 [kg] - desk wire(d) distance control
		P2	Mono-strand jack JU160-200/300/400/500 and mono-strand Jack JU250-200/300/400/500		- maximum force ..... 16/25 [tf] - courses ... 200/ 300/ 400/ 500 [mm] - oil capacity.......0,69-1,34/ 1,03-2,01/ 1,37-2,68/ 1,72-3,35 [dm ^{3}] - net weight............. 32-52/ 41-61/ 51-69/ 61-78 [kg]

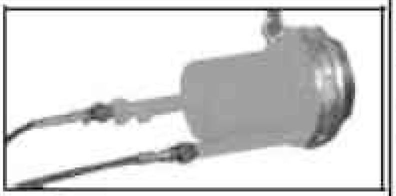
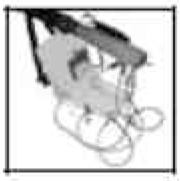
		P3	Multi-strand Jack JM100 –00		- maximum force ... 35-100 [tf] - course .... 120 [mm] - oil capacity .... 1,25 [dm³] - speed .... 0,15-0,005 [m/min] - net weight .... 73 [kg]
		P7	Tensiometric control system SCT 250		- maximum pressure ... 700 [bar] - course .... 30 [mm] - maximum force ...... 250 [tf] - oil capacity............. 5 [dm³] - net weight .... 18 [kg]
2	TENSRELAX for tension release equipment	P4	Mobile abutment span CM400/55 and fixed abutment span CF 400		- maximum force ... 400/55 [tf] - no. of openings 34+4/ 38 [buc] - board's thickness .... 40 [mm] - net weight .... 76,9; 27,9/ 297,2 [kg]
		P5	Hydraulic panel PHTD4-00		- maximum pressure ... 700 [bar] high pressure output .. 0,8 [l/min] - low pressure output......6 [l/min] - oil capacity .... 80 [dm³] - installed power .... 4 [kW] - network voltage ..... 380 [V ca] - frequency .... 50 [Hz] - net weight .... 160 [kg]
		P6	Roller support with mobile abutment span SACC510-1560-00		- maximum force .... 510 [bar] - vertical course .... 200 [mm] - horizontal course ...... 170 [mm] - net weight .... 3.200 [kg]

Table 2

Traits		Level	
Type	Name	RO	EU
functional	Single-core and multi-core strand pre-stressing "in situ" (in the place) or in stands		
	Multi-core strand tension release "in situ" (in the place) or in stands		
	Multi-core strand post-stressing in construction renewal		
	Setting precisely the traction or reduction power		
	Measuring, acquisition and laying out variation traction or reduction power		
Technical	force 160/250 [kN]; speed 0,23/0,12 [m/min]; course 200/300/400/500 [mm]		
	force 2x550/2x2000 [kN]; speed 0,015 [m/min]; course 170/300 [mm]		

	force 375÷1000 [kN]; speed 0,15/0,005 [m/min]; course 120 [mm]		
	pressure 700 [bar]; power 1,5/4 [kW]; voltage 220/380 [Vca]; 50 [Hz]		
	strand diameter 12,1 [mm]; metallic/composite materials type		
	Precise setting up of 2% of the force, digital display, data acquisition, laying out		

The prototypes produced by developing experimental models were tested both in the test laboratory and in situ (in the place); the products are introduced in production starting with the month of September 2010.

The achievement of the prestressed concrete represents a modern important requirement for the concrete buildings which are subjected to loads of high value.

The prestressing of the concrete structures can be achieved through the prestressing of reinforcement, followed by the casting and strengthening of the concrete in moulds and finally, there is a release of the reinforcement in order to transfer the compression strength to the concrete.

The prestressing through posttensioning is usually achieved, "in situ", involving the stressing of the reinforcement after the concrete has been cast and strengthened.

The structure of a stressing and release equipment involves the existence of some subsystems, such as: the casting stand of the concrete, the stressing device, the release device of the reinforcement and the measurement system and the on-line monitoring of the technological and working parametres of the equipment (stressing, stressing strength, release speed, remanent tensions in reinforcement).

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ANALYTICAL ISSUES RELATED TO INERTIAL MECHANICAL SPEED VARIATOR

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Abstract: *The following article wants to present a succinct description of the components and the kinematics of an inertial mechanical variator. Manual gearboxes have a limited number of gears and thus offering a fragmented adaptation of the torque to the resistant torque, thereby reducing their dynamic and economic qualities. Automatic gearboxes have greater complexity and a great number of components, using high quality materials and thus lead to a low cost-reliability ratio. This new transmission offers a very promising alternative in terms of production use and maintenance costs as well as a reduction in fuel consumption of the vehicles equipped with it. This is done by rationally adapting to the energetic needs of the vehicle by the engine unit.*

1. Introduction

First, it should be noted that there are several variants of inertial mechanical speed variator. These issues are too complex to tackle from an analytical and practical point of view.

Thus, for the sake of brevity, I chose to show some of the analytical aspects of the unconventional power transmission system - type Gogu Constantinescu, illustrated in Figure 1.

Considering the mechanism in Figure 1, one of the analytical aspects that can be debated, is the exit angle from the angle of entry.

2. Mechanism description

The transmission problem, defined in its broader sense, as can be seen below, is as follows: the calculation and design of a mechanism to perform the transmission and conversion of mechanical energy from a prime mover acting continuously on the input shaft (primary), to the output shaft (side) of the mechanism so that, regardless of the secondary shaft torque and speed, the primary engine develops maximum power efficiency. The above problem can be solved with a mechanism, whose schematic representation is shown in Figure 1.

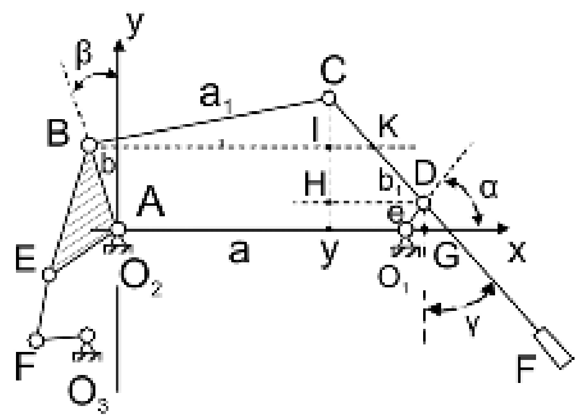

***Figure 1**. Variant of the unconventional design of transmission system and power conversion.*

The main elements composing the current cinematic variant are mostly simple (binary) with rank j = 2, and a complex component (ternary) with rank j = 3. All couplings, cinematic mechanism used to connect elements, are flat and provide a permanent contact, closed construction point of view. Couplings are generally reversible in terms of cinematic. It is the same regardless of the relative movements of the fixed elements. An exception occurs in the element of rank j = 3 where the coupling are irreversible.

This design version consists of:

- Input shaft (O_2)
- Auxiliary shaft (O_3)
- Ballast (F)
- Eccentricity (O_1D)

- Oscillating Body (CF)
- Bar (CB)
- One-direction coupling (A)
- Actuator arm (EO_2B)
- Bar (FE)
- Arm (O_3F)

The operating principle of SNTP is based on dividing a rotary motion into two components, one representing an oscillating motion of the ballast (F), the other as reciprocating, which is transmitted through the lever arm actuator (CB EO_2B), where, through a single-purpose device reciprocating turns in a rotation. This output shaft is transmitted to O_2. The drive arm (EO_2B) is connected to the auxiliary shaft (O_3) through the lever arm and FE O_3F, elements that are designed to synchronize the movement mechanism.

For dynamic balancing, the unconventional power transmission system is composed of two identical mechanisms, deviate at an angle of 180 ˚.

As can be seen, SNTP involves a simple construction, different from the classical case, in that no gears, no clutch and no synchronization are used. Also, from a basic physics principle (F = m · a) we can say that when we have a small number of rotations of the input shaft, the inertial force of the ballast F will be lower, it has therefore a higher magnitude. As the number of revolutions to the main shaft increases, the inertial force of the oscillating mass becomes increasingly important, and could thus see a decrease in amplitude of the oscillation movement ballast. In this case, it may be seen alternating component obtained from dividing the movement from the input shaft, an upward trend, thereby achieving an increased number of turns on the output shaft.

3. Analytical Calculation

The following is a calculation that can be determined analytically and constructively optimize the angular values of the output signal depending on the size of the angle of entry.

$$\begin{cases} x_b = b\cdot\sin(\beta) \\ y_b = b\cdot\cos(\beta) \end{cases} \tag{1}$$

$$\begin{cases} x_c = a \pm e\cdot\cos(\alpha) \\ y_c = e\cdot\sin(\alpha) + b_1\cdot\sin(\gamma) \end{cases} \tag{2}$$

$$\begin{cases} x_d = a + e\cdot\cos(\alpha) \\ y_d = e\cdot\sin(\alpha) \end{cases} \tag{3}$$

$$y_b = y_c - CI \tag{4}$$

$$CI = \sqrt{a_1^{\,2} - (a \pm e\cdot\cos(\alpha) + b\cdot\sin(\beta))^2} \tag{5}$$

$$y_b = e\cdot\sin(\alpha) + b_1\cdot\sin(\gamma) - \sqrt{a_1^{\,2} - (a \pm e\cdot\cos(\alpha) + b\cdot\sin(\beta))^2} \tag{6}$$

$$\boxed{b\cdot\sin(\beta) = e\cdot\sin(\alpha) + b_1\cdot\sin(\gamma) - \sqrt{a_1^{\,2} - (a \pm e\cdot\cos(\alpha) + b\cdot\sin(\beta))^2}} \tag{7}$$

$$\begin{cases} k_1 = e\cdot\sin(\alpha) + b_1\cdot\sin(\gamma) \\ k_2 = a \pm e\cdot\cos(\alpha) \end{cases} \tag{8}$$

$$k_1 - b\cdot\sin(\beta) = \sqrt{a_1^{\,2} - (+b\cdot\sin(\beta))^2} \tag{9}$$

$$a_1 - k_1^2 - k_2^{\,2} = b_1^2\cdot\sin(\beta)^2 + b^2\cdot\cos(\beta)^2 - 2\cdot k_1\cdot b\cdot\cos(\beta) + 2\cdot k_2\cdot b_1\cdot\sin(\beta) \tag{10}$$

$$\begin{cases} k_3 = b_1^{\,2} \\ k_4 = b^2 \\ k_5 = 2\cdot k_1\cdot b \\ k_6 = 2\cdot k_2\cdot b_1 \\ k_7 = a_1 - k_1^{\,2} - k_2^{\,2} \end{cases} \tag{11}$$

$$k_7 = k_3\cdot\sin(\beta)^2 - k_4\cdot\cos(\beta)^2 - k_5\cdot\cos(\beta) + k_6\cdot\sin(\beta) \tag{12}$$

$$k_7 = k_3\cdot\sin(\beta)^2 + k_4(1-\sin(\beta)^2) - k_5(\sqrt{1-\sin(\beta)^2}) + k_6\cdot\sin(\beta) \tag{13}$$

$$\sin(\beta)^2 = x$$

$$k_7 = k_3\cdot x + k_4(1-x) - k_5(\sqrt{1-x}) + k_6\cdot\sqrt{x} \tag{14}$$

$$k_6\cdot\sqrt{x} + k_5\cdot\sqrt{1-x} = k_3\cdot x + k_4 - k_4\cdot x + k_7 \tag{15}$$

$$k_6\cdot\sqrt{x} + k_5(\sqrt{1-x}) = x\cdot(k_3 + k_4) + k_4 + k_7 \tag{16}$$

$$\begin{cases} k_3 + k_4 = k_8 \\ k_4 + k_7 = k_9 \end{cases} \quad (17)$$

$$k_6 \cdot \sqrt{x} + k_5(\sqrt{1-x}) = k_8 \cdot x + k_9 \quad (18)$$

$$k_6^2 \cdot x + 2 \cdot k_5 \cdot k_6 \cdot x \cdot (1-x) = k_8 \cdot x + 2 \cdot k_8 \cdot k_9 + k_9^2 \quad (19)$$

$$\begin{cases} k_6^2 = k_{10} \\ 2 \cdot k_5 \cdot k_6 = k_{11} \\ 2 \cdot k_8 \cdot k_9 = k_{12} \\ k_9^2 = k_{13} \end{cases} \quad (20)$$

$$k_{10} \cdot x + k_{11} \cdot x - k_{11} \cdot x^2 = k_8 \cdot x^2 + (1-x) = k_8 \cdot x + k_{12} \cdot x + k_{13} \quad (21)$$

$$k_8 \cdot x^2 + k_{11} \cdot x^2 = k_{10} \cdot x + k_{11} \cdot x - k_{12} \cdot x - k_{13} \quad (22)$$

$$x^2 \cdot (k_8 + k_{11}) - x \cdot (k_{10} + k_{11} - k_{12}) + k_{13} = 0 \quad (23)$$

$$\begin{cases} k_8 + k_{11} = k_{14} \\ k_{10} + k_{11} - k_{12} = k_{15} \end{cases} \quad (24)$$

$$k_{14} \cdot x^2 - k_{15} \cdot x + k_{13} = 0 \quad (25)$$

$$x_{12} = \begin{pmatrix} \dfrac{k_{15} - \sqrt{k_{15}^2 - 4 \cdot k_{14} \cdot k_{13}}}{2 \cdot k_{14}} \\ \dfrac{k_{15} + \sqrt{k_{15}^2 - 4 \cdot k_{14} \cdot k_{13}}}{2 \cdot k_{14}} \end{pmatrix} \quad (26)$$

Analytical expression of the angular values of the output signal is:

$$\beta = \begin{pmatrix} \arcsin(\sqrt{x_{12}}) \\ \arcsin(-\sqrt{x_{12}}) \end{pmatrix} \quad (27)$$

4. Conclusions

The main advantage of this type of transmission is represented by the possibility to adapt the energetic needs of the vehicle to the characteristics of the engine unit. By doing this one can improve the price-reliability ratios, fuel consumption etc. with significant values compared to classical systems.

Another essential advantage from a production point of view is the low production cost. Vehicles equipped with this kind of inertial transmissions are easy to use and have low maintenance costs.

This new transmission offers a very promising alternative in terms of production use and maintenance costs as well as a reduction in fuel consumption of the vehicles equipped with it. This is done by rationally adapting to the energetic needs of the vehicle by the engine unit.

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MULTI-DOMAIN SIMULATION OF A HYDRAULIC VIBRATION SYSTEM FOR DYNAMICAL TESTING OF MECHANICAL STRUCTURES

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Abstract: Investigation of the dynamical behavior of mechanical structures, like bridges for example, needs a device in order to assure the real scale excitation of the structure. In the same time the exciter should be easily transportable and flexible. The paper presents the design and dynamical simulation using the multi-domain software Amesim of the solution that allows mechanical and hydraulic control of the excitation parameters.

Keywords: vibrations, exciter, hydraulic actuation, multi-domain dynamical simulation

1. Introduction

Mechanical structures especially designed for civil structures are exposed to a broad range of stresses, both under static and more important dynamical conditions. Different frequencies and stress amplitudes appear in a random order. Also the structure response properties, like materials and structure support, to this inputs play, as for all dynamical systems a major role in the dynamical behavior of the structure. This response is the source of system reliability, usability and overall mechanical performances.

Therefore, testing of such structures under different conditions is important in predicting system performance. An essential component of the test rig is an oscillation generator that is applicable usable to excite the mechanical structures.

2. The working principle of the hydraulic vibration system

The working principle of the hydraulic vibration system is based on the alternative movement of a mass that transfers the mechanical oscillations to the constraint points of the tested structure. The alternative movement of the mass is generated by a hydraulic system. The principle scheme is presented in figure 1.

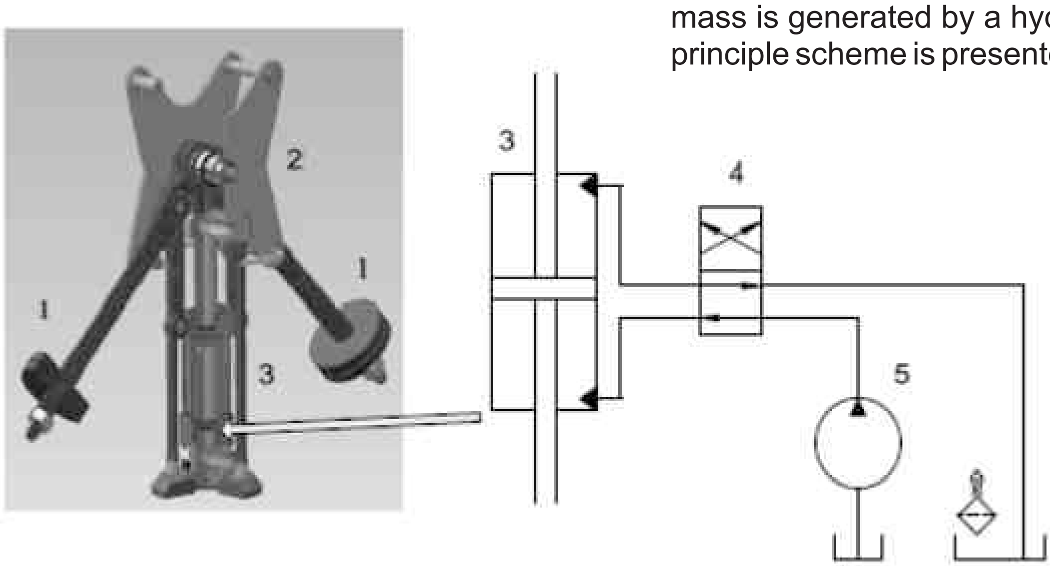

Fig. 1: The working principle of the oscillating mass

The oscillating mass is distributed on two support levers. The design of these elements allows that additional mass may be added. The individual masses are locked on the lever by a screw system. This additional system allows changing the position of the masses on the lever. The design assures two possibilities to influence the overall reaction force that will be generated on the constraints and directed to the mechanical structure. A possibility is induced by different masses and a possibility induced by the position of the masses on the lever. This allows that different amplitudes of the action force may be generated. The mass levers are actuated by a lever system 2, actuated itself by the hydraulic double-acting cylinder 3. A conventional hydraulic actuation system based on a hydraulic pump 5 and the directional control valve 4 is used to assure the necessary actuation force of the hydraulic system.
The working principle may be observed in figure 2 as a successive presentation of the positions of the system.

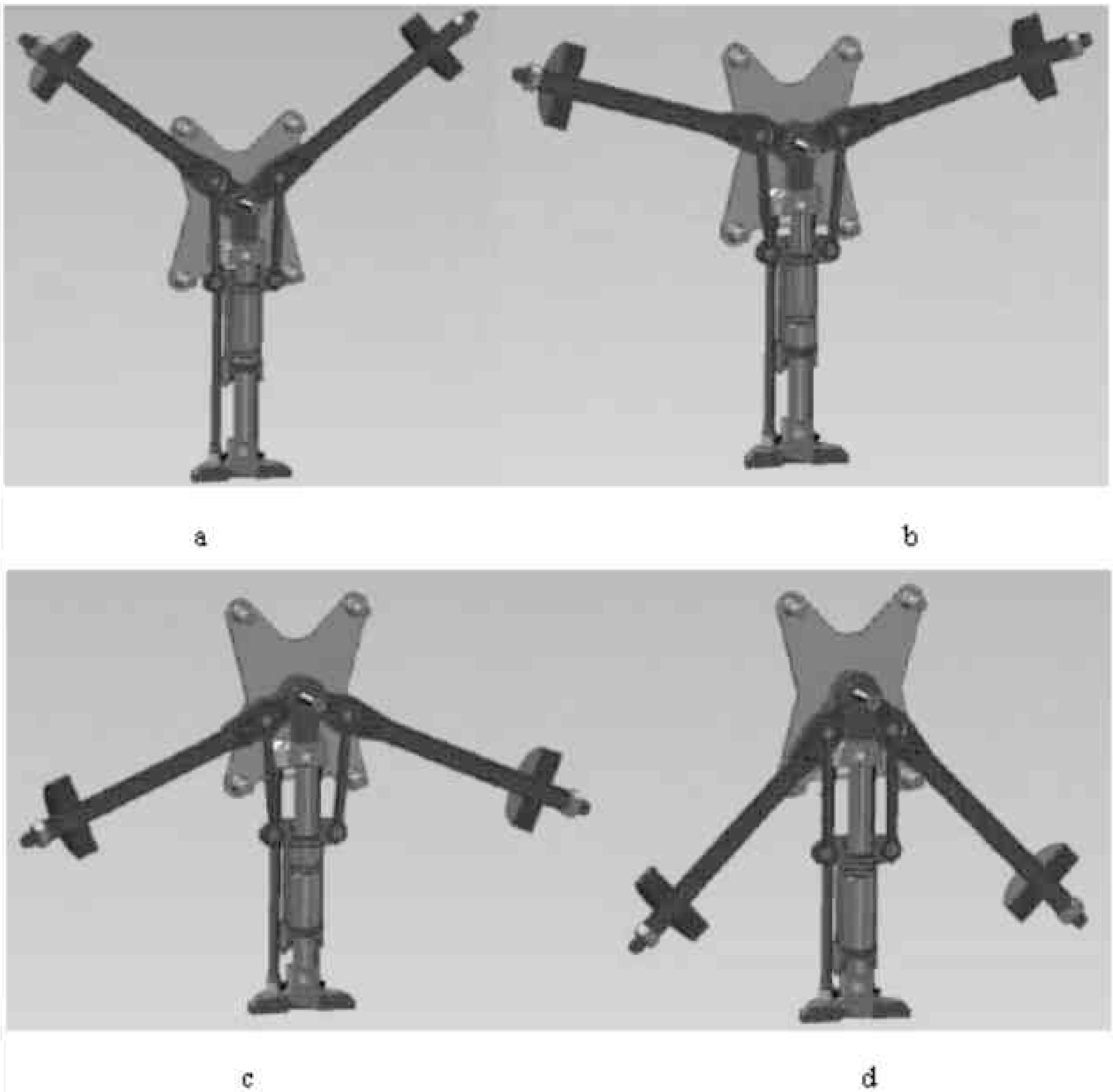

Fig.2: Successive positions of the masses during the oscillation process

1. **The simulation model of the hydraulic actuation system of the vibration device**

The goal of the simulations is to identify the dynamical behavior and influences on the hydraulic system during operation. For this purpose a multi - domain software, AMESIM was used. The model is presented in figure 3. The hydraulic pump is driven by a mechanical motor. The model has the possibility to define different rotational speeds. This feature allows the analysis of different flows. The directional control valve 2 assures the alternate flow to the working chambers of the double-acting hydraulic cylinder 3.

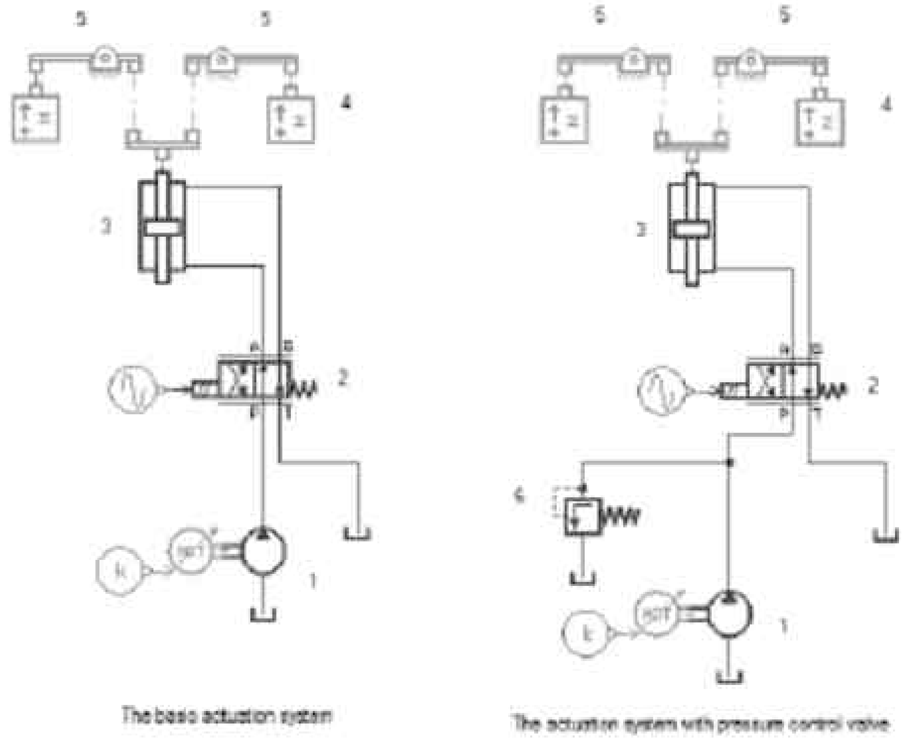

Fig.3: The multi-domain model of the hydraulic actuation system of the vibration device using the AMESIM software

The shaft of the hydraulic cylinder is connected via the lever system 5 to the masses 4 that are propelled in an alternative movement. The DCV – model allows defining different flow areas. Also it is possible to use for the DCV model the working frequency as parameter. At the hydraulic cylinder level piston and shaft diameters are the main input parameters, together with the maximum piston stroke. The flow losses are defined as flow coefficients at DCV and cylinder level. A second analysis step is considered by using the pressure control valve 6, that has the possibility do define the maximum working pressure in the cylinder.

1. **The simulation results and discussions**

The main parameters of the hydraulic actuation system of the vibration device are given in table 1.

Table 1

Parameter	Unit	Value
Cylinder mass	kg	5
Maximum working pressure	bar	120
Working frequency domain	Hz	1 →12

An additional requirement for the hydraulic system is the symmetrically displacement of the lever considering a horizontal reference plane perpendicular to the hydraulic cylinder.
For a constant flow rate of 20 l/min delivered by the pump, the DCV's generate a flow rate presented in figure 4, showing peak flows of up to 35 l/min, at the frequency of 1 Hz. Curve 1 is the flow rate for the mass to be lifted against the gravity force, curve 2 the flow rate for the opposed movement and curve 3 the flowrate delivered at the pressure valve. It can be observed that most of the time, the pump delivers the oil to the tank.

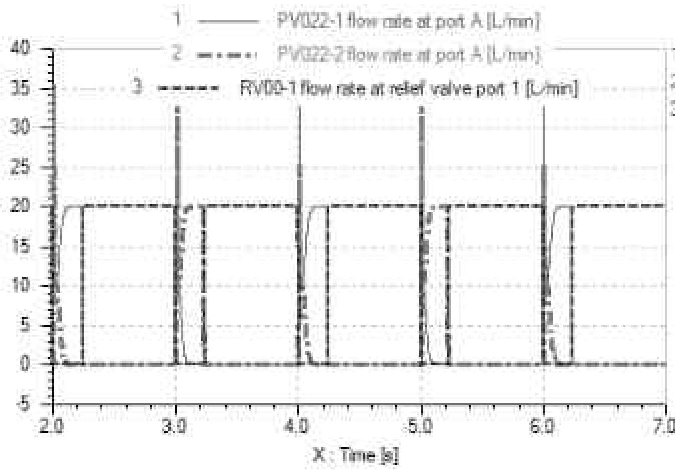

Fig.4: Flow rate at DCV output

At hydraulic cylinder level the pressure, as it may be observed in figure 5, shows no change for the pushing and retrieving phase, despite the presence of the gravity force for one of the stroke that is opposed to the mass displacement.

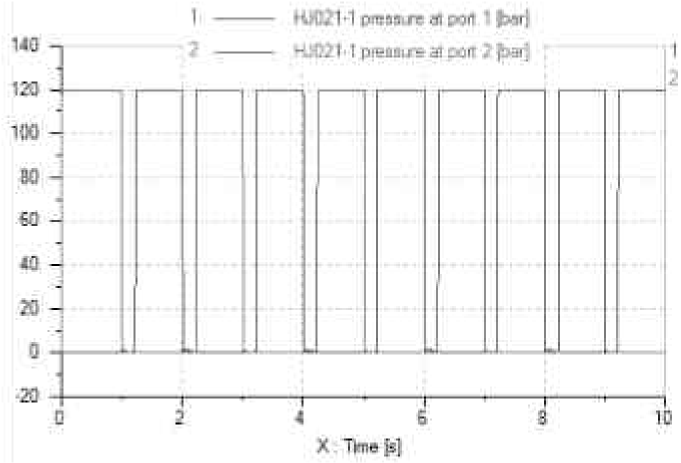

Fig.5: The pressure at cylinder level

The pressure - flow evolution have as result the piston displacement presented in figure 6.

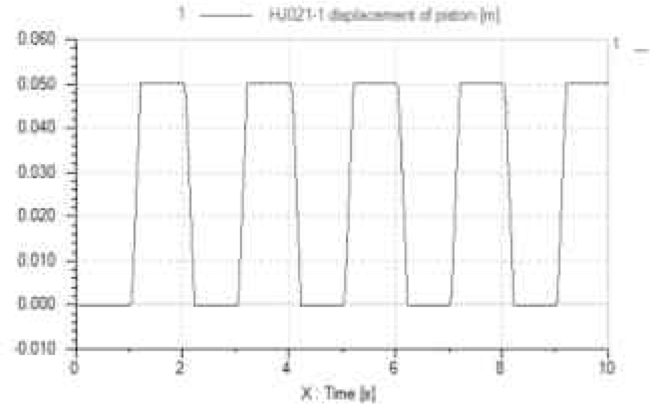

Fig.6: Piston displacement

At the same time a force is induced at piston level, having an intense dynamic character. The evolution is presented in figure 7.

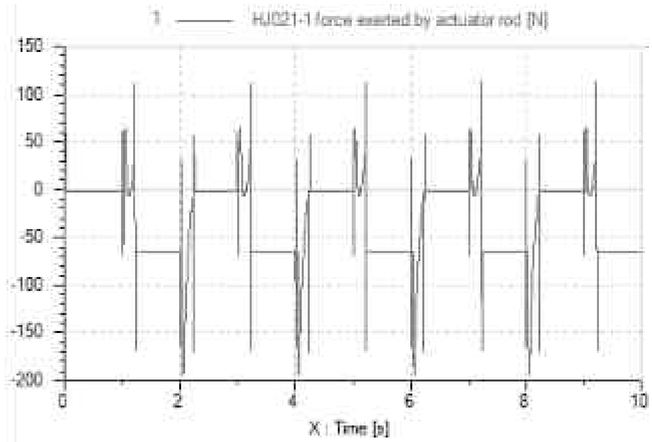

Fig.7: The force at piston rod level

In order to have an image on the dynamical behavior of the system, the acceleration of the main lever at the connection point with the actuation cylinder are presented in figure 8.

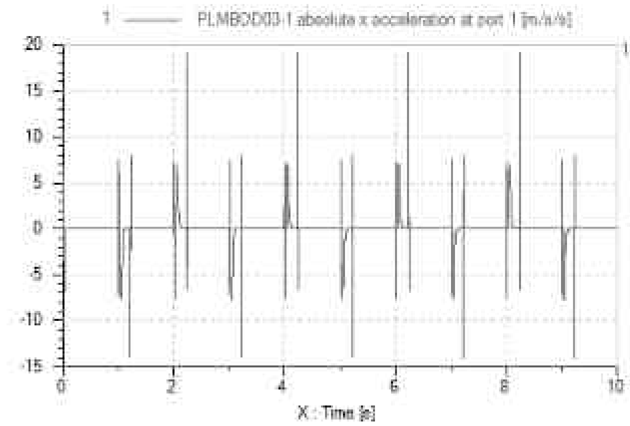

Fig.8: Lever acceleration at connection point with hydraulic cylinder

In order to have an overall image of the displacement of the main lever, three images of the system in different positions are presented in figure 9.

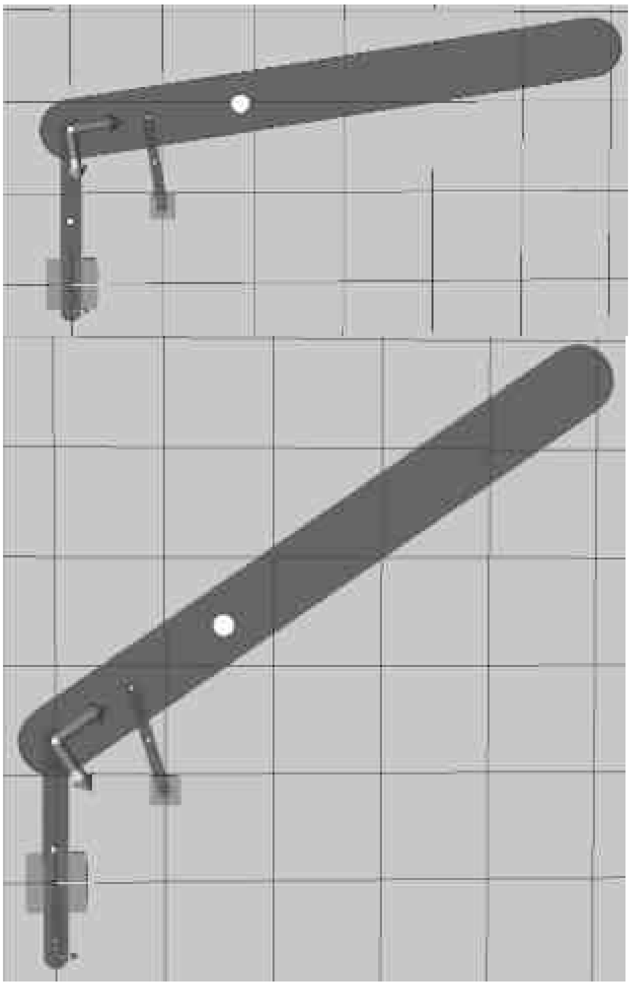

Fig.9: Lever position resulted from simulation

5. Conclusions

The vibration device based on a hydraulic actuator is a dynamical system that is accurate controlled by the dynamical actuation configuration. The main design parameters could be fulfilled assuring in the same time the alternative displacement of the levers.

Biography

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2. ***User Amnual AMESIM

Studies upon cavitation erosion of the stainless steels X12CrMoS17 and X22CrNi17

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Abstract:
Paper analyses the cavitation erosion behavior of the stainless steels X12CMoS17 and X22CrNi17 used for manufacturing hydraulic turbine runners and pump impellers. The researches were done in the Cavitation Laboratory of the Timisoara Polytechnic University (LMHT) using a vibratory facility respecting the conditions of the ASTM G32-2006 Standard. The steel behavior was evaluated both on the ground of microstructure erosion (through optic and electronic microscopy) and by comparisons with the reference steel OH12NDL used in Romania and other countries for manufacturing turbine blades. The similarities and differences of the erosion for the two analyzed stainless steels are put into evidence. The conclusion is that both steels can be used for manufacturing blades or runners for hydraulic equipments.
Key words: cavitation erosion, characteristic curves for cavitation erosion, facilities for studies upon cavitation erosions

Introduction

The damages produced by cavitation, especially to the turbine blades, pump impellers and ship propellers, determined the researchers to continue the erosion analyze [3, 4, 8, 9, 10, 11] and to establish which materials can give the best resistance to this kind of deteriorations. This trend was followed also by the present studies realized in the Timisoara Hydraulic Machinery Laboratory upon two stainless steels, with identical contents of carbon (0.038%) and with close contents of chromium (16.8% and 18.6%). The studies upon these steels were determined by the problems occurring in running of recent refurbished turbines. We think that a good evaluation criterion is the comparison with the erosion parameters of the stainless steel OH12NDL, used in the past to built details subjected to industrial cavitation [2].

STUDIED MATERIALS

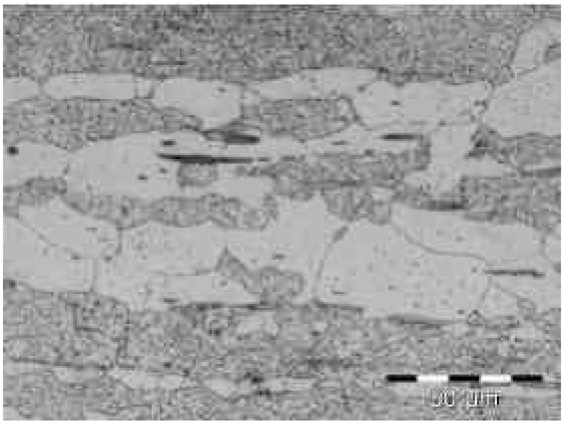
UCM Resita the manufacturer of the steels symbolized the researched steels. The chemical composition presented in Table 1 was obtained with an optical emission spectrometer with sparks of the type ”Foundry Master” produced by the German Firm WAS which is in the possession of the Laboratory for Optic and Fluorescent X Ray Emission Spectrometry (LISEOFRX) belonging to the Center for Special Materials of Bucharest Polytechnic University. In the same laboratory was determined also the nature and the proportion of the micro structural constituents (steel X12CrMoS17: 60 % martensite and 40 % ferrite; steel X22CrNi17: 80 % martensite and 20 % ferrite).

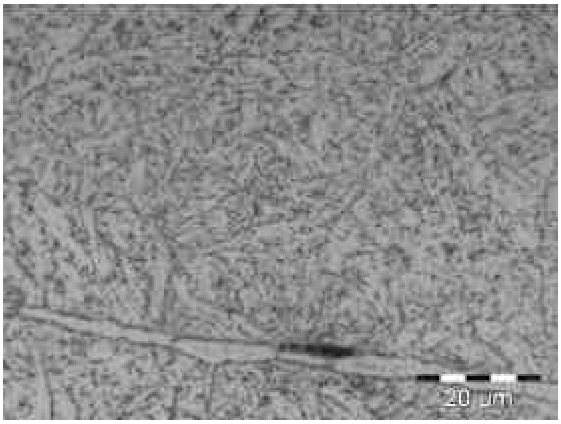
The microstructure analyze of the steels was obtained with the Reichert Metallographic Microscope and is presented in Figure 1. The analyzed microstructure is in agreement with the data established with the Schäffler diagram, the steels presenting close component structures characteristics with relatively fine grains. Both steels have as major components fine acicular martensite to which is added ferrite, in various proportions, disposed in islets.

Table 1 Chemical composition of the researched steels

Steel	Chemical element %							
	C	Si	Mn	P	S	Cr	Mo	Ni
X12CrMoS17 (X12)	0.038	1.15	3.13	0.007	0.016	16.80	2.59	-
X22CrNi17 (X22)	0.038	1.16	2.12	0.007	0.016	18.06	1.69	1.62

Fe-rest





a) X12 **b) X22**

Figure 1. Microstructure aspect of the used stainless steels (attack nitromuriatic acid with glycerin, x1000)

Test FACILITY and procedure

The cavitation erosion tests were performed using the vibratory device presented in Figure 2, taking into account the ASTM G32 Standard [13]. The device parameters are:

- Power 500 W,
- Vibration frequency 20 0.3 % kHz,
- Double amplitude of vibrations 50 m,
- Specimen diameter 15.8 mm;
- Type of specimen: vibratory.

The working agent was double distilled water having constant temperature of 21±1°C. In conformity with the procedure of our laboratory [14], the total test duration was 165 minutes, divided in 13 periods (one of 5 minutes one of 10 minutes and 11 of 15 minutes). At the beginning and the end of each period, the specimen was successively washed with tap water, double distilled water, alcohol and acetone and afterward weighted.

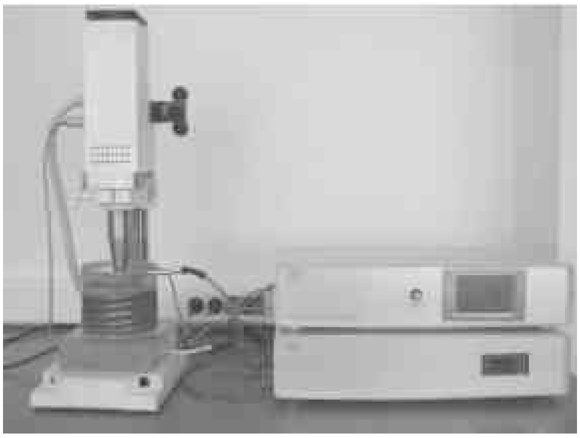


Figure 2 The T2 standard vibratory device

During the waiting periods, the specimens were maintained in dry atmosphere, to avoid any influence of the environment upon the specimen surface.

From each material three specimens were tested. The experimental points of the diagrams presented in the paper are averages of those three results. After the erosion tests, there were analyzed two surfaces situated in perpendicular planes. The first was the surfaces exposed to cavitation attack. The second obtained by cutting the specimen was necessary in order to determine the maximum penetration depth and the material state under the eroded area. In order to establish the structural characteristics, the analyzes were accomplished by: the optic stereomicroscope OLYMPUS SZX 7 equipped with the program quickMicrophoto 2.2 for image processing, the REICHERT UnivaR metallographic microscope with an automatic table and a video camera with adaptor and a system for image acquisition and the scanning electronic microscope XL-30-ESEM TMP.

Experimental results

Relaying on the mass losses recorded at the end of each testing period there were obtained the characteristic curves: the time dependence of the cumulate mass losses, Figure 3 and the erosion velocities, Figure 4. The mass losses and the erosion velocities presented in the diagrams are the average values obtained from three specimens tested for each material.

In order to evaluate the qualities of the tested steels, the diagrams present also the results for the steel OH12NDL, used in the past for manufacturing numerous hydraulic turbines and tested in our laboratory.

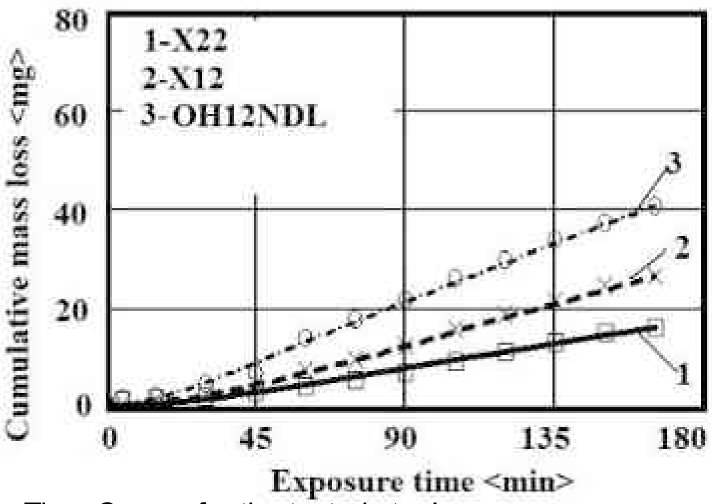


Fig.3 Cumulative Erosion-Time Curves for the tested steels

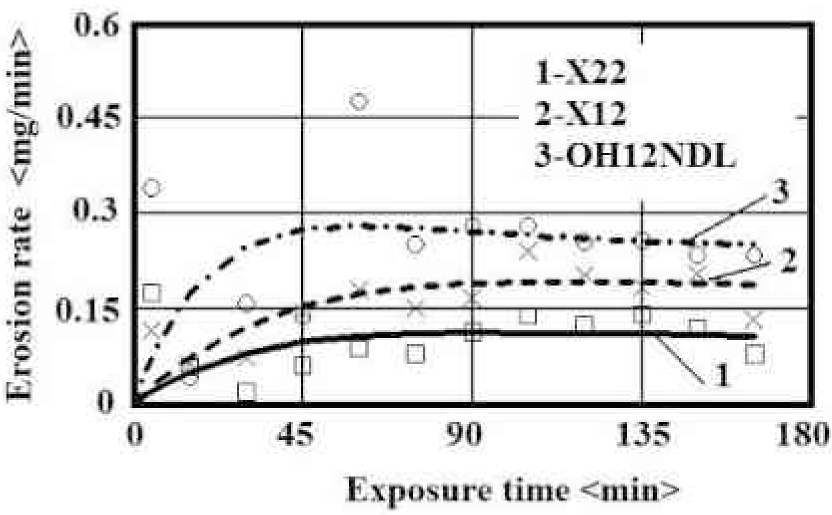
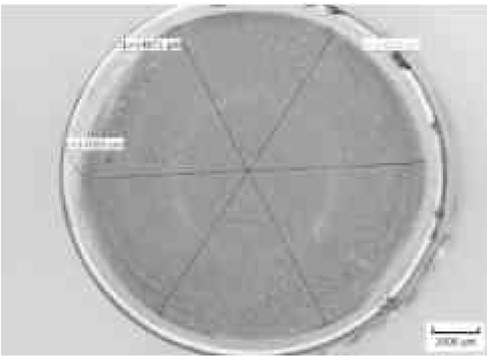


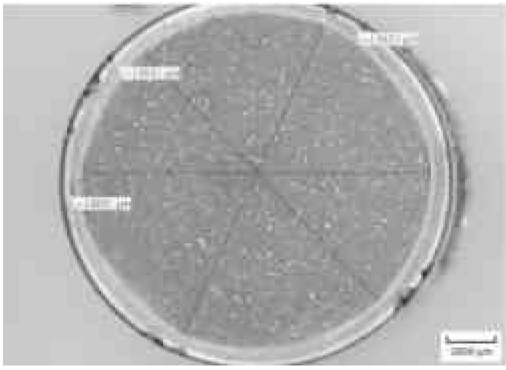
Fig.4 Erosion rate against exposure time for the studied steels

The cavitation erosion evolution and the comparisons of the specific structural aspects for different microstructure components was put into evidence both for the macrostructure level accomplished with the stereomicroscope and for the microstructure level accomplished with the metallographic optic microscope as well as the scanning electronic microscope.

The macrostructure analyze on the surface subjected to cavitation accomplished with the stereomicroscope is presented in the Figure 5. The eroded surfaces, regardless of the structure, have an irregular outline and the eroded area occupies approximately the same area (78.98% for X12 and 78.95% for X22).



Mean diameter of the eroded area =13831 m
Percentage of the eroded area = 78.98 %
a) Steel X12



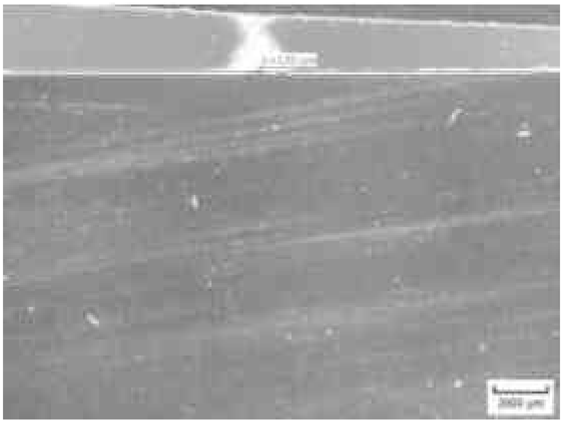
Mean diameter of the eroded area =14078 m
Percentage of the eroded area = 78.95 %
b) Steel X22

Figure 5. Stereo microstructure of specimens and measurements of the eroded area (x8)

The maximum penetration depth, determined after cutting the specimens has values between 135 m (for the steel X12) and 233 m (for the steel X22), as can be seen in Figure 6

Suggesting a greater cavitation erosion resistance of the steel X12 conclusion which is in contradiction with the data of Figures 3, 4 and Table 2.

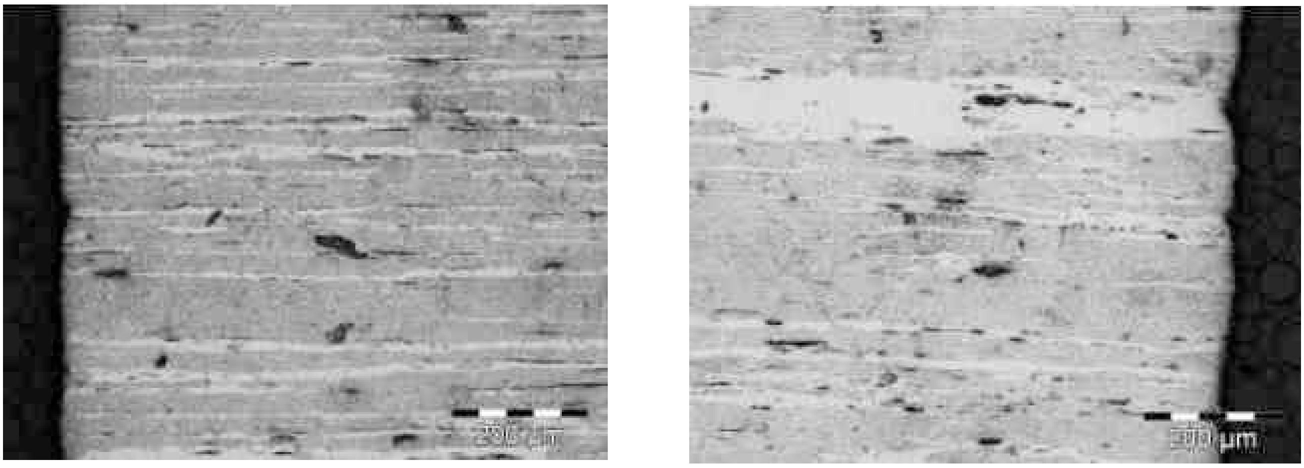
(mărire 8 x)
DP_{max} = 233 m
a) Oţel X22



(mărire 8 x)
DP_{max} = 135 m
b) Oţel X12

Figure 6. Erosion maximum penetration depth (stereo microscope images)

In Figure 7 it can be seen the damages at the micro structural level as well as the zone hardened by the implosion of the cavitation bubbles [7, 8, 12] of the layer adjacent to the eroded area.



a) Steel X12 **b) Steel X22**

Fig.7 Aspects of microstructure damages and hardening under the eroded area (attack: nitromuriatic acid with glycerin, x100)

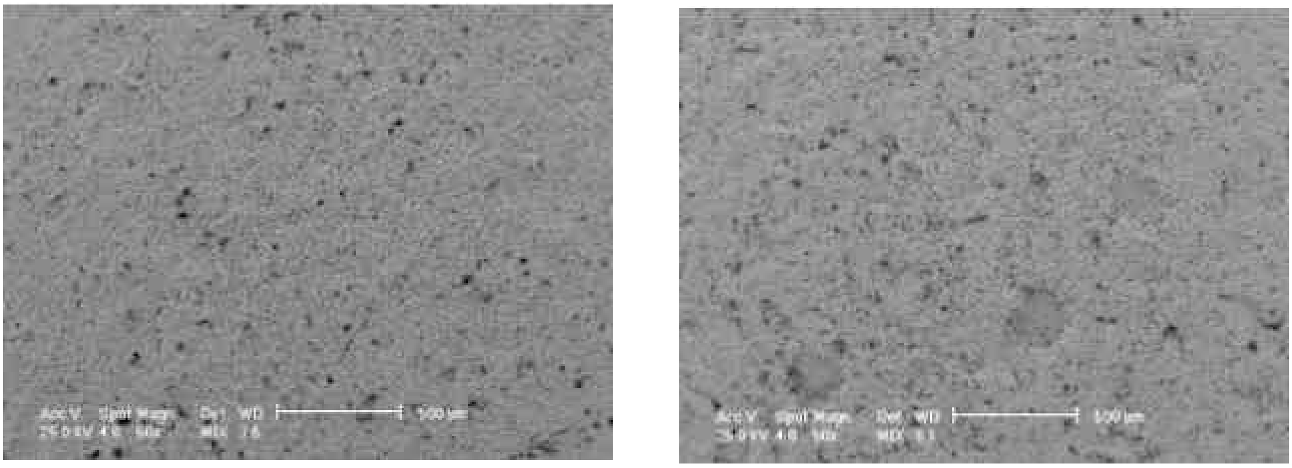
Results ANALYZE. DISCUSSIONS

a. Results analyze on the ground of characteristic curves and fractographic images

The data from Fig. 3 and 4 and the comparison with the martensitic steel OH12NDL (0.1 %C, 12.8 %Cr, 1.25 %Ni, 74% martensite, 26% ferrite) [2] show that both the studied steels have better cavitation erosion resistance. Comparing the two investigated steels, it results that X22 (with 80% martensite) has the best erosion resistance. This behavior is due by the increased percentage of martensite, the constituent with the greatest resistance to cavitation erosion [2].

The scatter of the measured points (Figure 4) is the result of the coarse grains obtained in the casting procedure and entirely expelled during the cavitation attack, and are in good agreement with the images of the eroded areas (Figures 5 and 8). The images in Figures 6 (maximum penetration depth) and 7 sustain also this conclusion.

The analyze of the images in Figure 6 show that the maximum penetration depth, measured when the tests were concluded, differs for the two studied stainless steels and are in contradiction with the characteristic curves evolution and the values of the specific parameters v_s and R_{ns} (see Table 2). This result are in agreement with the studies realized in the Project ID-34-2007 [16] in which it was concluded that the maximum penetration depth DP_{max} depends on the dimensions of crystalline grains and is not suitable for material comparisons. Perhaps it could be used for appreciating the behavior of materials on the ground of the manufacturing procedure. Our experience accumulated in over 40 years of researches in the field, leads us to appreciate that the mean penetration depth (recommended also in the Standard G32) is the best parameter for comparing the resistance of various materials to cavitation erosion.



a) Steel X12 b) Steel X22

Figure 8. SEM images of specimens (100x)

The images in Figure 7 show a very tiny zone, in the immediate vicinity of the erosions, subjected to local deformations. This zone is created by the repetitive impacts of the collapsing bubbles [5, 6, 13].
The analyze of the images obtained with electronic microscopy, Figure 8 put into evidence the following evolution of the microstructure damages

1. Steel X11

- Mix aspect with fine and coarse caverns uniformly distributed on the surface, with cleavage ruptures and inters grain cracks,
- Fragile fracture with inter grain propagation and numerous secondary fine fissures.

2. Steel X22

- Cavitation fragile fractures with fine (5-10 m) and coarse caverns uniform distributed on the attacked area,
- Existence of fine secondary cracks and zones with cleavage ruptures.

In Table 2, the cavitation erosion resistance of the studied steels is evaluated on the ground of the parameter Rns, using as reference the stabile erosion rate of the steel OH12NDL [16].

Table 2 Comparison cavitation erosion resistance, using OH12NDL as reference steel

Parameter	**X12**	**X22**
v_s [mg/min]	0.188	0.107
Rns	0.75	0.43

Data of Table 2 confirm the analyses undertaken with the characteristic curves in Figure 3, 4, and show that both steels have good erosion resistances but the steel X22 is better than X12. Finally, we consider that the studied steels, having different chromium contents and with enough different metallographic structures obtained similar cavitation erosion behavior. For improving the selection, the possibility of repair by welding must also be taken into consideration.

Conclusions

1. The studied steels present good and very good resistance against cavitation erosion better than the reference steel OH12NDL and as a consequence both steels can be used in manufacturing pieces subjected to such erosions.

2. Analyze of steels manufactured with controlled contents of chromium and reduced carbon content (under 0.1 %) gives profound knowledge regarding the behavior of the

chemical composition and offer the possibility to find the optimum content of chemical components.

3. Our opinion is that the use of the maximum depth penetration (DP_{max}), measured for the final testing period does not represent a good parameter to state the cavitation erosion behavior, because it depends essentially on the dimensions of the excavated grains. The mean penetration depth, computed on the ground of the cumulative volume loss (recommended also by ASME G32 Standard) is more reliable and we strongly recommend its use. Eventually, the maximum penetration depth may be used to study the behavior of materials with different grain dimensions

Acknowledgments

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SOUND ANALYSIS OF THE FIRST VERSION OF THE GEARLESS AND CLUTCHLESS NON-SYNCHRONOUS TRANSMISSION

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Abstract: The gearless and clutchless non-synchronous transmission is somewhat similar to a modern automatic transmission. As one of the objectives would be to include it into commercial cars, one must take into account the sound generated while the transmission is in operation. In this sense the transmission was connected to a small engine dynamometer while driven by a 2.2 kW electrical motor. During this time the vibration level was measured with a PCB microphone. The tests were done both under partial and full load, with the input frequencies ranging from 5 to 50 Hz.
Keywords: gearless, clutchless, non-synchronous transmission, sound analysis, vibration level.

1. Introduction

The automotive industry has high quality standard for its components. One of the necessities of rising to these standards is controlling the noise level of the moving components. To be able to control the noise level, one must first identify the sources and analyze the sound component to be able to soundproof it accordingly.

2. Octave Analysis

The range of 20 Hz to 20,000 Hz is called the audible frequency range and used in octave analysis although it reflects the actual capability of only a small percentage of the population. The entire audible frequency range can be divided into eight or 24 frequency bands known as octave bands or one-third octave bands, respectively, for analysis. [1]

Octave analysis is performed with a bank of parallel bandpass filters. The output of each filter then is averaged to compute the power in each band and displayed as a bar graph. Octave band filters can be either passive or active analog filters that operate on continuous-time signals or analog and digital filters that operate on discrete-time signals. Traditional octave analyzers typically used analog filters, but computers host-based octave analyzers most often use digital filters. [1]

Due to the computational load of one-third octave analysis, analyzers often synthesized one-third octave bands from FFT data by assigning the energy from appropriate bins to a particular proportional band filter. This method has drawbacks due to leakage. [1]

3. Signals

A signal is a set of data or information. Examples include a telephone or television signal, monthly sales of a corporation or daily closing prices of a stock market. In all these examples, the signals are functions of the independent variable time.

Signals may be processed further by systems, which may modify them or extract additional information from them. A system is an entity that processes a set of signals (inputs) to yield another set of signals (outputs). A system may be made up of physical components, as in electrical, mechanical, or hydraulic systems (hardware realization), or it may be an algorithm that computes an output from an input signal (software realization).

The size of any entity is a number that indicates the largeness or strength of that entity. Arguing in this manner, we may consider the area under a signal x(t) as a possible measure of its size, because it takes account not only of the amplitude but also of the duration.

However, this will be a defective measure because even for a large signal x(t), its positive and negative areas could cancel each other out, indicating a signal of smaller size. The difficulty can be corrected by defining the signal size as the area under x2(t), which is always positive. We call this measure the signal energy Ex, defined (for a real signal) as:

$$E_x = \int_{-\infty}^{\infty} x^2(t)dt \qquad (3.1)$$

There are also other possible measures of signal size, such as the area under |x(t)|. The energy measure, however, is not only more tractable mathematically but is also more meaningful in the sense that it is indicative of the energy that can be extracted from the signal.

The signal energy must be finite for it to be a meaningful measure of the signal size. A necessary condition for the energy to be finite is that the signal amplitude → 0 as |t|→ ∞ . Otherwise the integral in equation 3.1 will not converge.

When the amplitude of x(t) does not → 0 as |t|→ ∞ the signal energy is infinite. A more meaningful measure of the signal size in such a case would be the time average of the energy, if it exists. This measure is called the power of the signal. For a signal x(t), we define its power Px as:

$$P_x = \lim \frac{1}{T}\int_{-T/2}^{T/2} x^2(t)dt \text{ with } T\to\infty \qquad (3.2)$$

There are several classes of signals. The most important are:

1.Continuous-time and discrete-time signals
2. Analog and digital signals
3. Periodic and aperiodic signals
4.nEnergy and power signals
5. Deterministic and probabilistic signals

1. Continuous-time and discrete-time signals

A signal that is specified for a continuum of values of time t is a continuous-time signal, and a signal that is specified only at discrete values of t is a discrete-time signal.

2. Analog and digital signals

A signal whose amplitude can take on any value in a continuous range is an analog signal. This means that analog signal amplitude can take on an infinite number of values. A digital signal, on the other hand, is one whose amplitude can take on only a finite number of values.

3. Periodic and aperiodic signals

A signal x(t) is said to be periodic if for some positive constant T_0

$$x(t) = x(t+T_0) \text{ for all t} \qquad (3.3)$$

The smallest value of T0 that satisfies the periodic condition of Equation 1.3 is the fundamental period of x(t). A signal is aperiodic if it is not periodic.

1. Energy and power signals

A signal with a finite energy is an energy signal, and a signal with finite and nonzero power is a power signal. Observe that power is the time average of energy.

2. Deterministic and probabilistic signals

A signal, whose physical description is known completely, either in a mathematical form or a graphical form, is a deterministic signal. A signal whose values cannot be predicted precisely but are known only in terms of probabilistic description, such as mean value or mean-squared value, is a random signal. [2]

4. The time system constant

Like human beings, systems have a certain response time. In other words, when an input (stimulus) is applied to a system, a certain amount of time elapses before the system fully responds to that input. This time lag or response time is called the system time constant. The system time constant indicates how fast the system is.

A larger time constant implies a sluggish system because the system takes longer to respond to an input. Such a system cannot respond efficiently to rapid variations in the input. In contrast, a smaller tie constant indicates that the system is capable to responding to rapid variations in the input.

Thus there is a direct connection between a system's time constant and its filtering properties.

A high-frequency sinusoid varies rapidly with time. A system with a large time constant will not be able to respond well to this input. Therefore, such a system will suppress rapidly varying (high-frequency) sinusoids and other high frequency signals, thereby acting as a lowpass filter (a filter allowing the transmission of low-frequency signals only). A system with a time constant Th acts as a lowpass filter having a cut-off frequency of fc = 1/ Th Hertz, so that sinusoids with frequencies below fc Hertz are transmitted reasonably well, while those with frequencies above fc Hz are suppressed.

The frequency fc is also known as the bandwidth of the system because the system transmits or passes sinusoidal components with frequencies below fc while attenuating components with frequencies above fc. Of course, the transmission in system behavior is gradual. There is no dramatic change in the system behaviour at fc = 1/ Th. [3]

5. Analysis of the signal and extracting of main features

After the signal has been acquired from the sensors, amplified, filtered, and stored it must be analyzed. There are different methods that can be applied. The signal can be analyzed in Time and Frequency domains.

Time domain

Analysis in the time domain includes:

- absolute and weighted values
- trends, discharges the mean curves
- statistical parameters (mean, distribution, frequency distribution, variance, skewness, kurtosis, etc.)
- parameters of the spectra [4]

For the analysis in time domain the raw values and the RMS are the main value of the signal in question.

The raw value represents the unfiltered, unprocessed by mathematical calculation acoustic emission signal from a certain frequency range. The analysis of the raw value is limited usually to the evaluation of the event rate. The event rate is described by the number of bursts per unit time.

From studies of the mechanical vibration is known that the determination of the RMS signal value (root-mean-square value) is an appropriate size for the characterization of the vibration strength of a signal [5]

The time evolution of the actual values (URMS) gives essential information about the process state. Consequently, there is a correlation between the signal energy ΔE, which is released in a time period ΔT, and the RMS signal of acoustic emission according to the equation:

$$\Delta E = U_{RMS}^2 \cdot \Delta T \tag{5.1}$$

The URMS value is calculated with the formula:

$$U_{RMS} = \frac{1}{T} \cdot \sqrt{\int_0^T u^2 dt} \tag{5.2}$$

Or from discrete values with the formula:

$$U_{RMS} = \frac{1}{n} \cdot \sqrt{\sum_{i=1}^{n} X_i^2} \tag{5.3}$$

With the help of statistics we can derive different characteristics both from the raw and the URMS signal. The most important is the average USTAT. The average is calculated according to the equation:

$$U_{STAT} = \frac{1}{n} \cdot \sum_{i=1}^{n} X_i^2 \tag{5.4}$$

The standard deviation σ can be determined with the formula:

$$\sigma = \sqrt{\frac{1}{n-1} \cdot \sum (X_i - X)^2} \tag{5.5}$$

It helps to draw conclusions about the average dispersion of the measurement of a signal whose mean value is known. Thus it represents a measure of the dynamics of the signal.

Skewness S (symmetry) and kurtosis K (flatness, curvature) may be calculated with the following formulas:

$$S = \frac{1}{n} \cdot \sum \left[\frac{(X_i - X)^3}{\sigma^3} \right] \tag{5.6}$$

$$K = \frac{1}{n} \cdot \sum \left[\frac{(X_i - X)^4}{\sigma^4} \right] - 3 \qquad (5.7)$$

The skewness is a measure of the distortion of the distribution function. A value of zero means a normal distribution. If there are more values below the mean, the skewness is negative, otherwise it is positive. The kurtosis describes the width of a distribution function. A kurtosis greater than zero indicates that a large number of readings are in the vicinity of the average. Conversely, a negative value means that many measurements are away from the mean value. [6]

Frequency domain

It is possible that not all the important features are available in the time domain and therefore it is possible to transform the signal. The goal of a signal transformation (for example, from the time in the frequency domain) is to provide information that is not visible in the time domain. This transformation from the time into the frequency domain is made by use of the Fast Fourier Transform (FFT).

The FFT algorithm is an extremely efficient way of calculating the so-called Discrete Fourier Transform (DFT). The actual equation for the forward transform is:

$$G(k) = \frac{1}{N} \sum_{n=0}^{N-1} g(n) \cdot e^{-i \cdot \frac{2\pi k n}{N}} \qquad (5.8)$$

and for the inverse transform is:

$$g(n) = \sum_{k=0}^{N-1} G(k) \cdot e^{-i \cdot \frac{2\pi k n}{N}} \qquad (5.9)$$

where G(k) represents the spectrum values at the N discrete frequencies k Δf, and g(n) represents samples of the time function at the N discrete time points nΔt.

Whereas the Fourier transform equations are infinite integrals of continuous functions, the above equations are finite sums, but otherwise they will be seen to have similar properties. [BRO84]

6. Experiment

The experimental stand (1) presented in figure 6.1 consists of:

· A Therpa small engine dynamometer (2);
· The gearless clutchless non-synchronous transmission (3);
· A 2,2 kW / 3000 rot/min electrical engine (4);
· An inverter for changing the speed of the engine (5);
· A PCB microphone (6);
· An acquisition card from National Instruments (7);
· A computer (8) with a monitor (9) placed on a desk (10);
Acquisition and analysis software;

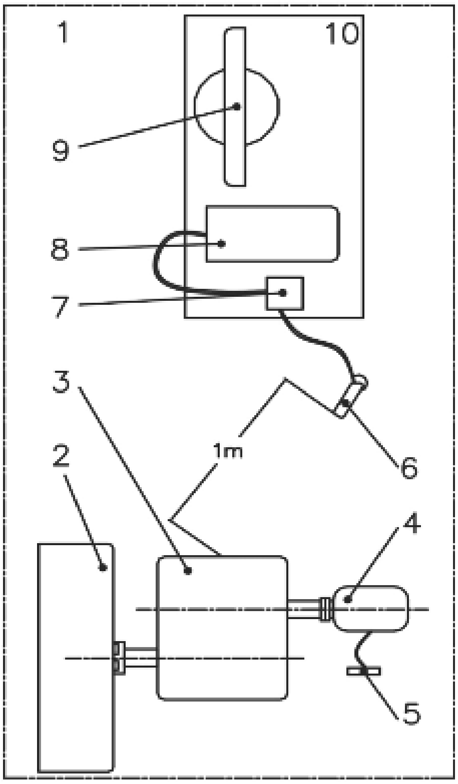

Fig. 6.1 The experimental stand

The transmission is connected to the small engine dynamometer and is driven by the motor. The microphone is placed at a distance of 1m from the source. The signal is then acquired by an acquisition card and then transmitted to the PC where the signal processing will take place.

A photo of the gearless, clutchless non-synchronous transmission is shown in figure 6.2.

Fig. 6.2 The gearless, clutchless non-synchronous transmission

In this case the analysis was done in the sound domain with a frequency range between 125 Hz and 10,000 Hz. The chosen bandwidth was 1/24 octave as shown in the figure 6.3.

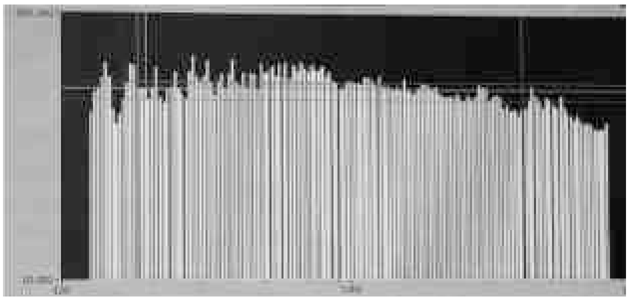

Fig. 6.3 The sound frequency configuration at a motor speed of 35 Hz

The motor speed was varied from 5 Hz to 50 Hz with a step of 10 Hz. There were two sets of trials, one with partial load and one with full load. In figure 6.4 one can observe an example of the sound level and the waveform recorded.

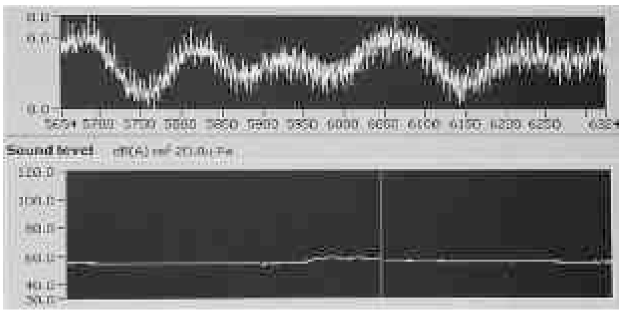

Fig. 6.4 The time waveform and sound level at a motor speed of 15 Hz

7. Result and conclusions

After acquiring the signal, we can analyse it. In both cases, with a partial load and full load, we could determine some mean values for every step corresponding to the motor speed.

As shown in Figure 7.1 the mean values grew from around 55dB at 5Hz to 84.5 dB at 50Hz. Although the curves look similar, one can observe that in the case where the load is at 50% there is a slight increase in the sound level at a frequency of 15Hz. This seems to be the systems resonance frequency. This effect disappears when fully loaded.

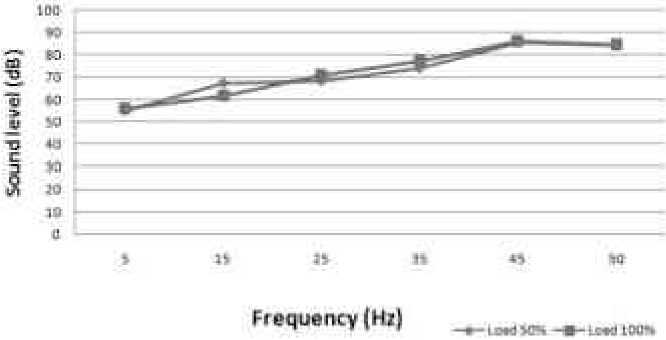

Fig. 7.1 Evolution of the sound level

Another thing to be taken into account is the surrounding environment noise. There are multiple sources that need to be filtered out, like computer fan noise, stand table resonance sound, etc.

To be able to fully soundproof this type of component other tests must be done, for example with different soundproofing materials.

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DYNAMIC VISCOSITY IN VARIABLE TEMERATURE AND PRESSURE CONDITIONS

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Abstract

From the earliest days of scientific studies on lubrication, the importance of lubricant viscosity has been recognized. The performance of the equipments and machines that use lubricants is decisively influenced by the variation of viscosity depending on pressure and temperature. The paper succinctly presents the installation that has been used, the testing methods as well as part of the measurements. The analysis of experimental results bears out the interdependence between viscosity on the one hand, and pressure–temperature on the other hand. The results are synthetically shown on three diagrams.

Keywords

viscometer, temperature, pressure, lubricant, transducer, thermostat

Nomenclature

t $[s]$ ball fall time

z $\left[\frac{dyn}{cm^2}\cdot\frac{1}{Skt}\right]$ cylinder constant

α $[Skt]$ value read on the scale of the device

η $[Pa\cdot s]$ viscosity oil

ρ_b $[Kg/m^3]$ density metal ball

ρ_v $[Kg/m^3]$ density oil

v_r $[H_z]$ frequency electrical network

D_r $[s^{-1}]$ speed gradient

K $[-]$ viscometer constant

Introduction

The role and importance of lubricants in the friction, wear and lubrication processes is well-known.

It is also known that, no matter its nature, the lubricant represents the third body between two moving surfaces of all kinds of bearings, [1].

One of most important attributes of lubricants is viscosity. A usual estimation of liquid lubricant's viscosity is done by liquid physics; at least for ordinary liquids, [2]. But, even in these conditions, the fluid viscosity results as an intricate function depending on pressure and temperature [3, 4]. If the pressure increases, the number and volume of liquid vacancies goes down, so that there is indirect pressure dependence. Lubricants are usually used on a large scale of pressures and temperatures.

The need to know the simultaneous dependence of viscosity on pressure and temperature arises from the fact that it influences the technical performances of usually used mechanical systems as: hydrodynamic radial and axial bearings, elastohydrodynamic variators, slide ways, etc.

Liquid physics offers only intricate information with low-range validity, so that the simultaneous dependence of viscosity on pressure and temperature has to be experimentally determined.

System for Viscosity Measurements

The measuring device is shown in figure 1. The three main parts of this system are: the electronic ball viscometer 1, the electronic falling time measuring system 2, the oil's thermostat 3. The ball viscometer is based upon the principle of the free falling of a solid into a liquid. It also includes a pressure creating and increasing system 10 (0.1 MPa – 100 MPa) and a pressure transducer 4. The falling space is limited by two pick-ups 5 and 7, so that the solid's falling time can be precisely determined by the electronic measuring system 2.

The oil to be tested is introduced in cylinder 9; it is calculated to resist to 100 MPa. Cylinder 6, concentric with cylinder 9, ensures the recirculation of the oil coming from the thermostat.

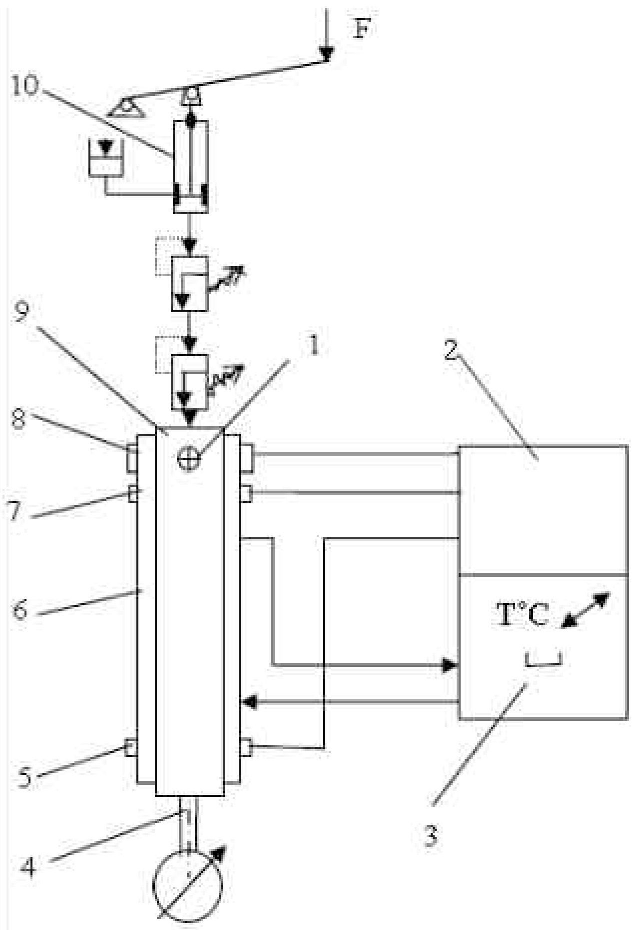

Figure 1. System for viscosity measurements

Some prerequisite conditions had to be constructively imposed in order to prevent the distortion of measured values:

1. A constant interspace has to be between the falling solid (a metal ball) and the cylinder's inner diameter (the oil is poured into the cylinder).
2. The metal ball has to be kept in the normal position. This is done by means of an electromagnetic field, created by coil 8. Coil 8 is far enough from pick-ups 5 and 7, so that the ball's speed would be steadied when it passes by them. Another measurement concerns the bringing back of the ball by dumping the viscometer and its bringing back again to the initial position, till the metal ball would be caught by the electromagnetic field of coil 8.

Experimental results

The method may be used with all kinds of oils. The measurement steps are:

a) determining the viscometer constant (K). A standard Rheotest II, a German apparatus, has been used to measure the dynamic viscosity η in usual conditions – at air pressure and a temperature range between 17–100ºC. By means of the measured parameters, respectively those indicated in the apparatus's technical manual, the dynamic viscosity is calculated using the relation:

$$\eta = 8.334 \cdot \frac{z \cdot \alpha}{D_r \cdot \nu_r} \tag{1}$$

The same conditions have been used to determine the metal ball's falling time in the electronic viscometer. In order to calculate η we have used the following relation, [5]:

$$\eta = K(\rho_b - \rho_v) \cdot t \tag{2}$$

where: t is the ball's falling time between pick-ups 7 and 5. Considering the notation $K(\rho_b - \rho_v) = K_1$ we have obtained:

$$\eta_i = K_1 \cdot t_i \tag{3}$$

b) we have used the following oils: T90 and K40. For each real case, viscosity has determined using the relation (3). The viscometer's constant and the falling time had been known, so that we have determined the oil's viscosity for different values of pressures and temperatures.

The steps by measuring were Δp=5 MPa, and respectively Δt=10^{0}C.
The pressure value was limited to 60 MPa by the maximum pressure of transducer. In the both cases the approximate values of constants are the following: $K = 0.0034042802, K_1 = 0.014$
c) the experimental results are synthetically shown in the figures 2 – 4.

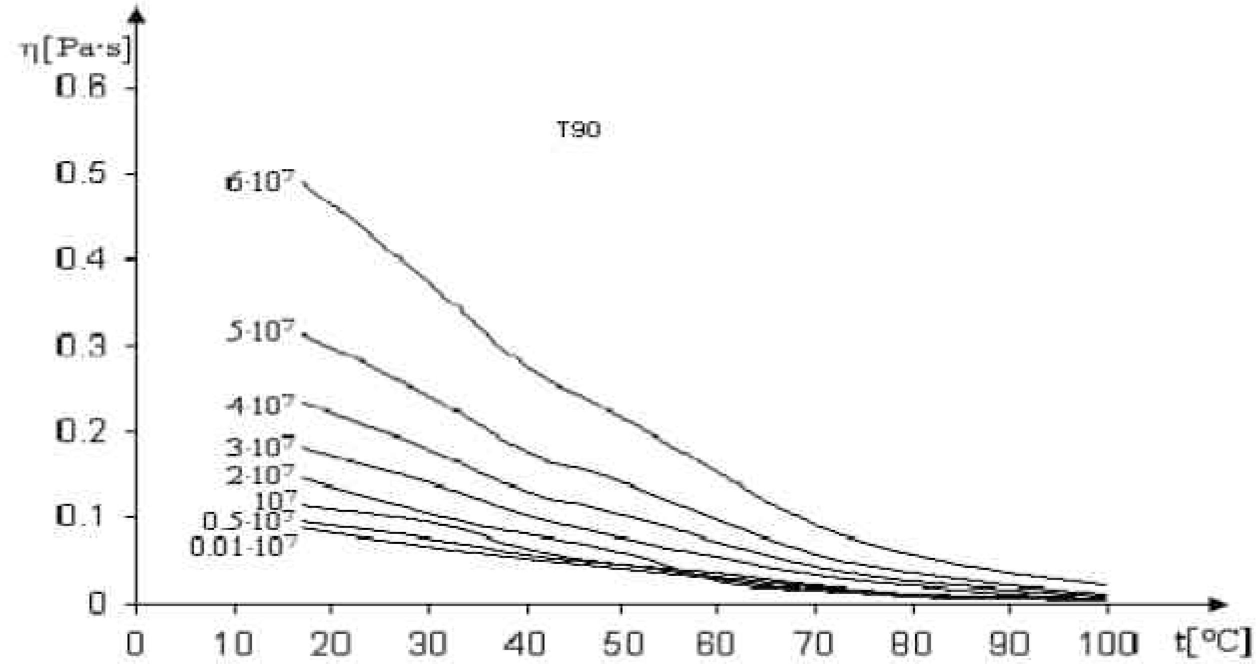

Figure 2. The variation of viscosity depending on pressure and temperature [T90]

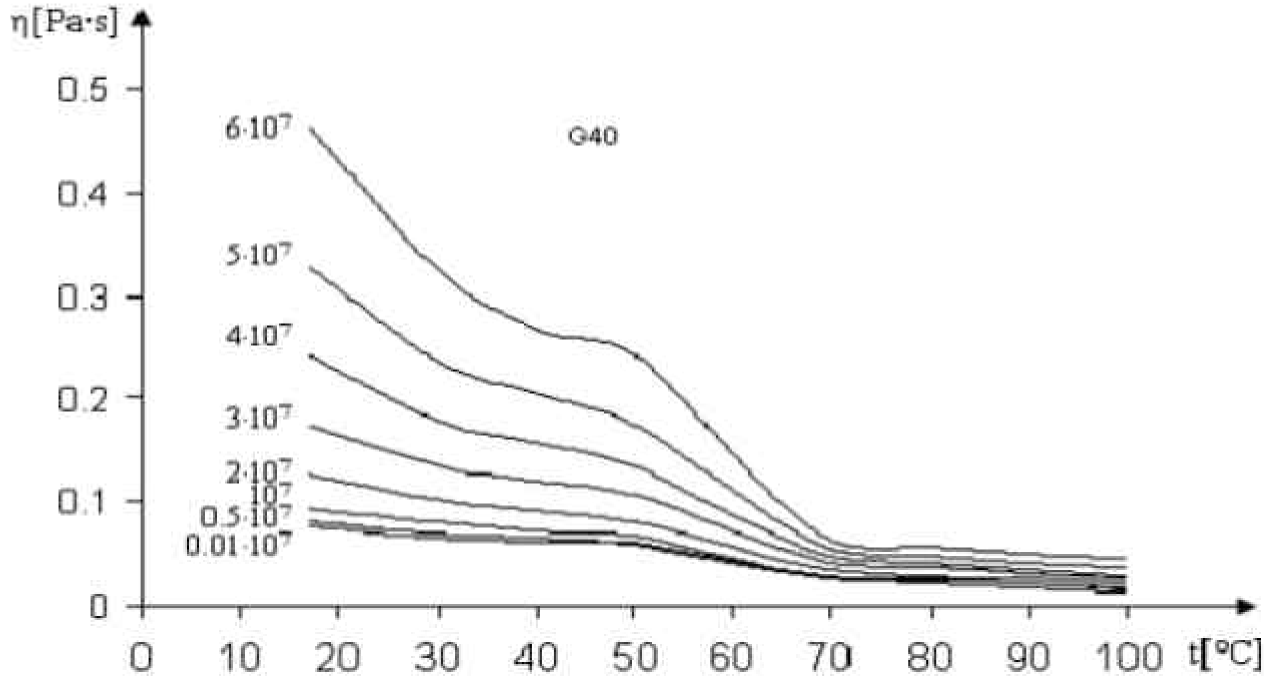

Figure 3. The variation of viscosity depending on pressure and temperature [G40]

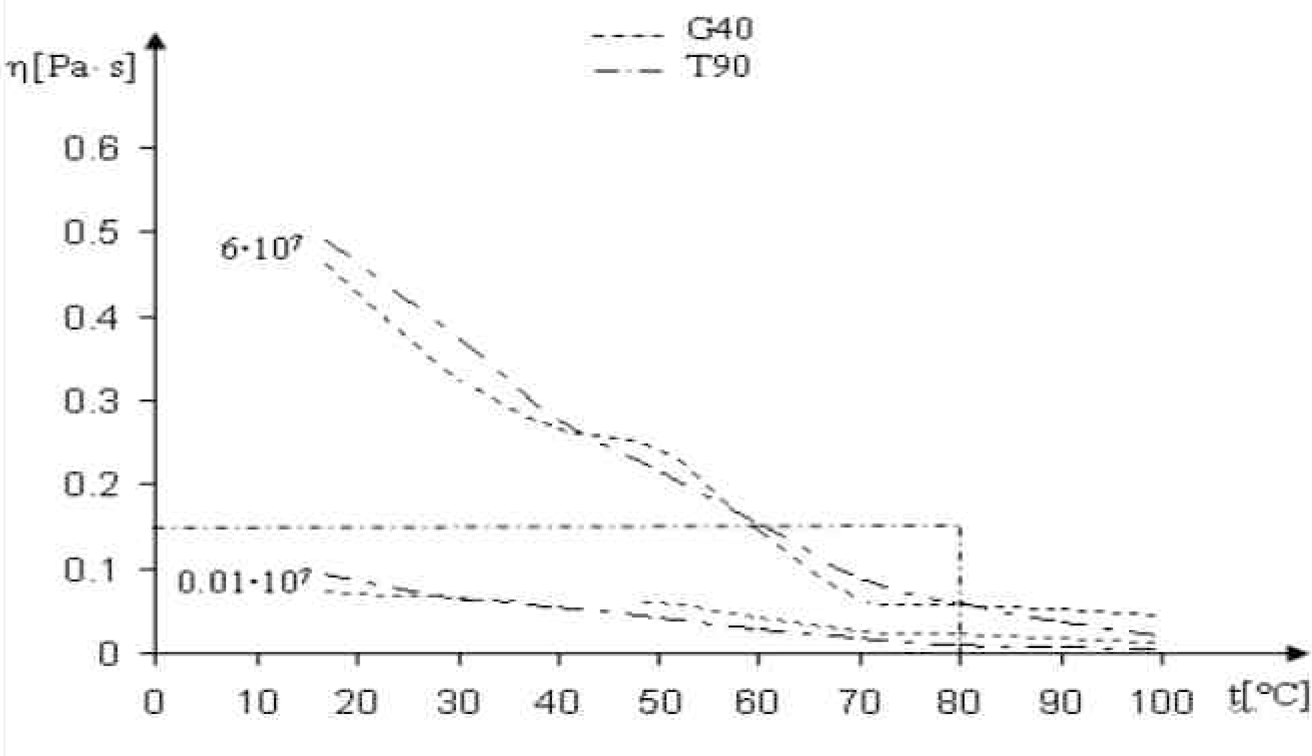

Figure 4. The variation of viscosity depending on pressure and temperature

Conclusions

Some authors say that pressures lower than 100 MPa do not influence viscosity; the pressure variation may be neglected.

We have observed that viscosity is highly influenced by pressures lower than 100 MPa. There are inflexion points on the curves $\eta_i = K_1 \cdot t_i$ they have in common the same temperature. There are three domains:

1. for p<50 MPa and t<80^{0}C, when $\Delta\eta$ =0;
2. for t >90^{0}C, then no matter what the pressure is, the viscosity variation is low for both kinds of oils and we may consider a mean value,
3. for p>50 MPa and t<80^{0}C, when the variations of viscosity are high.

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INCREMENTAL PNEUMO-HYDRAULIC POSITIONING UNIT

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Abstract: The paper presents the principal aspects regarding the pneumatic actuating systems used in robotics, focusing on the positioning units with a limited stop points. The methods used to stop the actuated load are discussed and two pneumatic positioning systems using classic linear pneumatic motors are described. A specially designed linear incremental pneumo-hydraulic positioning unit is presented and also the experimental model built by the authors.

Key words: pneumo-hydraulic, incremental, positioning unit

1. Introduction

Pneumatic actuating systems are frequently used in robotics despite their working fluid disadvantages (high compressibility and low viscosity). The explanation rests in the undoubted qualities of this type of actuation: stamina, simplicity in construction, productivity, high reliability, lower costs and last but not least the fact that pneumatic systems are environmental friendly. Such systems are generally used when:

- average values of forces and torques are needed;
- the moving speed of the load must not vary strictly according to a certain low;
- the positioning of the load must not be of high accuracy;
- the operating conditions are severe (detonation or fire danger, humidity, etc.);
- certain sanitation standards must be strictly respected (food industry, pharmaceutical industry, nuclear technique, etc.).

The pneumatic actuating systems are challenging the other types of actuating systems (electrical, hydraulically, mechanical) in many cases, but there are certain applications where the pneumatic systems are exclusively used, being irreplaceable.

Conclusively, the pneumatic actuated robots are used when the load is not very heavy and the positioning accuracy is not very high.

A large number of robots are built combining rotational and translational units. On the other hand, such a unit may be used in a large number of lower complexity applications, requiring an imposed positioning accuracy of the load. In this cases it is more cost-effective to use such a unit or combinations of units instead of using a robot. This is the reason the producers offer a large variety of pneumatic positioning units:

- horizontal and vertical linear units;
- running bridge type actuating units;
- oscillating units;
- rotation units.

There are also offered some modules having well defined functions, such as:

- universal and specialized mechanical grippers;
- sensing units;
- controllers;
- safety systems;
- software modules;
- programming units, etc.

All these are produced in a large range of typo-dimensions. Choosing the units and the modules and their assembly must be done according to the informations given by the manufacturers. Every module is designed in order to assure a quick and safe connection with the other modules. Some modules feature special centring functions.

In most applications a linear unit must position the actuated load with an imposed accuracy, either in a limited number of points along the stroke, or in any point of the stroke. The mobile assembly movement may be: alternative linear, alternative rotational or rotational with an unlimited angle. Accordingly, the motor of the system may be: a linear motor (a cylinder or a membrane chamber), an oscillating motor or a rotational motor.

A known disadvantage of the pneumatic actuating systems is that the accurate positioning of the actuated load can be obtained only for a few number of points along the stroke.

This points may be the limits of the stroke or some intermediary points established by mechanical stops. The positioning in any other point is difficult to control because of the compressibility of the air.

2. Positioning units with a limited stop points

For a limited number of stops there are built pneumatic units that meet this requirement, generally using two types of motors:

- a classic linear pneumatic motor, or
- a specially built pneumatic motor.

In the first case (figure 1) the stoppage of the mobile assembly is achieved at the stroke ends (materialized by the lids of the linear motor or by specially mounted stops) or at intermediate stops; significant dynamic loading are generated because of the impact between the mobile assembly and the fixed part. The stoppage of the actuated load must be controlled even in the case of a variable load.

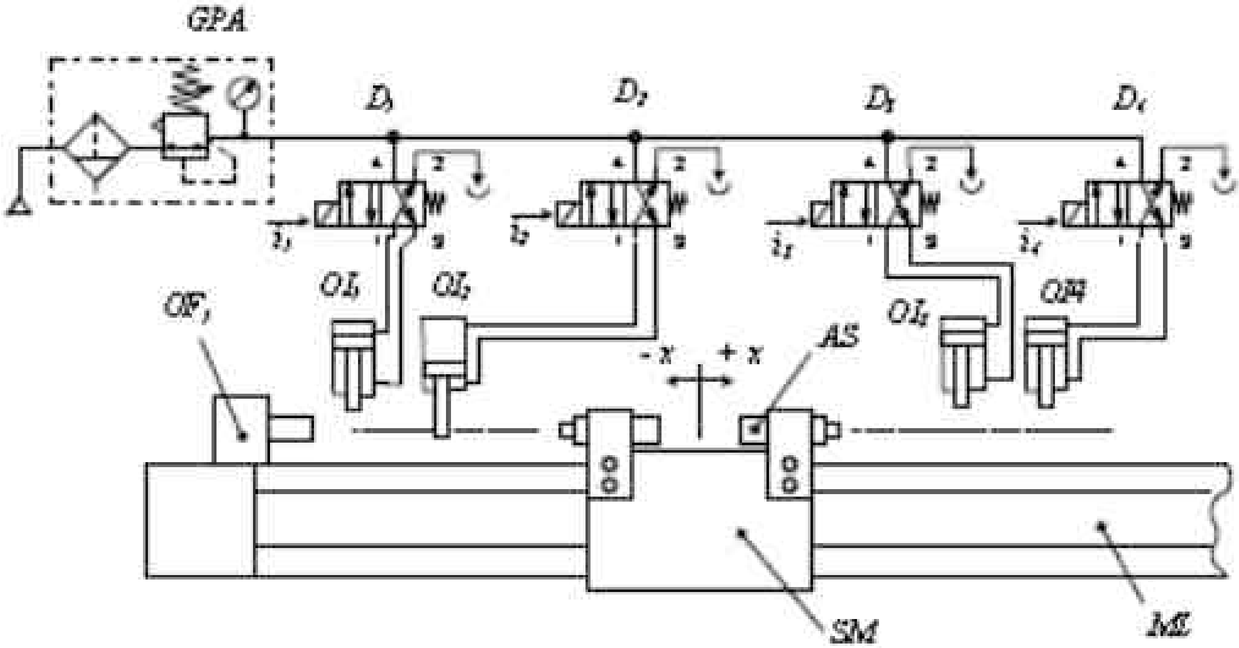

Fig. 1 Pneumatic unit using a classic linear pneumatic motor

The braking process must not rudely begin and the end of the process has to take place without back stroke, in the shortest time possible. There are many solutions for the stoppage of the actuated load, as follows [2]:

- stoppage on rubbery rings or springs;
- air cushion braking;
- using hydraulic dampers;
- using industrial shock dampers;
- using progressive dampers.

Figure 2 shows the variation of the braking force along the braking stroke,)(ffxfF=, for the solutions mentioned above. The rubbery rings and springs assure a linear characteristic (figure 2, curve "1"), with a shortly ramp and the tendency to stow more energy than the absorbed one, thus producing back stroke effects and significant shocks. This method is recommended when the displacement speed and the load are reduced.

The air cushion braking (figure 2, curve "2") assures a maximum braking force at the end of the braking stroke, meaning that a large amount of the kinetic energy is absorbed at this point. Considerable loadings depending on the weight and the speed of the actuated load appear at the end of the braking stroke.

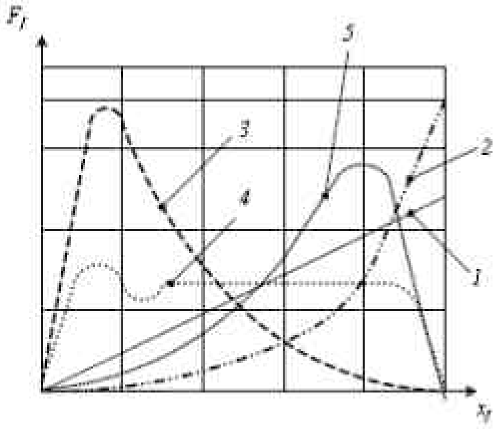

Fig. 2 The variation of the braking force

When the energy to be damped is to large, external hydraulic dampers are used (figure 3, a). This is the simplest braking method. The braking force (figure 2, curve "3") shows a maximum immediately after the start of the braking process, when the largest amount of energy is absorbed. Thus braking forces greater then necessary are generated.

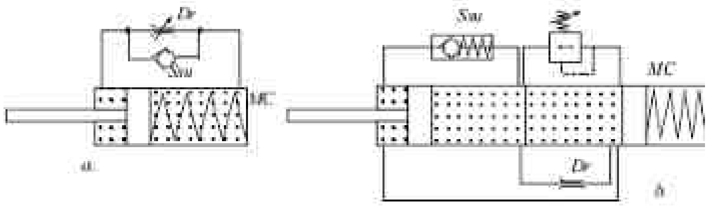

Fig. 3 a) Hydraulic damper; b) Industrial shock damper

When industrial shock dampers are used (figure 3, b) the braking force is nearly constant (figure 2, curve "4"). The energy of the mobile assembly is absorbed with a constant rate, without shocks or back strokes, and the dynamic loadings are lower.

Figure 4 shows a comparison between an industrial damper and a simple hydraulic damper taking into consideration the $F_f = f(x_f)$ (figure 4, a) and $v_f = f(t_f)$ (figure 4, b) characteristics. The hachured surface represents the mechanical work spent during braking. Making the assumption that the mechanical works of the two dampers are equal, figure 4, b shows a braking time for the industrial damper *60%* shorter then for the simple hydraulic damper. This is the reason why industrial dampers are largely used.

The progressive dampers are used by FESTO for a part of the offered translation units. Their characteristic (figure 2, curve "5") shows a long ramp, thus the dynamic loadings are lower and the initial oscillations are reduced.

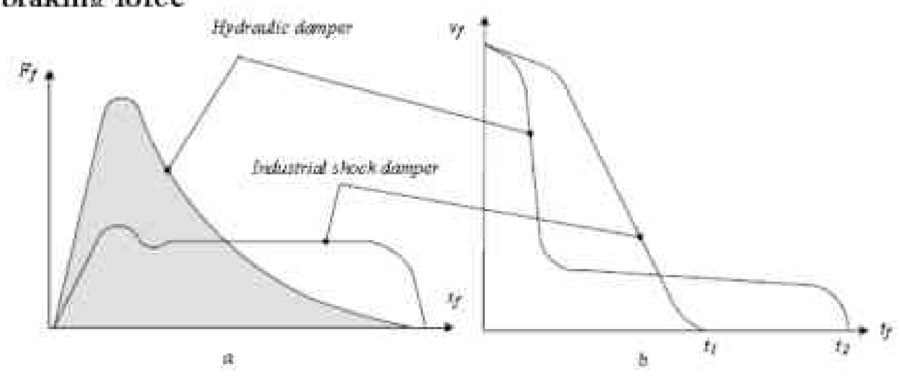

Fig. 4 a) The variation of the braking force; b) The variation of the braking speed

The producers offer a series of methods in order to choose correctly and quickly the appropriately damper for the specified application. The impact force, the weight and the speed of the actuated load are required.

There are also other ways to accomplish fast and controlled approach and stoppage at the desired points. Figure 5 shows such an example. The actuated system includes a linear potentiometer *Tp*, the stroke end controller *C*, the adjustable stops OM_1 and OM_2 and the proportional distributor *DP*.

There are no stroke end shock dampers. The *C* controller features a number of inputs for the system parameters: the actuated load, the resistant force, data regarding the constructive parameters of the cylinder. The controller "learns" the working distance and assures an accurate positioning, even if some perturbations apear while working (modifications of the weight and the resistance force). The repeatability is *0,01 mm*.

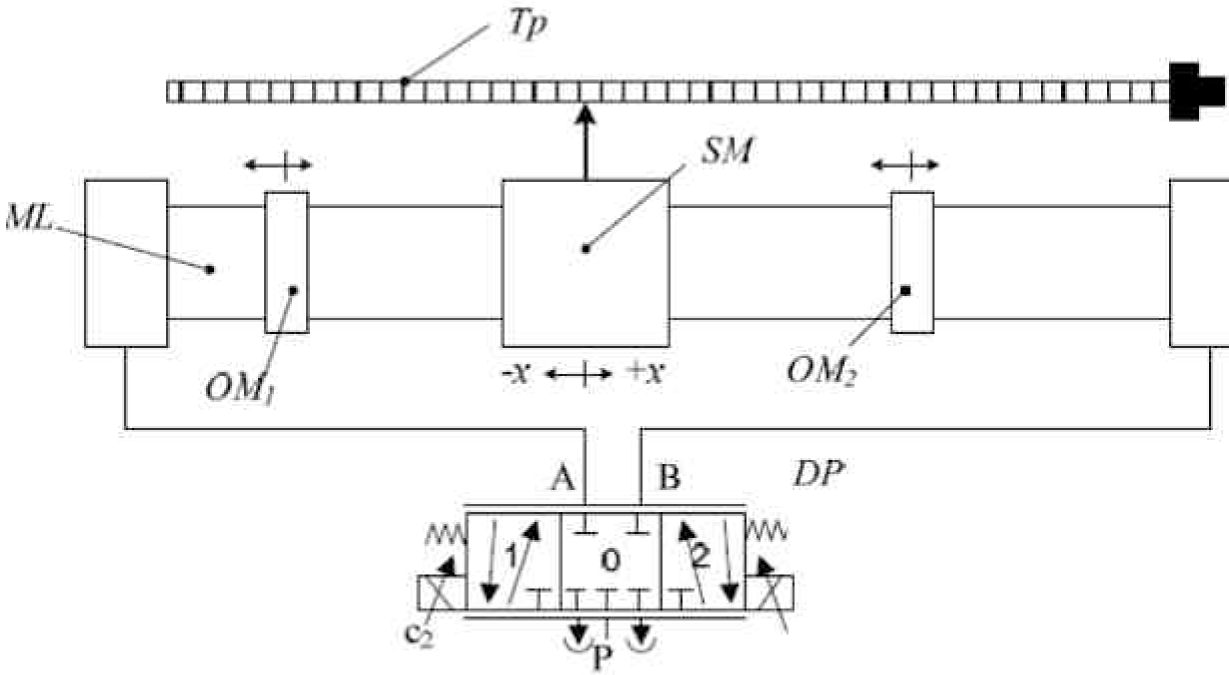

Fig. 5 Pneumatic positioning system using a proportional distributor

3. Incremental pneumo-hydraulic positioning unit

Figure 6 shows the principle scheme of a specially built linear positioning unit [3]. A number of binary charger cylinders are used - 4 in the considered scheme - having the following characteristics:

- the strokes of the pistons are: $2^0 \cdot x_b, 2^1 \cdot x_b, 2^2 \cdot x_b$
- and $2^3 \cdot x_b$
- ; the value of the increment x_b and the strokes may be modified choosing the right lengths of the stops O_1, O_2, O_3 and O_4;
- the chambers having the volumes V_1, V_2, V_3, and V_4 are connected to the chamber of the main cylinder having the volume V; all this chambers are filled with oil.

If the four electromagnets $EM_1 ... EM_4$ are commanded using a binary logic, the actuated load may be positioned in 16 distinct points.

Figure 7 shows a view of the experimental model.

Another examples of such units are presented in [3].

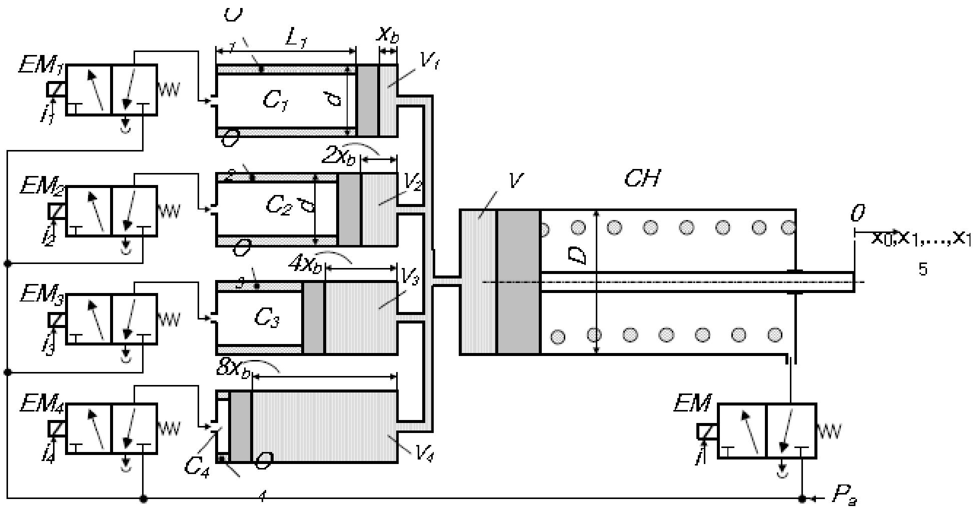

Fig. 6 Incremental pneumo-hydraulic positioning unit

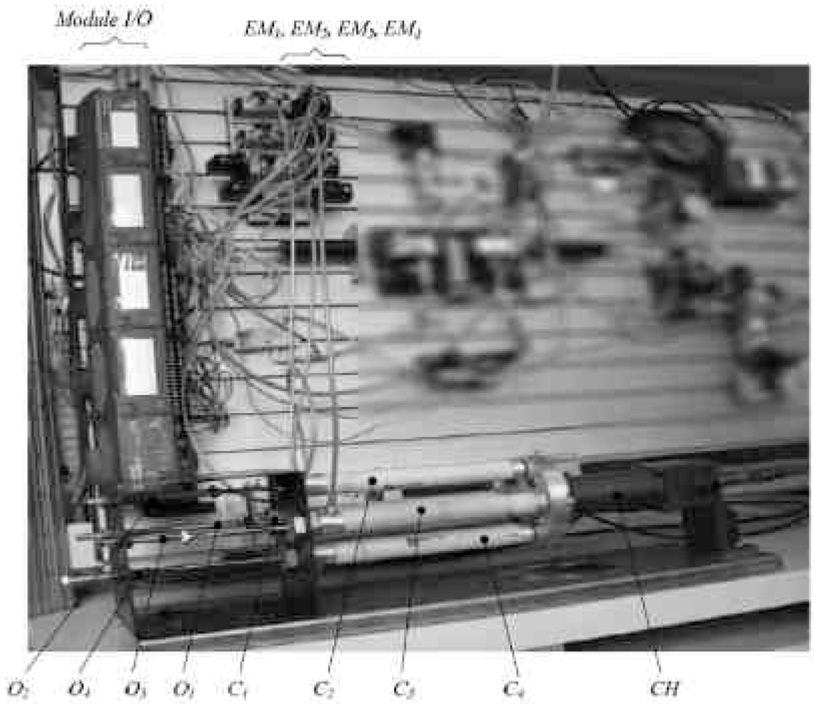

Fig. 7 A view of the experimental model

4. Conclusions

Pneumatic actuating systems are more and more used in robotics especially because they are non polluting and the problem of accurate positioning is often solved using different solutions to improve this characteristic, as described in the paper. The designed and built experimental model presented is subject for further studies.

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E-SKILLS IN SMALL AND MEDIUM SIZED ENTERPRISES AND THE CONTRIBUTION OF E-LEARNING

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Abstract:
Recent surveys show that in small and medium sized companies (SMEs) “e-Skills”, necessary in order to implement and use successfully information and communication technologies (ICT) for their work and business, are missing. In this paper three categories of “e-Skills are presented as well as contribution of e-Learning and foresight scenarios to achieve such skills. Examples of projects in this context are also given

1. Introduction

It is known that ICT technologies offering new communication facilities with faster information retrieval and flexible manipulation possibilities, as well as the advent of the in house networking and development of more powerful electronic communications, will impact business productivity in all companies.

Every recent survey covering the business domain implementing and using ICT shows an evident skill shortage at the top of the list on conclusions but it is conspicuous that the availability of adequate skills (e-Skills) represents a key condition for successful innovation and for the competitiveness of European enterprises. The demand for “e-Skills”, that is skills needed to access and use electronic information to function effectively, socially and economically, at home as well as at work (eLearning Glossary), increased drastically with the growth of e-Business. In this perspective, as from the i2010 initiative – A European Information Society for growth and employment: “a new era of 'e-business solutions' is coming, based on integrated ICT solutions, secure web-services and 'collaboration tools' to raise worker productivity. New developments indicate that the use of ICT will increase in the next years. It is also essential to adapt the working environment through efficient use of ICT at the workplace and for a flexible organisation of safe and high quality work” (European e-Skills Newsletter, 2006).

The term “e-Skills” encompasses a wide range of capabilities (knowledge, skills and competences) and issues, where “e-Skills” concept in spanning over a number of economic and social dimensions.

At present, one critical problem is that European and national programmes showed the importance of digital technologies and of the Internet, especially for Small and Medium Sized Enterprises (SMEs), without providing a consolidated set of empirical evidence and documentation of the corresponding changes in production and knowledge processes that are taking place, implying the emergence of new sets of “e-Skills” to be systematically grouped and developed. The Cambridge conference “e-Business: The Way Forward”, held in December 2005, confirmed that major European enterprises see the need for a long term EU strategy to ensure adequate “e-Skills” for the future covering both workforce and population.

The European Commission is preparing Actions in this area including the promotion of training resources in e-Learning and the networking of e-Learning and training centres to upport the development of “e-Skills”. The European “Towards a Long Term e-Skills Strategy” 2006 Conference, which will take place on 5th and 6th October in Thessaloniki, Greece, in the framework of the European Centre for the Development of Vocational Training (Cedefop), a major milestone will be the preparation of a long-term “e-Skills” agenda for Europe.

One direction of straightening up the world of “e-Skills” is to develop multiple foresight scenarios and to examine what could emerge from foreseeable, 'wildcard' developments and structural changes and how these might affect the supply and demand for “e-Skills” within the next 10 years. One of the key tasks is to identify the drivers that influence demand for the following three types of e-Skills: ICT practitioner Skills, ICT user Skills, and e-Business Skills.

In this paper there are treated just these three categories of “e-Skills”: ICT practitioner skills, ICT user skills and e-Business skills.At is will be clearly pointed out, in what follows, there is a distinction between “e-Skills”, and e-Learning demand in large enterprises companies and SMEs. Where as, in the last 5 years, large enterprises have been in fact forerunners in the adoption of e-Learning throughout Europe, the same cannot be pointed out for small and medium sized companies. Also, it can be observed that very little information and interest could be found about eLearning in European SMEs. In the third part of this paper some explanations for this situation are given. In the final part of the paper there are presented some examples on European projects.

2. e-Skills, e-Learning, foresight scenarios

Corresponding to the eLearning Glossary the main three categories of “e-Skills” mentioned above could be characterized by the following content:

· ICT practitioner skills: the capabilities required for researching, developing and designing, managing, the producing, consulting, marketing and selling, integrating, installing and administrating, maintaining, supporting and servicing ICT systems.

· ICT user skills: the capabilities required for effective application and utilisation of ICT systems and devices by the individuals; ICT users handle ICT systems as tools in support of their own work, which is, in most cases, not of ICT nature. User skills cover the abilities using of common generic software tools and of specialised tools supporting business functions within industries other than ICT industry.

· eBusiness skills: the capabilities needed to exploit opportunities provided by ICT, notably the Internet, to ensure more efficient and effective performance of different types of organisations, to explore possibilities for new ways of conducting business and organisational processes, and to establish new businesses.

The development of “e-Skills” can be supported by e-Learning and one of the activities planned within the European Qualification Framework announced in “i2010” is to promote training resources in e-Learning with this goal.

Scenario planning is a tool that can help organisations to make a decision in the midst of uncertainty and that supplements traditional prognosis methods. A growing number of corporate executives are using scenario planning to make difficult decisions more effective.

Scenario planning derives from the observation that, given the impossibility of knowing precisely how the future will play out, a good decision or a robust strategy to be adopted is one that plays out best across several possible variants.

To find that "robust" strategy, scenarios are created always in plural, such that each scenario diverges markedly from the others. These sets of scenarios are, essentially, specially constructed “stories” about the future, each one modelling a distinct, plausible world in which we might someday have to live and work.

There is no formal definition about what scenarios exactly are (as revealed by the citations above) nor about how they have to be constructed, but few attributes can be found often as follows:

· scenarios should contain all relevant key factors of the problem sphere

· scenarios are creative-intuitive, i.e. a combination of single data and factors that have to be condensed to a plastic picture of the future

· scenarios have to be transparent, that is all steps, information and hypotheses leading to the scenario creation must be clearly shown and explained

· scenarios have to be practical, they are a “call” to achieve a positive future by active participation

· scenarios must be complex, they can not be reduced to a simple set of “if-then” relations

· scenarios do not need to be of high probability, but at least they must be possible.

3. SMEs and e-Learning

The important role of the private sector for economic and social development of all economies is already well known. SMEs are universally acknowledged as «engines of growth», and they generate more employment opportunities at the lowest cost per new employment. But in many countries SMEs have now come under a severe pressure as they lack required capabilities to be able to take advantage of new opportunities opening up in front of them as a result of the globalization process and to remain competitive on the national/international market.

SMEs have a couple of specific organisational needs and characteristics: these companies have a dependence on a limited number of people (often owners and managers are one and the same person) and there is almost always a close relationship to customers and business partners. If SMEs don't acquire, maintain or improve their business skills continuously, their competitors will benefit of this weakness and their business will move elsewhere. The impact on the workplace situation and the business while staff is not involved in training, cannot be under-estimated, given that there are over 18 million individual enterprises in the EU, of which over 99 per cent fall within the definition of SMEs.

The European Board of Life Long Learning CEC found that lifelong development of skills, including “e-Skills”, depends on implementing the following measures:

· Identification and anticipation of skills and qualification needs;

· Recognition and validation of skills and qualifications;

· Procuring of information, support and guidance;

· Finding resources.

The identification of needed “e-Skills” should take place both at the enterprise level and at national/sectoral level. In the latter case, the collective analysis of skill needs and of the development of vocational or professional qualification is a priority referring to young people in the context of their career guidance and integration into working life. It is also important to employees in the management of their careers and their capacity to remain in employment, to job-seekers and, in general, to companies in terms of their competitiveness (CEC, 2004). In enterprises the process of identifying skills and qualification needs should become a main axis of human resource policies, covering all employees of the SME and being an issue for in-depth social dialogue.

The delivery of “e-Skills” by using e-Learning has, for the SMEs, many advantages over conventional training delivery techniques.

Delivery costs are considerably lower and staff will not be off site while training. Downtime would be minimised and productivity would be maintained. Training could take place at any time and could be scheduled to take place during slack periods of the working day. Training courses could also be provided immediately almost on an “à la carte” basis, rather than waiting until the required number of participants has been gathered for a conventional, face to face, off-site course.

But, it seems that, so for, e-Learning process took place only within big companies. Outside of the IT sector there is little activity going on in SMEs which is related to e-Learning. "SMEs often agree with the need to put training in place," remarked Gordon Gough, Chair of the Institute of Business Advisers in Northern Ireland, "but they are slow to implement any training plan. On-line delivery may encourage adoption, but the training providers need to get the benefits message across accurately." (ONLINE EDUCA BERLIN 2004)

Many of the perceived problems are, however, based on misconceptions or prejudices born out of a general suspicion concerning an educational process in such companies where it is not teacher driven. They are afraid of high costs and overheads for the content maintenance. The other difficulty for SMEs is that most of them do not have a suitable infrastructure for learning. Staff will not, in general, be allowed to take time off for study when it is necessary, and very often will not be funded to undertake further training.

Moreover, SMEs do not seem to be very interested in using e-Learning system because of the nature of e-Learning products, which are mostly standard products. Standard products are not adapted to the specific needs and demands of SMEs. For big enterprises it is possible to use standard products for some tasks and goals while getting tailored products for specific needs, mostly in cooperation with an e-Learning manufacturer. For SMEs this strategy is too expensive. One approach to solve these problems is the so-called "Mass Customisation".

This concept is based on modules of the teaching units. Sometimes it is even necessary to “destruct” produced eLearning units and to rebuild them into modules. Another important aspect for high quality and “payable” products is a "Content-Sharing-Platform" (see for example, the results of LERNET at www.lernet.info).

Another obstacle in radically changing the way training is delivered lies in the organisational culture, especially the learning culture (Wade, 2003). In short, the problem is not related to the technology or the delivery of e-Learning, but with the learning culture. Every company has established an own learning culture. Therefore, the companies need to understand the type of learning culture they have created and they are supporting.

Examples

ARIEL (www.ariel-eu.net) is an internationally joint project funded by the European Commission in the framework of the *e*Learning Initiative. The project was co-ordinated by IAT Gelsenkirchen, whereas the Consortium was formed of partners from Ireland, Romania, Italy and Hungary. The project investigated e-Learning supply for SMEs, particularly to develop “e-Skills”, concerning didactic approaches, benefits and fields of application. One of the major themes was the evaluation of the impact of former EU programmes in the field of electronic learning. On this basis, the ARIEL team built different scenarios of the future development of “e-Skills” and e-Learning in Europe, particularly referring to SMEs.

One of the main approached aspects referring to the ARIEL scenarios was related to the following question “*Can eLearning support European SMEs to build “e-Skills” to be successful and to integrate into the European market?”*

With the year 2010 being ARIEL's time horizon, the project is in concordance with the time horizon 2010 of the Lisbon strategy. As basic factors of influence ARIEL team identified the level of skills, organisation of learning process, type of used technology, costs, motivation, nature of users, certification of e-Learning for “e-Skills”.

For each of the built four scenarios an evaluation of the situation in 2005 was carried out. It was supposed that until 2010 the subdescriptors of the scenarios will develop in different ways – positive (increasing), negative (decreasing) or remaining with stationary contributions (stagnation) – to get a satisfactory answer to the appointed question. There were used questionnaires in order to analyze the answers of experts in relation to the contributions of different factors in the foreseen scenarios in different countries (regions).

The second example of EU project, where authors of this paper were involved, stems from the second phase (2000 – 2006) Leonardo da Vinci programme. The name of the project was "eCASME" having as prime goal development of on on-line training needs analysis (TNA) tool for SMEs. The project was a pilot one belonging to the open and distance training domain and cavering a wide approach of "e-Skills" feature. The consortium was formed of university and organization partners from Ireland, Romania, Portugal, Sweden and Latvia, being co-ordinated by University of Limerick, Ireland.

"eCAPTURE", meaning of eCAPture of SME training needs and specification, eCASME, was an on on-line software using best practice in learning needs analysis and the content specification for training in a user friendly format.

The project was successful in achieving all the aims and objects set forth in the original project application. The central goal of the project "eCASME" was to encapsulate best practice in training needs analysis and training content specification for a user from SMEs, including ICT companies based on the on-line format.

To achieve this a number of surveys were conducted to determine the "best practice", the results of which were documented in the reports. The final on-line tool is available is all partner languages, thus inclusive Romanian language, following extensive testing has been localized to accommodate regional and cultural differences.

The entire project consisted of 15 work packages with separate deliverables in each.

In the first part of work, an extensive survey was conducted accross the partner countries, including Oltenia region among ICT companies, to gather information to help determine the common and diverse factors that characterize Small and Medium Enterprises accross the partnership, both regionally and sectorally. The major considered sector was that of IT SMEs, thereby tackling the "e-Skills" innovations.After that, a number of possible design tools and methodologies were studied to determine the most effective tools and techniques that should be used in the development of the on-line tool. Thereafter, an initial prototype tool (version alpha) was developed and tested with SMEs in each region and sector to determine the exact needs of the SMEs, including "e-Skills" and to discover if any localisation issues existed. Following extensive testing by the partners and the users a final specification for the on-line TNA tool was elaborated and implemented (beta version). The partners once more tested the final tool and various companies to ensure it operated correctly and met the users requirement. Obviously, after these new tests, a number of improvements were made to the final version of the tool.

The tool is now available on-line at ecasmetool.ul.ie in all partner languages and is localised to ensure it meets the needs of the users in the various partner countries. Referring to the University of Craiova contribution to this work details can be read at http://www.cs.ucv.ro/cooperari/ecasme/ecasme.php. The target group of the "eCASME" project was clearly SMEs. The project was very appreciated by the Commission, being considered successful in providing SMEs with a mechanism to better define their training needs, including "e-Skills" and to ensure their training solutions are alligned to then business strategies, aims and objectives. The feedback from SMEs, who used the tool during the project progress has been very positive and was critical to the successful completion of the on-line tool.

It is considered that the tool developed by partners in “eCASME” project is the first open source customisable TNA tool that assists SMEs to identify and prioritise training plans for employees taking into account best practice Instructional Design theories. The evident benefits of these features ensure that SMEs making use of the tool can ensure that their budgets are spent only for training that is effectively required to help deliver their goals and strategy.

A particular feature related to this project was inclusion of partners with a geographic spread accross Europe, ensuring thus an opportunity to gain different regional and sectoral perspectives on TNA. The varied skills of the different partners meant that the project had access to the skills required to run a successful project. The key skills available include, among others, expert ICT development skills, “e-Skills”.

The contribution of transnational partners has resulted in a generalisable tool, tested to ensure that it satisfies the cultural and sectoral requirements of the different countries (including Romania) and industry sectors (including ICT technology) that participated in the project. This was achieved through the availability of the different perspectives of a European wide audience and has also resulted in the translation of the tool into five partner languages (including Romanian).

CONCLUSIONS

This paper discussed briefly an important issue related to eLearning and “e-Skills” development. It is appreciated that the present priority given to eLearning is the result of the imperative need to provide “e-Skills” to all workers and citizens to face the challenges of Information Society and the need to use ICT to support the learning processes in view of a growing demand for learning. The osmosis between learning ICT and learning through ICT concepts gave a strong impetus to accelerated development of eLearning at the beginning of the new century.

Nowadays, there are some disputes at the level of EU policy makers, so that the eLearning market has developed at a lower rate than foreseen some years ago, the “eLearning Initiative” has almost disappeared from the scene to leave ground to the “eLearning Programme” that privileges higher education twinning, but ignores lifelong learning. Therefore it was proposed the new “Integrated EU programme for lifelong learning after 2007” which treats ICT as part of a transversal programme crossing the sectoral lines of (OMENIUS, LdV, GRUNDVIG, SOCRATES schemes (Dondi 2005).

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MECHATRONIC MODULE FOR MONITORING DUAL AXIS TILT

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ABSTRACT:
The mechatronic module for monitoring dual axis tilt have many applications in transport platform, manufacturing for maintaining horizontality or maintaining tilt etc. Rugged construction and wide temperature range make these device suitable for numerous automotive, industrial, construction, wheel alignment, laser, medical, virtual reality and robotics applications. The module has an integrated tilt sensor providing information about the slope. Slope is displayed on two LED barographs in both directions, the X-axis and Y-axis, percentage <20%, 20..40%, 40..60%, 60..80%, 80..100% and > 100%. Corresponding indication threshold slope is 100% set by the customer by operating a push button located on the electronic module when the module is tilted when the desired value. Output module is a contact type "npn" which is activated when the module is pitched on any axis and in every respect, more than the threshold set. The state of bending <20% on one axis is indicated by intermittent lighting of LED central, state slope <20% on both axes, that module in a horizontal position is indicated by continuous lighting LED center. Driving the 20 LED's is provided by using only five TTL signals with an original driving circuit.
Keyword list: tilt sensors, mechatronics, Microsystems, positioning

1. INTRODUCTION

Mechatronic assembly, figure 1, contains a two-axis tilt sensor, a microcontroller, a barograph display and stabilized power supply.

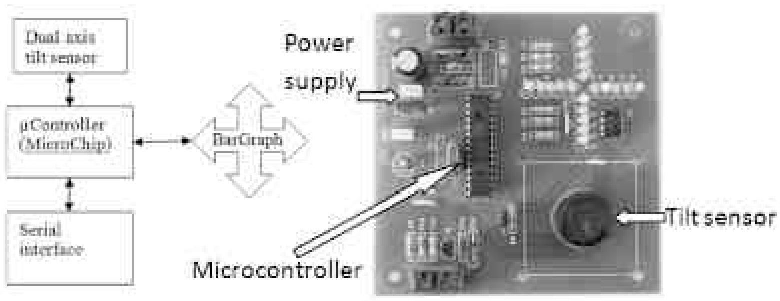

Fig.1. Mechatronic assembly

2. TILT SENSOR

DX-008 dual axis POLYMER based electrolytic tilt sensors, http://www.aositilt.com , provide economical and reliable two axis tilt solutions for applications where very good linearity, high resolution and superior symmetry are required.

Rugged construction and wide temperature range make these sensors suitable for numerous automotive, industrial, construction, wheel alignment, laser, medical, virtual reality and robotics applications. Low profile and standard pin spacing facilitate simple PCB utilization.

Tilt sensor, figure 2, contains a horizontal enclosure filled with electrolyte, fitted with five electrodes *Y1, Y2, X1, X2* and *Out*. The X-axis tilt measurement is done with electrodes *X1, X2* and *Out*, which forms a resistive half bridge whose output signal is proportional to the tilt on axis X. Similarly the Y-axis tilt measurement is done with electrodes *Y1, Y2* and *Out*. The microcontroller assures the signals for excitation of the sensor electrodes *X1, X2, Y1, Y2* and processing the signal of the electrode *Out*.

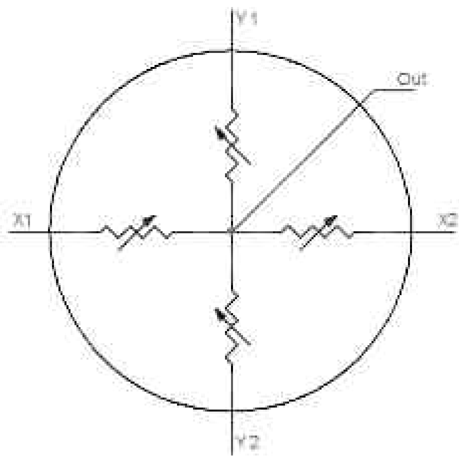

Fig.2. Tilt sensor electrical diagram

3. MICROCONTROLLER

The electronic module is build based on a general purpose PIC16F876A microcontroller, made by Microchip. Few of the main characteristics of this type of microcontroller are:

- RISC architecture with 35 instructions with one word length (14 bits);
- instructions are executed within a machine cycle except the jump instructions which need two machine cycle as execution time.
- maximum operation speed is 200 ns per instruction cycle;
- program memory is a flash memory with the capacity of 8096 instructions;
- data memory (RAM) has 386 bytes;
- parameters memory (EEPROM data memory) consists in 256 bytes;
- pin out compatible with all 28 pins microcontrollers made by Microchip;

The PIC16F876A microcontroller has a large variety of integrated peripherals such as:

- a 8 bit timer and two 16 bit timers;
- two Capture/Compare/PWM modules with the speed of 12,5 ns in Capture mode, 200 ns in Compare mode and the maximum PWM resolution of 10 bits;
- synchronous serial communication port with SPI support (Master mode) and I2C;
- USART communication port with address detection;
- brown-out detection circuit for Brown-out Reset (BOR);
- 5 channels 10 bits analog to digital converter;
- two analog comparators;
- programmable voltage reference.

The control program, written in the flash memory of the microcontroller, has been developed using the programming language ANSI C. The program consists in a initializing sequence of the integrated peripherals in the microcontroller, the main loop which consists in a state machine implementing the functionality of the electronic module and the interrupt treating routine, which realize: analog acquisition, the real time clock, the display multiplexing and handling of the emission/reception buffers for serial communication.

4. LED DRIVING CIRCUIT

Figure 3 shows the electric diagram used for driving the barograph display on two axis with 10 LED's for display of tilt value on X-axis and 10 LED's for display of tilt value on Y-axis; the central LED is handled separately. Driving the 20 LED's is provided by using only five TTL signals *I/O1*, *I/O2*, *I/O3*, *I/O4* and *I/O5*. For activate (light-on) only one LED is needed to put on cathode “0” value and put to anode “1”value; for example to activate LED *D11* (see fig. 3) is needed to put “1” on *I/O2* and “0” on *I/O4* and *I/O1, I/O3, I/O5* is needed to configure as inputs (“High Z” state).

If we provide the *n* TTL inputs/outputs *IO1…IOn* is possible to drive LED's. The *IO1* line is connected with *IO2* line with two LED's, one LED with anode at *IO1* line and cathode at *IO2* line and another one with cathode at *IO1* line and anode at *IO2* line.

Similarly connect another two LED's between *IO1* line and *IO3…IOn-1* line. The numbers of new LED's on *IO1* line is , on *IO2* line is … on *IOn-1* line is 2.

The total number of LED's is

$$\sum^{n-1} 2\cdot i = 2\cdot\sum^{n-1} i = 2\frac{n\cdot(n-1)}{2} = n\cdot(n-1) \qquad (1).$$

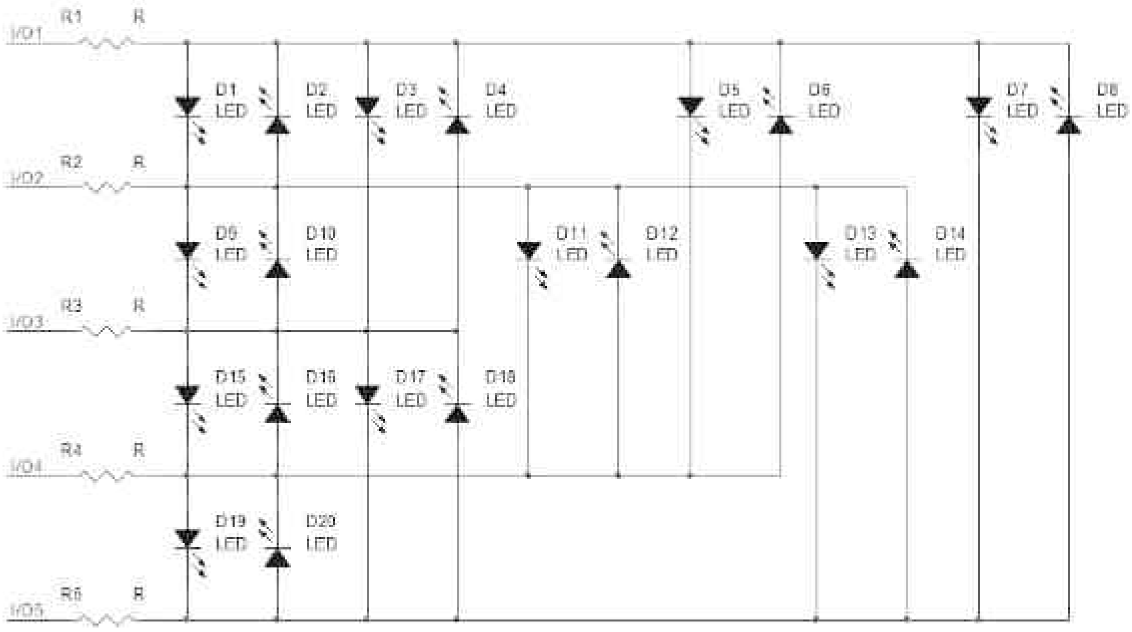

Fig.3. LED driving circuit

5. CONCLUSION

The mechatronic module for monitoring dual axis tilt have many applications in transport platform, manufacturing for maintaining horizontality or maintaining tilt etc. Rugged construction and wide temperature range make these device suitable for numerous automotive, industrial, construction, wheel alignment, laser, medical, virtual reality and robotics applications. The module has an integrated tilt sensor providing information about the slope. Slope is displayed on two LED barographs in both directions, the X-axis and Y-axis, percentage <20%, 20..40%, 40..60%, 60..80%, 80..100% and > 100%. Corresponding indication threshold slope is 100% set by the customer by operating a push button located on the electronic module when the module is tilted when the desired value.

Output module is a contact type "npn" which is activated when the module is pitched on any axis and in every respect, more than the threshold set. The state of bending <20% on one axis is indicated by intermittent lighting of central LED, state slope <20% on both axes, that module in a horizontal position is indicated by continuous lighting LED center. Driving the 20 LED's is provided by using only five TTL signals with an original driving circuit.

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MODELS USING PNEUMATIC ARTIFICIAL MUSCLES HUMAN MUSCLE SYSTEM FOR ACTIVE MOVEMENT OF THE HUMAN BODY

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Abstract

Study the mechanism of muscle contraction of the muscles biological and comparative analysis with pneumatic muscles was based on simplified models. Pneumatic muscle performance suggests that the human muscle system. Pneumatic muscle actuator module was compared with other types of actuators. Operation of the pneumatic muscles and destination sought to identify the advantages and disadvantages.

Keywords: contraction, pneumatic muscles, diaphragm, prostheses, orthoses

Since 1930 Russian inventor discovers Garasiev S. fluid element used as artificial muscle. Following studies found that the system hydraulic fluid acts on muscles based on pressure or vacuum and membrane smooth or embossed elastic or rigid. Due to pressure of 5-8 bar and values of small relationship between power and mass, using hydraulics is not attractive. For these reasons they watch features pneumatic drive system.

McKibben muscles with braided sleeve

In 1950 the cuff muscles were invented and were braided McKibben named after the inventor. Because of similarity between natural and muscles functioning of artificial muscles, J.L. McKibben wish to use it to power system ortotice arm orthosis in patients suffering from polio. McKibben muscles form an elastic tube and tightly surrounded and overlaid on the outer sleeve length of a fabric woven with nylon and aromatic polyamides. By pressurizing the twine and push the tube inside pressure is offset by its yarn tensions. Spaces of the fabric acts as a pantograph mechanisms and causes longitudinal nodes directed to approach the net, while radial nodes depart. Change angle propeller diameter and length sleeve woven edit it. During these transformations cylindrical tube tends to keep the muscle shortens and produces tension during coupling to a mechanical load.

Occurs between the tube and sleeve contact pressure required to force transmission, because this type of muscle does not act by depression. Disadvantages due to the limitation of energy accumulation and poor quality pneumatic valves have resulted in a decrease of interest in these muscles. After the 80 robotics reintroduce this type of muscle and are marketed under the name *rubbertuator* on all of Japan by Bridgestone Rubber Company and Hitachi Medical and Germany after 2000 in England by Festo and the Shadow Robot. Lately they are using more and more in the making prostheses and orthosis ortotice. Recent studies have found various uses in manufacturing pneumatic artificial muscles anthropomorphic arms with articulated hands and fingers high dexterity. Improving functional characteristics of this type of muscle were made (Tondu) and showed a power / mass values developed maximum force of 650 N for rest length 150 mm, 300 N to a shrinkage of 15% muscle and 0 N the shrinkage of 30%, all meet the pressure of 3 bar, length 150 mm, diameter 14 mm and 50 g. The mass was followed by research (Inoue) and present strength of 220 N values at rest, 100 N 10% contraction 0 N and 20% contraction at 3 bar pressure, 150 mm length and weight of 32 g. The researcher (Caldwell) presented values of 1.5 kW / kg at p = 2 bar and 3 kW / kg at p = 4 bar, while others (Winters, Hannaford) reported 5 kW / kg and 10 kW / kg, achieved without resistance valve interposed in the pneumatic circuit supply.

Pneumatic muscles was found compared with the same diameter pneumatic cylinders generates a thrust of 10 times, and air consumption is much lower for that same force is developed by the muscle with diameter of up to ten times lower than cylinder, but with the length twice as big as his. The advantage of these muscles based on simple construction and easy assembly with high strength compared to weight, the intrinsic elasticity and its automatic recommended, robotics, construction vehicles, machinery and equipment manufacturing industry, medical. Pneumatic muscles presents some disadvantages. Stabilization and muscle control is quite complicated, because the principle of operation and air flow passing through the holes variables are not linear, compressed air and pneumatic servo valves have is strong and dynamic properties. However, the pressure-displacement relationship during expansion and compression cycle was observed increased hysterics. This phenomenon is due to dry friction between sleeve and tube, the fibres between them and the elastic deformations caused by friction with the inner tube, which causes the actuator to be moved in positional control. Reliability of muscle is weak and cracks occur early. As materials for making membranes of McKibben muscles require wear resistance, tensile and abrasion rubber latexes were used, silicone rubber and chloroprene, and network wires were used nylon fibres, glass and Kevlar.

Muscle Morin

Are known since 1953 and although embedded within muscles are unfit category called "muscles", although the muscles were at McKibben and the same operating principle. Muscles form an elastic tube subjected to internal pressure or external and fixed device capable of transmitting displacement measuring instruments or similar apparatus.

Muscle Kukolj

Kukolj inventor named their muscles and muscles derived from McKibben except that place is not close to the outer tube is made of tows that loosely wrap the tube with gaps between them when the muscle is pressurized. The significance of the apparent gaps tend to contract the net faster than tubular membrane by looping its ends. Realizing the maximum extent of muscle when it is loaded but without any pressure, and when put under pressure inflates the membrane and placed it sits on.

Muscle ROMAC

Description of these muscles was performed in 1986 and was patented in the U.S. after four years by Guy Immega and Mirko Kukolj. Muscles have articulated form of balloons coated with several lobes at the ends closed with mesh and fittings. The balloon is made of tensile membrane rigid, tight and flexible. Membrane is wrapped in fine mesh made of flexible connecting elements united inextensible nodes form a rhomboid structure. Structure increases radiate, axially shrinks by 50% of its original length and changing the prominent lobes. Actuator surface is constant, the internal volume changes and deformations of the membrane do not like the pleated muscles. Adjacent lobes are connected to each other by flexible pleats or folds continue and extend below the network elements. These muscles generate relatively large forces, friction are insignificant and have the disadvantage that they are practically difficult due to complicated shape of the structure. Reduced version has a length between 1-6 cm and the standard is between 6 to 30 cm and variable forces developed between 4500-13600 N at a pressure of 7 bar.

Muscle torsion Kleiwachter

This type of muscle called his inventor and is a device equipped with a torsion inflatable membrane form a cake, attached to the outside into the inner ring and a tree. Membrane is fixed between wires placed obliquely to the radial direction from outside to inside the membrane swell and threads the central shaft rotates.

Muscle hyperboloid

This type of muscle in a state of extreme tension receives as a hyperboloid. Elastomeric membrane is fixed in place by flexible fibre inextensible, anchored at both ends with fittings. When the actuator reaches the maximum length of some linear stretch yarn from end to end, with an equal step with the rotating axis and the other part of the fibres are oriented in opposite sense. While maintaining pressure actuator membrane becomes spherical and generates a maximum contraction.

Pleated pneumatic muscles

Belgian researchers earlier this century (Dirk Lefeber and Frank Daerden) introduced pneumatic muscles "pleated" embossed membrane with radial folds and arranged lengthwise axis, which enabled it swells like a medicine ball. Like natural muscles and pleated pneumatic muscles are considered "linear motors" uni powered by compressed air. These muscles have the appearance of skeletal muscle contraction forces influencing the size, degree of shortening and shows higher values than other types of pneumatic artificial muscles. Since skeletal muscle have similar properties and role in activating the body joints, muscles may act pleated pneumatic as antagonistic pairs.

If we compare the various actuators that drive the same role, pleated pneumatic artificial muscles see that they have: large force per unit mass of 1000 W / kg at 1-5 bar pressure activation, various forces away from the constant pressure gas (compared with pneumatic cylinders where the force depends on the pressure and the piston form) intrinsic elasticity due to changes in force-displacement strength and compressibility of gas used, contractions over 50% of its original length compared with McKibben muscles and only travel to 30% possibility of operating with different pressures and forces to develop low to highest; properties explosion, fire, pollution, properties do not lose energy and volume increase membrane without deformation and without tension in the direction perpendicular to the axis of symmetry and properties of orthotropic, traction resistance and elasticity in longitudinal direction perpendicular direction, unlike McKibben muscles that lose 60% of energy and reduces the force generated, absent during the dry friction increase or return to the folds of the membrane and hysteresis in force-length relationship, compared with the friction between the tube and the braided McKibben muscles.

Powered by compressed air causes the muscle membrane which creates increasing tensions along the meridians manifested line parallel folds without tensions expressed in section perpendicular to the axis of symmetry, because in this direction membrane acts freely without resistance. Material stiffness makes unstretchable tensile membrane. These muscles to eliminate the disadvantages encountered McKibben muscles, because the membrane has no contact with foreign material, we have no friction and hysteresis, and the membrane deformation is trivial or is even smaller as the number of folds is greater. Therefore, the deformation of the membrane does not consume energy, and muscles are light and highly durable.

Contraction force exerted by these muscles depend on: activation pressure, muscle length, ratio of resting length and minimum diameter, the rate of shrinkage, membrane material characteristics. Thinner muscles will shrink more than thicker ones, almost 45%. If these muscles were larger forces obtained so on contractions of 5% was obtained F = 3300 N, 1300 N 2o% was achieved, 43% reached 0 N - the corresponding value at a pressure of 3 bar, the length rest of 10 cm minimum diameter of 2.5 cm and weight 100 g. To obtain these values membrane was made of Kevlar fibres coated with polypropylene film.

Although the elements outlined above have certain advantages, the use of special devices are not too out of order and lack of appropriate technologies for development of existing solutions. Although McKibben muscles are recognized issues facing their control and lifetime. When the elastic membrane is connected to terminal fittings are inserted rigid concentrators of membrane tension and danger that comes to sell, unlike pneumatic cylinders to not meet these problems. Although the manufacture pneumatic muscles using quality materials, all problems can be solved. Duration of pneumatic muscle can be increased depending on environmental factors, frequency and applied load. Electric drive instead recommend using pneumatic artificial muscles in robots mobile generators, large forces at low speeds and connect directly to the driven structure. The construction of prostheses and active orthosis seeks new pneumatic drive systems. On motion of knee extension (Yamamoto) was used pneumatic bellows capable of generating rotation when fed with pressurized air. The advantage is that the hysteresis is reduced solution, the disadvantage is to achieve the function of residence. Another researcher (Schulte) has equipped with a pneumatic artificial muscle manipulator arm. Others (Caldwell) McKibben muscles used to actuate a mechanical sleeve arrangement of four muscles on each finger and thumb muscles six action flexion / extension elbow and wrist of one arm anthropomorphic. Followed (Hannaford) construction of anthropomorphic arm with McKibben muscles 15 and controlled by spinal neural channels, the author has sought to improve movement in people with disabilities. ROMAC muscles were used (Grodski and Immega) degree of freedom control of an arm orthosis by stimulating myoelectric biceps and triceps of the human operator. He continued (Yoshinada) use McKibben muscles acting hydraulic underwater manipulator and using the same external drive fluid was removed weight problem. A group (Frank and Dirk Lefeber Daerden) used to drive a robot muscles pleated jumper based on the properties of energy accumulation by muscle and that the springs. Another research team are equipped with ankle orthosis of pneumatic muscles to ensure the movement of flexion-extension foot plant. Besides these company *Bridgestone* has made an arm of industrial painting, whose joints were based on pneumatic artificial muscles.

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DATA ACQUISITION EQUIPMENT FOR MEASUREMENT OF THE PARAMETERS FOR ELECTRIC ENERGY QUALITY

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Abstract
The paper presents the equipment used to measure some parameters that characterize the electric energy quality.
The proposed equipment performs test and acquisition of analogue data (U and I) and numerical data. The sampled data are recorded when preset thresholds are exceeded by the analogical inputs or when the digital inputs states change. The fixed variant is supplementary provided with 2 analogue outputs and 8 numerical outputs. The operation of equipment is simulated and the corresponding software are exemplified for the case of a highly distorting consumer, a set of electric energy quality parameters being determined for this case.

1. INTRODUCTION

The recent implementations based on power electronics provide a lot of advantages related to the designing of some high power electrical drives with variable speed, such as the increase of driving system performances. Unfortunately this kind of equipment added new quality problems to the existing ones. The new problems are related to the electric nature waveforms distortions, with direct impact over the consumers supplying [1], [2], [5], [7].

The energetic effects that affect the electric energy quality must be precisely evaluated in order to their consecutive limitation. The quality parameters measurement is related to the existing voltage level, to the data acquisition time speed, to the employed numeric algorithms, etc. [9], [10] Test and isolated implementations were recently performed in our country and abroad, but none became a market leader.

2. GENERAL DESCRIPTION OF THE EQUIPMENT

In order to determine some of the electric energy quality parameters and also to achieve a complex equipment that should be able to determine some other quantities and unpleasant phenomena, a modular portable system was conceived. The main functions provided by it are:

- determination of electric energy quality parameters that should consequently result in measures for improving of qualitative and quantitative efficiency of energetic consumptions;
- events recording, in order to detect the faults causes and the repeated connections and disconnections over electric lines.

The equipment modular designing makes possible the realization of a family of fixed and portable systems for tests and data acquisitions. Due to its modular conceiving, the system provides:

- acquisition of 9/16 analogue inputs and 6/32 numerical inputs by means of circuits that perform the conditioning of analogue signals compatible to the electric quantities supplied by the electro-energetic systems;
- portable variant will be supplementary equipped with 2 analogue outputs and 8 numeric outputs for simulations, tunings and tests;
- non-volatile recording of finite number of records;
- connection through a serial line of a PC compatible computing system for data loading corresponding to the recordings that present interest.

3. EQUIPMENT's FUNCTIONS

The equipment family provides the following functions:
- test and acquisition of analogue data (voltages, currents and powers) and respectively of numeric data (switching apparatus state) for nodes of the electro-energetic system where the distorting regimes occur;
- numeric processing of data, in order to determine the energetic parameters, the performance indices concerning the electric energy quality;
- recording, evaluation, administering and displaying along periods of the consumptions and events concerning the deviations from the quality of the used electric energy;
- permanent monitoring of the energetic parameters;
- faults detection and localization;
- signalization when some quality indices standardized values are exceeded.

A series of facilities are provided, as follows:
- determination of data corresponding to the voltages and currents for phases and neutral wire. The apparatus input voltages are supplied either by some voltage transformers secondary windings with a rated value of 100 V a.c., or by instant values transducers. The apparatus input currents are supplied either by some current transformers secondary windings with a rated value of 1 A a.c., or by instant values transducers.

- consumptions evaluation;
- evaluation of analogue quantities, separately for each phase (RMS values, initial phases of currents and voltages harmonics, spectral analysis);
- displaying of time variations for quantities (currents, voltages) , state of switches from the distribution utilities;
- real time clock, non-volatile memory, graphical display of extended sizes 75 x 140 mm;
- analysis and determination in the three phase network of the following parameters:
- phases and neutral impedances;
- direct, reversed and homopolar components of the unbalanced systems of voltages/currents;
- determination of the survived element operation regime (load, idle, voltage missing, fault, etc).

The estimated and recorded data are processed by means of a soft package that allows:
- harmonic analysis of measured quantities (voltages and currents) ;
- computation of electric energy quality indices based on an unitary theory, according to European standards;
- displaying, on request, of some electric parameters: active and reactive electric energies, active, reactive and distorting powers, power factor, currents, voltages, frequency;
- displaying on request of superior harmonics weights for voltages and/or currents;
- detection of normal rapid variations and of accidental unbalancies from the three phase systems of voltages and currents;
- recording, evaluation and displaying for a month of the events corresponding to the electric energy quality deviations;
- prescription of thresholds both for the quantities estimated in the system and respectively for the estimated quantities; when the respective thresholds are reached, sound and optic alarms are generated;
- obtaining of the main energetic parameters situation.

The software packet relies on the existing national and European standards and takes into account the correlations between both standards. The considered standards are: PE 143/94, IEC 60664, ANSI-IEEE 519, CEI 1000-2-4 [9].

4. TECHNICAL FEATURES

The equipment presents the following characteristics:
- Number of monitored and evaluated lines:
  - 3 (test variant 3 voltages and 2 currents) ;
  - 2 (test variant 3 voltages and 3 currents) ;
- Analogue outputs (fixed variant): 2;

- Tests accuracy:
- U, I………..0,5%
- P, Q, S, D…1%
- Frequency…0,05%
- Active/reactive energy …according class 2 IEC1268
- Distortion coefficient I/U…2%
- Storing capacity: 256 KO ... 8MO (depending on variant);
- Period of recording: 3 sec - 12 min, equivalent of maximum 240 events, each of 3 seconds; the records are non volatile;
- Supplying: 230 V c.a / 50 Hz; -15% ... +15%; and battery 12V.

5. UTILIZATION OF EQUIPMENT FOR THE DETERMINATION OF SOME ELECTRIC ENERGY QUALITY PARAMETERS

The equipment was tested under normal operation conditions, taking data from a connection point of a major distorting three phase consumer. The sampling frequency was 3,6 kHz.

For the beginning the distorting three phase receiver voltages and currents waveforms were recorded. The recorded signals were afterward acquisitioned. Based on an original processing algorithm, the harmonics analysis was performed, considering the EU standards (in order to obey the European standards while considering the specific of Romanian consumers and networks) [6]. The recorded three phase voltages waveforms are depicted by fig,1(a) and those corresponding to currents are depicted by fig. 1(b). Using the decomposition algorithm mentioned above, the first 40 harmonics of current and voltage were determined. The signals recomposed from the first 40 harmonics of the first phase voltage together with the significant harmonics from the u1 waveform and their initial phases are depicted by fig. 2.

In fig. 3 we represented the signal recomposed from the current through phase 1, compared to the initial signal (Fig. 3(a)), along with the harmonics magnitudes from the i1 waveform (Fig,3(b)) and their initial phases (Fig.3(c)).

Based on the harmonic decomposition we could determine some coefficients related to the electric energy quality corresponding to phase 1 [3]:

- for u1: RMS value: 3.8984e+002 V; peak factor: 1.4024e+000; shape factor: 1.0988e+000; VTHD 1: 1.0264e+000;
- for i1: RMS value 7.2715e+000 A; peak factor : 1.3890e+000; shape factor: 1.1534e+000; ITHD 1: 1.3631e+001

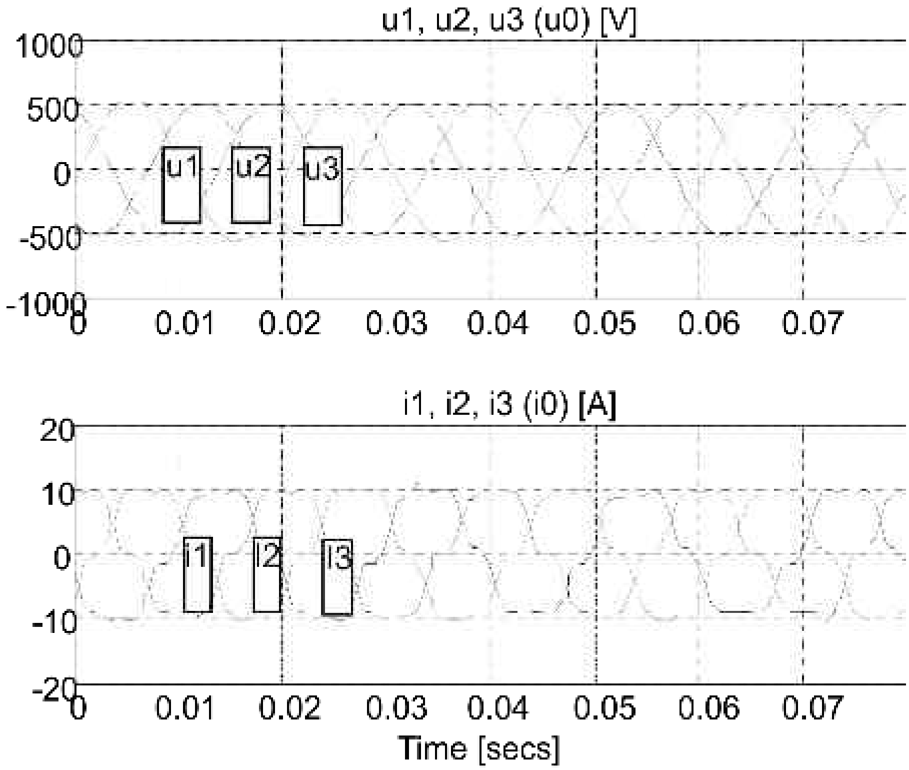

Fig. 1. Three-phase voltages and currents from system

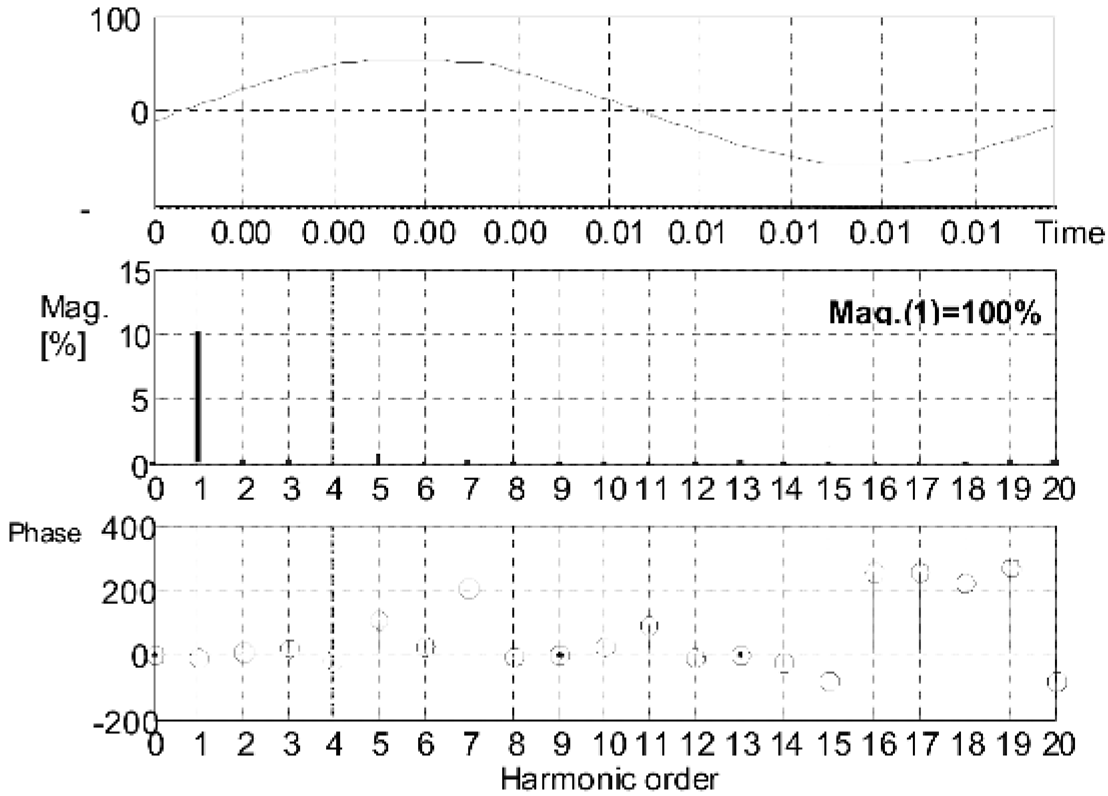

Fig. 2 Voltage u1 – Signal reconstructed from 40 harmonics superposed over the original signal

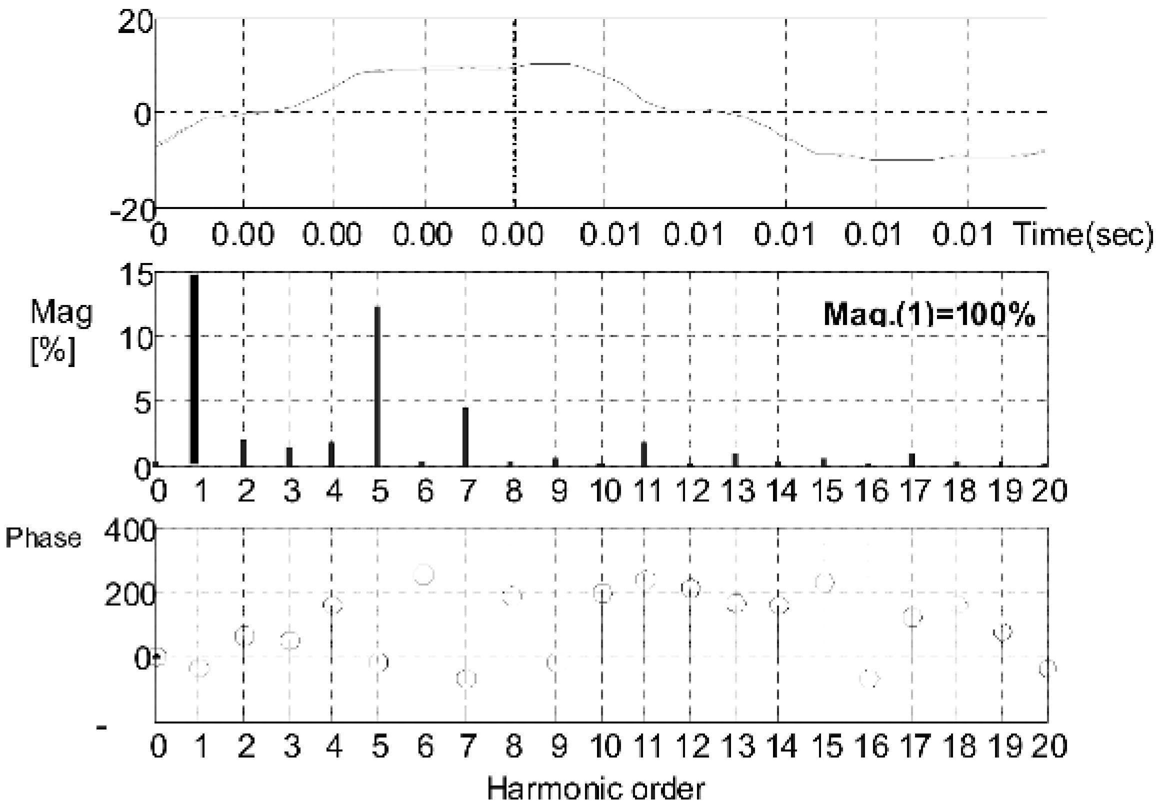

Fig. 3. Current i1 signal reconstructed from 40 harmonics superposed over the original signal

The analysis also proved that the three-phase system is symmetric, so that for the analyzed consumer the problems related to the electric energy quality are actually those related to the distorting regime [8].

4. CONCLUSIONS

As far as we are awared, in Romania there is no equipment similar to the one presented in this paper. Famous manufacturers as Chauvin Arnoux/ Enerdis France, Siemens Germany, Schneider France, General Electric SUA, Circutor Spain produce equipment that provide only partial similarities to it.

The manufacturers we analyzed make efforts to modernize the test principles, to use small size transducers, provided with local intelligence and respectively to increase the number of facilities provided by the equipment: functions for rapid electric events recording, simultaneously with the recording of electric parameters along long periods, SCADA compatibility, electric energy quality analysis, etc.[3], [4]. This test principle results in an increase of test accuracy, operation safeness and improved reliability.

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SNOW CLEANING ROBOT

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ABSTRACT

This paper presents the actual status of snow cleaning robots, the main methods used in this field and a architecture for a autonomous robot. As this robot navigates through unforeseeable space the sensoristic part is the most important part of this project .There are presented the sensors needed for moving, searching, control and detection accordingly to the plan action needed.

INTRODUCTION

In the present time there are well know a multitude of snow cleaning methods ,starting from the simple ones and already considered classics to methods who benefit from large technological development and applies new ideas ,constructive solutions or innovative materials.

There are two main generic families for cleaning the snow

- Mechanical methods – methods in which the snow is remove from certain spaces (streets, sidewalks, public squares) with the help of mechanical machines
- Chemical methods – methods in which the snow is removed by applying different types of chemical substances who have a double role: melting down the snow and stopping the water from icing

Mechanical methods for cleaning the snow

It can be observed that although the work methods and many of the mechanical execution elements can be found in many types of cleaning snow machines, there can be spotted differences regarding with the type of action of this elements and the movement module:

- Manual
- Electric
- Internal combustion motors

Honda Model HS724TA

Taking notice of the operating possibilities there can be mentioned the following snow cleaning methods related to the type of the elements used to clean the snow

- Removing the snow by using cleaning razors and discharging the snow on the side of the road with shapes and ways to operate
- Removing the snow by using collecting mechanisms and discharging the snow on the side of the road
- Removing the snow by collecting and throwing it outside the useful space
- .Removing the snow by combing one of the two first presented methods and removing the snow outside the useful space

Cleaning the snow with mechanical methods presents a series of advantages:

- time needed for removing the snow reported to the quantity/aria is much smaller than the chemical method therefore allowing faster resuming of the traffic
- quantity of removed snow is larger than in chemical methods
- there are not needed preliminary or during the work preparations for operations/devices
- Access to snow areas/objectives is fast
- This method don't attack or chemical degrade the area in which the snow is placed

On the other hand the mechanical method also presents some disadvantages

- Tools needed have high prices
- Tools needed for removing the snow are action mostly by internal combustion motors which consume petrol fuels
- In the case of wrong manipulation of the device, the superficial layer of the area can be mechanical affected
- The snow removed from street must be discharged in the closed proximity therefore it can create problems related to limited access/blocking certain objectives on the sidewalk
- Maintenance of this devices requires a well organized space and certain condition during the time there are not used

Chemical methods for snow cleaning

A chemical method represents the treatment of snow with certain chemical substance in the area that needs to be cleared. These substances melt the snow (ice) and keep the water from icing

Methods can different by the nature of the substance that is used

- Solid particles
- Liquid solutions

Similarly to mechanical methods also the chemical ones present a series of advantages

- Low prices
- There are not needed highly powered action motors
- In general all the procedure is simple and the time needed for deploying chemical substances is low
- In the case of snowing forecast , the substances can be deployed before the actual snowing therefore there are creating a environment in which the snow will melt immediate
- Many substances can be combined for better effects , like for snow melting and antiderapant effect

Disadvantages for chemical methods:

- Time needed for snow melting is high and this method can not be implement for immediate effect
- Snowing quantity that is melt is less compared to the mechanical method
- Losing of essential time due to recharging
- Access to specified area could be difficult if the layer of snow is large
- Ecological impact should be analyzed
- The risk of effect/risk of decaying the area should be analyzed
- The population should be warned about the possible negative effects

Tyler Ice Control Solution de-icers

Small compact unit size for ramp work

Tank size set between 875…3500 liters (stainless steel or poly)

Tank includes 3 sections

Product pump capacity of 180 GPM allows for loading and off-loading and transferring of liquid from one compartment to another

Convenient pump station location, safe and easy to operate

Electrically operated boom shutoff valves.

Flow based ground speed control system.

Fan equipped exhaust system

Stainless steel spray bar system.
18hp Kohler engine.

Tank size: 1890, 3780, 7560, 9450, 15120, 18 900 liters

Pump mounted in a safe and accessible location

Flow control system

Internal or external shutoff valves

Stainless steel tank

Truck or trailer mounted

Pump flow between 100 and 2200 l/min

Fixed or cab controlled washers

Optional hose reel.

Autonomous cleaning robots

Autonomous robots are robots which can perform desired tasks in unstructured environments without continuous human guidance. Many kinds of robots have some degree of autonomy. Different robots can be autonomous in different ways. A high degree of autonomy is particularly desirable in fields such as space exploration, cleaning floors, mowing lawns, and waste water treatment.

A fully autonomous robot has the ability to

- Gain information about the environment.
- Work for an extended period without human intervention.
- Move either all or part of itself throughout its operating environment without human assistance.
- Avoid situations that are harmful to people, property, or itself unless those are part of its design specifications.

An autonomous robot may also learn or gain new capabilities like adjusting strategies for accomplishing its task(s) or adapting to changing surroundings.

Autonomous robots still require regular maintenance, as do other machines

Plan acting and sensors for snow cleaning robots

A GPS sensor is placed on the robot allowing it to receive satellite signals. This is used for orientation so as the robot will know the right path to follow and when it will the path finish
Compass sensor provides the direction to Nord. There are two types of compass sensors: magnetic and gyroscopic
- The magnetic direction sensors measure the Earth magnetic impact and extract the horizontal component to show the direction to North
- The gyroscopic direction sensors is made from a gyroscope who under the influence of gravity and Earth rotation show the real north direction
Encoders are mounted on the wheels and it has the purpose to convert the rotation of the wheels in impulses

Work Mode		Command	Sensors used for the activity
1	Moving of the robot	Motor	- direction sensors - GPS - Ballista - Moment transducers
2	Searching for snow	Motor	- direction sensors - temperature sensors - ultrasonic sensors network
3	Gathering snow control	- Motor - device for gathering snow	- frontal bumpers for snow size detection and density -direction sensors -GPS -ultrasonic sensors network -Temperature sensors for live beings detection
4	Finishing work and returning	Motor	- direction sensors - GPS -weight sensors -sensors for altitude

In case of obstacle/ live person in proximity, the robot could take 3 decisions:

- STOP until the obstacle removes himself off the path (only for live beings)(A)
- Obstacle avoidance (B)
- Pursuing of another path (C)

In case of obstacle/ live person at a certain distance, the robot could take 3 decisions:

- STOP until the obstacle removes himself off the path (only for live beings)(A)
- Keep walking until the obstacle is in proximity
- Pursuing of another path (C)

The robot is in permanent contact with the dispatch for permanent knowing of location (for the case of stealing or aggression against) and also provided with a black box in witch all the operations should be stocked

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TEHNICI DE FILTRARE NUMERICĂ A SEMNALELOR PENTRU SISTEMELE DE COMANDĂ A DISPOZITIVELOR HIDRO-PNEUMATICE

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1. INTRODUCERE

Sistemele numerice de comandă şi control pentru echipamente hidropneumatice necesită putere de calcul suficientă pentru algoritmii digitali de reglare din familia PID(Proportional, Integrative, Derivative) şi dimensiuni reduse pentru a putea fi înglobate în respectivele echipamente. Utilizarea sistemelor de calcul clasice cu microprocesor şi circuite periferice separate nu permite obţinerea gradului dorit de miniaturizare şi de aceea se folosesc în mod curent sistemele bazate pe microcontrolere şi sisteme într-un chip. Microcontrolerele moderne dispun de o serie de module funcţionale analogice şi digitale integrate ce uşurează dezvoltarea aplicaţiilor de comandă şi control, atât din punct de vedere hardware(se simplifică logica de interfaţă, cablajul imprimat, scade consumul de energie şi se reduc problemele de compatibilitate electromagnetică).

Modulele electronice de comandă existente în industrie includ un număr ridicat de componente analogice – amplificatoare operaţionale, comparatoare şi componente discrete. Trecerea la electronica digitală, prin utilizarea de microcontrolere cu resurse bogate de memorie şi elemente periferice permite integrarea unei mari părţi a subsistemului electric într-o singură componentă (fig. 1). Tendinţa este de integrare a funcţiilor într-o singură capsulă SoC (System on Chip) sau în cazul unui număr mare de funcţii integrare de tipul SoP (System on Package).

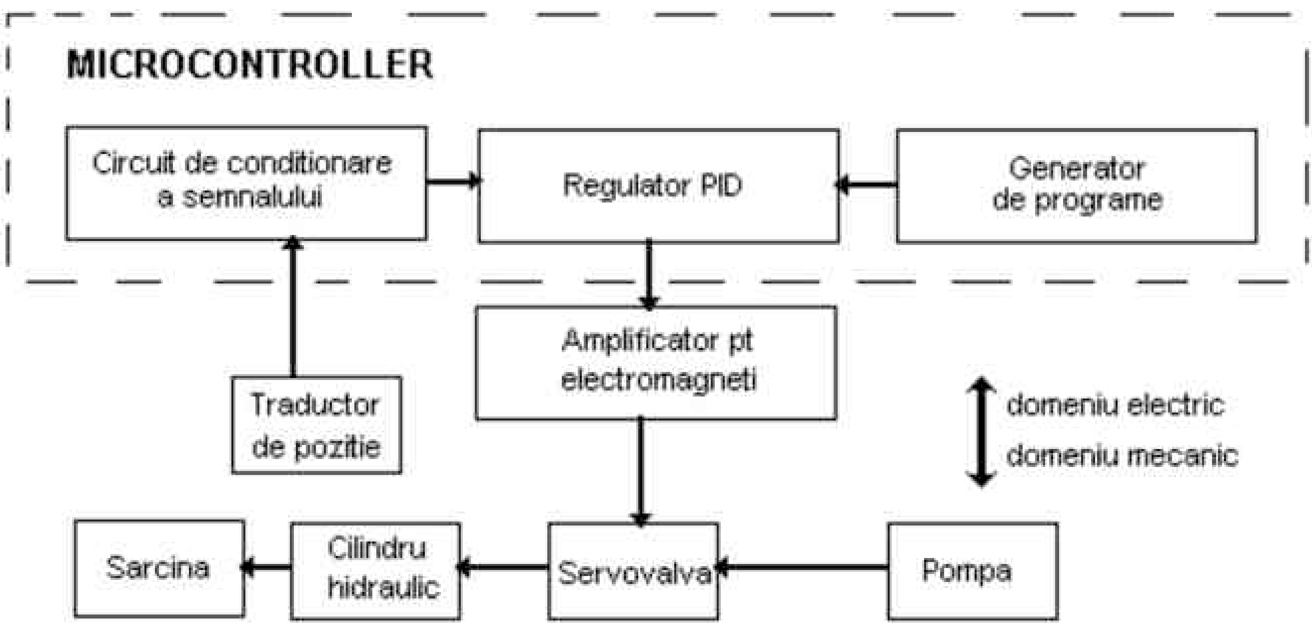

Fig. 1 Sistem de reglare a poziţiei – schemă bloc cu evidenţierea utilizării microcontrolerului

Performanţele cerute microcontrolerului utilizat sunt determinate de blocurile a căror funcţionare trebuie să o realizeze, acestea fiind:

§ Pentru a realiza funcţia de condiţionare a semnalului de la traductorul de poziţie, microcontrolerul trebuie să posede convertor AD (preferabil cu referinţă de tensiune integrată) de minim 8 biţi şi cât mai rapid; frecvenţa sa de eşantionare dictează performanţele dinamice ale sistemului de reglare

§ Regulatorul PID presupune efectuarea unei serii de operatii matematice (adunări şi înmulţiri) astfel că este de dorit o viteză cât mai mare de execuţie; datorită timpului mare de realizare a unei multiplicări soft este absolut necesară existenţa unui multiplicator hard în unitatea aritmetica şi logica (ALU) a procesorului

§ Comanda amplificatorului pentru electromagneţi se face analogic; este necesar astfel ca microcontrolerul să posede un convertor DA sau ieşire PWM

§ Generatorul de programe realizează temporizări şi semnale cu anumite forme de undă; pentru aceasta sunt necesare circuite Timer/Counter şi spatiu suficient de memorie (prin tabelare în memorie se pot genera cu precizie foarte bună forme de undă arbitrare sau predefinite – rampe, sinusoide, semnal dreptunghiular)

2. ASPECTE TEORETICE

Reglarea numerică presupune utilizarea de tehnici speciale de procesare a semnalelor şi de reducere a zgomotului. Semnalele de intrare, înainte de a fi prelucrate în regulatorul numeric, sunt procesate în vederea reducerii zgomotului.

Această operaţiune este de fapt o filtrare a semnalului. Orice sistem de reglare numeric conţine şi un subsistem de filtrare a datelor măsurate.

Filtrarea semnalelor reprezintă o operaţie de bază în prelucrarea informaţiei obţinute pe cale experimentală. Filtrarea poate fi făcută analogic (cu reţele de tip RLC sau cu calculatoare analogice), fie numeric, cu circuite logice sau cu microprocesoare.

Principalele avantaje ale filtrelor numerice, comparativ cu cele analogice sunt: dimensiunile mai mici, performanţele mai ridicate, stabilitatea şi precizia sporite, nu ridică probleme legate de adaptarea impedanţelor şi prezintă flexibilitate mărită în reconfigurare sau ajustare.

Filtrul numeric poate fi descris matematic printr-un operator P, care transformă mărimea de intrare x(nT) în mărimea de ieşire y(nT), conform următoarei relaţii:

$$y(nT) = P[x(nT)] \tag{1}$$

Filtrele numerice fac parte din clasa sistemelor liniare.

Expresia generală a semnalului eşantionat este de forma:

$$x(nT) = \sum_{k=0}^{\infty} x(kT)\delta(nT - kT) \tag{2}$$

Răspunsul filtrului la impulsul unitate (nT-kT) este:

$$y(nT) = \sum_{k=0}^{\infty} x(kT)P[\delta(nT - kT)] = \sum_{k=0}^{\infty} x(kT)h_k(nT) \tag{3}$$

unde hk(nT) este funcţia pondere, adică răspunsul filtrului numeric la impulsul unitate, aplicat la momentul k=n. Deoarece filtrele numerice sunt sisteme invariante în timp, pentru mărimea de intrare (nT-mT) răspunsul va fi h(nT-mT).

Relaţia precedentă capătă forma:

$$y(nT)=\sum_{m=0}^{\infty}x(nT)h(nT-mT)=\sum_{m=0}^{\infty}x(nT-mT)h(mT)$$
$$=x(nT)*h(nT)=h(nT)*x(nT) \qquad (4)$$

unde ultimele două relaţii matematice reprezintă produsul de convoluţie al celor două secvenţe x(nT) şi h(nT). Produsul de convoluţie este comutativ.

Stabilitatea şi cauzalitatea sunt cele mai importante proprietăţi ale filtrelor numerice. Stabilitatea se referă la proprietatea de mărginire a semnalului de ieşire pentru un semnal de intrare mărginit. Această condiţie se transpune matematic sub forma:

$$|x(nT-mT)|<M$$
$$\sum_{m=0}^{\infty}|h(mT)|<N \qquad (5)$$
$$|y(nT)|\le M\sum_{m=0}^{\infty}|h(mT)|<MN$$

Cauzalitatea semnifică faptul că niciodată semnalul de ieşire nu-l precede pe cel de intrare.

După modul cum sunt realizate, există două tipuri de filtre:

- recursive, la care mărimea curentă de ieşire depinde de valorile anterioare ale mărimii de ieşire precum şi de valorile curentă şi anterioară ale mărimii de intrare:

$$y(nT)=\sum_{i=0}^{r}L_i x(nT-iT)-\sum_{i=r+1}^{m}K_i x(nT-iT) \qquad (6)$$

unde L_i şi K_i sunt coeficienţi reali, constanţi;

- nerecursive (transversale, cu memorie finită), la care mărimea de ieşire se exprimă explicit în funcţie de valorile prezentă şi anterioară ale mărimii de intrare:

$$y(nT)=\sum_{i=0}^{r}L_i x(nT-iT) \qquad (7)$$

După tipul funcţiei pondere h(nT) filtrele pot fi:

- filtre cu răspuns de durată finită (FIR), caracterizate prin h(nT) finit:

$$h(nT)=0,\ \text{dacă}\ n>N_1<\infty$$
$$h(nT)=0,\ \text{dacă}\ n<N_2>-\infty \qquad (8)$$
$$N_1>N_2,\ \text{finite;}$$

- filtre cu răspuns de durată infinită (IIR), caracterizate prin h(nT) infinit; nu există N_1 şi N_2 ca în cazul precedent.

Filtrele FIR sunt de obicei nerecursive, în timp ce filtrele IIR sunt recursive.

3. IMPLEMENTAREA TEHNICILOR DE FILTRARE NUMERICĂ

Cea mai simplă metodă de filtrare numerică este medierea. Avantajul major este faptul că presupune o singură operaţie de înmulţire, deci se execută rapid pe unităţi de calcul de putere redusă cum sunt microcontrolerele pe 8/16 biţi. Atunci când semnalul măsurat cu un microsistem bazat pe microcontroler conţine zgomote, vârfuri datorate fluctuaţiilor tensiunii de alimentare şi alte componente de semnal nedorite se recomandă medierea rezultatelor convertorului ADC. Există diferite metode simple de realizare a acestui lucru, printre care:

-Supraeşantionarea – se efectuează mai multe măsurători iar media acestora este luată în considerare pentru prelucrările ulterioare

-Medierea continuă – se utilizează un buffer circular pentru stocarea rezultatelor iar valoarea trimisă pentru prelucrare în rutinele următoare se obţine prin medierea valorilor din buffer

-Sumare ponderată – valoarea veche şi noul rezultat al măsurătorii se adună iar rezultatul se înjumătăţeşte. Rezultatul se salvează şi se procesează mai departe.
-Rejectarea valorilor extreme – valoarea maximă şi cea minimă dintr-un lot de măsurători sunt ignorate iar celelalte valori se procesează mai departe.
-Sincronizarea măsurătorilor cu frecvenţa reţelei

Supraeşantionarea

Supraeşantionarea este cea mai simplă metodă pentru prelucrarea rezultatelor măsurătorilor: N eşantioane sunt însumate iar rezultatul este împărţit la N sau, uneori, este utilizat aşa cum este. În cazul în care se utilizează corecţii de tip Slope şi Offset se poate utiliza urmatoarea formulă:

$$V_{normal} = Slope \times ADC + Offset \quad \rightarrow \quad V_{supraesantionare} = \frac{\sum (Slope \times ADC + Offset)}{N} \tag{9}$$

Un exemplu de implementare a algoritmului de supraeşantionare pentru un sistem de achiziţie bazat pe un microcontroler performant pe 16 biţi este prezentat în continuare. Se foloseşte limbajul de asamblare specific respectivului microcontroler, din familia Texas Instruments MSP430.
De exemplu, N măsurători cu ADC12 trebuie adăugate în variabilele SUMLO şi SUMHI.

Numărul N este definit în variabila N_ADC. Dacă N<16, variabila pe 16 biţi SUMLO este suficientă pentru păstrarea valorii sumei întrucât valoarea maximă a unei conversii ADC este 7FFh (12 biţi pe 1 logic) iar 16*7FFh = FFF0h < FFFFh. Codul în limbaj maşină asociat este editat în forma standard, instrucţiunile în partea stângă, comentariile în partea dreaptă, separate prin semnul punct şi virgulă.

```
SUMLO  EQU      R4              ; suma valorilor masurate,LSB
SUMHI  EQU      R5              ; suma valorilor masurate, MSB
N_ADC  EQU      R6              ; numarul de valori ADC sumate
;
              MOV     #32,N_ADC
              CLR     SUMLO
              CLR     SUMHI
OVSLOP        CALL    #MEAS_ADC12 ; rezultatul conversiei in
ADC12MEM0
              ADD     &ADC12MEM0,SUMLO
              ADC     SUMHI
              DEC     N_ADC
              JNZ     OVSLOP
```

Dezavantajele supraeşantionării sunt consumul relativ ridicat de energie datorită numărului mult mai mare de achiziţii ADC şi viteza maximă teoretică de eşantionare mai mică (de N ori) iar avantajele sunt programarea mai simplă, rezoluţia îmbunătăţită prin sumarea a N rezultate ale măsurătorilor şi reducerea influenţei valorilor extreme.

Medierea continuă

O metodă foarte rapidă şi simplă în acelaşi timp de mediere a semnalelor digitale este medierea continuă (Continuous Averaging): într-un buffer circular se scrie cea mai nouă măsurătoare iar cea mai veche este eliminată din buffer (practic, bufferul fiind circular, cele două măsurători au aceeaşi adresă RAM astfel că valoarea nouă suprascrie valoarea cea mai veche). Pentru minimizarea timpului de calcul, valoarea veche este scazută din sumă iar valoarea nouă este adaugată. Suma, stocată în variabila CFSUM, este o valoare pe 32 de biţi şi contine practic N rezultate ale măsurătorilor. Variabila CFSUM va fi utilizată în programul principal la procesări ulterioare.
Trebuie avut în vedere că această valoare nu este media aritmetică a măsurătorilor, ci suma lor, deci de N ori mai mare decât media. Răspunsul în frecvenţă al medierii continue este similar unui filtru pieptăne, deci se obţine o atenuare puternică a anumitor frecvenţe de anumite valori raportate la frecvenţa de eşantionare (de exemplu în figura 2, de 4, 8, 16 ori mai mici).

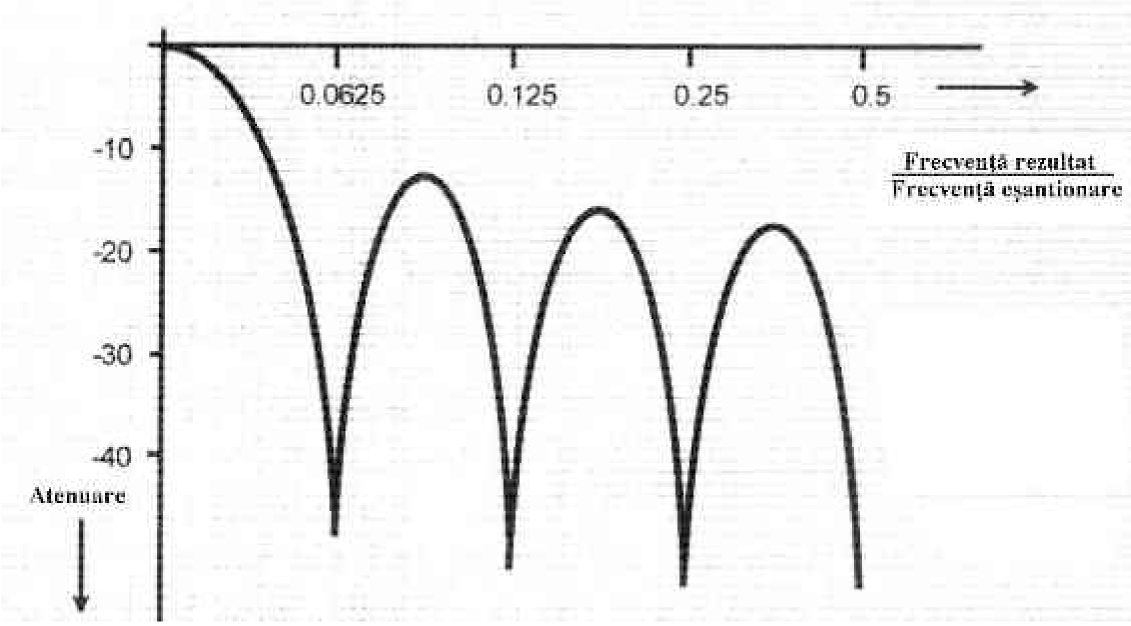

Figura 2 Răspunsul în frecvenţă al medierii continue

Dezavantajul metodei constă în utilizarea a N cuvinte de memorie RAM pentru bufferul circular, dar avantajele sunt numeroase – consum de curent redus, întrucât pentru fiecare valoare rezultată e necesară o singura măsuratoare, rezoluţie îmbunătăţită prin sumarea a N măsurători, actualizare rapidă a bufferului circular şi buna rejecţie a anumitor frecvenţe (submultipli ai frecvenţei de eşantionare).

Implementarea practică a medierii continue se poate face utilizând întreruperile. O rutină lansată de o intrerupere (de exemplu întreruperea sfârşit conversie a ADC12, conversie pornita de Timer_A sau Timer_B) actualizează conţinutul bufferului circular cu N valori. Suma CFSUM se actualizează prin scăderea valorii celei mai vechi şi adaugarea celei mai noi. Variabilele CFSUM şi CFSUM+2 conţin întotdeauna suma ultimelor N măsurători. Codul sursă este urmatorul:

```
N           EQU      16
CFSTRT      DS       N*2
CFSUM       DS       4
CFPOI       DS       2      ; pointer la valoarea cea mai veche
...
CFHND       PUSH     R5
            MOV      CFPOI, R5
            CMP      #CFSTRT+(N*2),R5
            JLO      CF00
            MOV      #CFSTRT,R5
; valoarea cea mai veche e scazută din CFSUM, valoarea noua o
suprascrie şi e
; adaugată la CFSUM
CF00        SUB      @R5,CFSUM
            SBC      CFSUM+2
            MOV      &ADC12MEM0,0(R5)
            ADD      @R5+,CFSUM
            ADC      CFSUM+2
            MOV      R5,CFPOI
            POP      R5
            RETI
```

Sumarea ponderată

Sumarea ponderată a măsurătorilor anterioare şi valoarea actuala sunt mediate aritmetic iar rezultatul este stocat. Metoda acordă fiecărei măsurători o anumită pondere (fie T perioada eşantionării).

Moment de timp	t_0	t_0-T	t_0-T	t_0-T	...
Pondere	0.5	0.25	0.125	0.0625	...

Tab. 1 Coeficienţii pondere pentru medierea continuă

Dezavantajul metodei este că eventualele vârfuri corespunzătoare zgomotului sunt insuficient atenuate, întrucât sunt divizate numai cu 2. Ca avantaje se pot enumera consumul de curent redus (datorită necesităţii unei singure masurători per rezultat), codul scurt şi rapid şi consumul redus de RAM – numai un cuvânt.

Implementarea în limbaj maşină este simplă (suma actualizată este în WSSUM):

```
WSSUM       DS       2
...
WSHND       ADD      &ADC12MEMO, WSSUM
            RRA      WSSUM                   ; divizare cu 2
            ....                             ; mai departe cu suma
```

A doua variantă este rotunjirea noii valori obţinute prin adunarea unui termen 0.5 (2^{-1}) cu ajutorul fanionului Carry.

```
WSHND       ADD      &ADC12MEMO, WSSUM
            RRA      WSSUM                   ; bitul LSB în Carry
            ADC      WSSUM
```

Prin utilizarea pachetului de calcule în virgulă mobilă se pot face sumări ponderate şi cu alţi coeficienţi pondere în afară de puterile lui 2. Dezavantajul este consumul mai mare de resurse şi viteza de calcul mult mai scăzută.

Eliminarea valorilor extreme

Această metodă de mediere presupune realizarea a N+2 măsurători şi eliminarea dintre ele a valorii celei mai mari şi a celei mai mici. Cele N valori rămase sunt mediate aritmetic iar această valoare este utilizată mai departe, sau se pot însuma numai (ceea ce conduce la o rezoluţie de reprezentare mai bună, dat trebuie avut în vedere că suma este în medie de N ori mai mare decât valoarea unei măsurători).

Avantajul metodei este dat de programarea simplă, atenuarea foarte buna a vârfurilor (nu sunt utilizate!), consum moderat de memorie (doar N+2 cuvinte). Dezavantajos este consumul relativ mare, întrucât sunt necesare N+2 măsurători pentru un rezultat.

Implementarea se realizează relativ simplu: datele de la cele N+2 măsurători sunt salvate într-un buffer de N+2 cuvinte care este baleiat pentru sumare şi în acelasi timp se determină valoarea maximă şi cea minimă, iar apoi se scad aceste valori din sumă şi eventual se realizează împărţirea acesteia la N. Pentru o viteză mai mare se recomandă ca N să fie putere a lui 2 pentru ca împărţirea să se poata face prin deplasări la dreapta.

Sincronizarea măsurătorilor cu frecvenţa reţelei. În cazul în care zgomotul de reţea afectează puternic măsurătorile se poate utiliza sincronizarea achiziţiei de date cu frecvenţa reţelei. Figura 3 ilustrează principiul metodei: se incearcă reducerea efectului tensiunii reţelei asupra semnalului generat de un senzor.

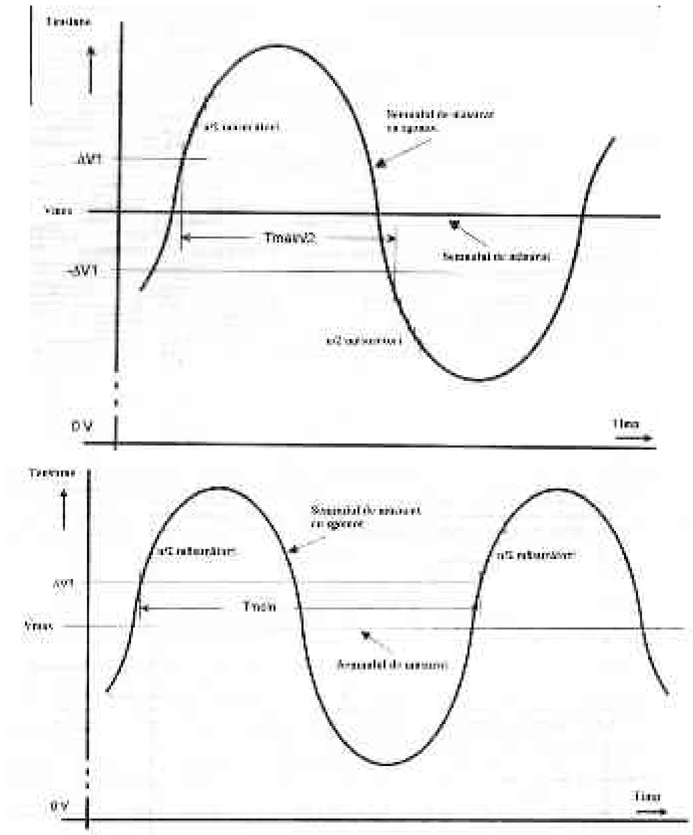

Figura 3 Metoda sincronizării măsurătorilor cu frecvenţa reţelei

Numărul necesar de măsurători, N=10 în cazul de faţă, se împarte în doua părţi egale, iar a doua serie va avea loc exact după o jumatate de perioadă a frecvenţei reţelei $T_{main}/2$ faţă de măsurătorile din prima serie. Datorită faptului că sin(pi+x) = -sin(x) rezultă că însumând rezultatele măsurătorilor se vor forma perechi Asinx, Asin(pi+x) reprezentând zgomotul de la reţea care se vor anula, deci se minimizează influenţa zgomotului de 50Hz (a brumului). În cazul în care este necesară o măsurare se poate aplica aceeaşi tehnică de utilizare a proprietăţilor funcţiei sinus, dar nu cea indicată mai sus pentru că amplifică zgomotul. Astfel, în acest caz diferenţa între măsurători trebuie să fie o perioada completă a frecvenţei reţelei pentru că sinx=sin(2pi+x).

Metoda de mai sus se aplică, de exemplu, în contoarele de energie termică, pentru că acestea trebuie să masoare diferenţa între temperatura apei pe tur şi pe retur pentru a calcula energia. Pentru generarea şi masurarea intervalului de timp T_{main} se poate utiliza un modul timer disponibil al procesorului.

4. CONCLUZII

Reducerea zgomotului în sistemele mecatronice controlate de microcontrolere uzuale se poate face şi prin metode software – tehnici de filtrare numerică – uşor de înţeles şi simplu de implementat.

Microcontrolerele pe 16 biţi de genul familiei MSP430 de la Texas Instruments îndeplinesc cerinţele tehnicilor de filtrare numerică prezentate şi se pretează aplicaţiilor de comandă şi control ale dispozitivelor hidropneumatice, respectiv ale sistemelor mecatronice de complexitate redusă.

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PNEUMATIC POSITIONING SYSTEM WITHOUT PROPORTIONAL DIRECTIONAL VALVES

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Politehnica University of Bucharest

Abstract : The paper covers a pneumatic positioning system based on SMC equipments that doesn't use any proportional way valves. Precision positioning is obtained by implementing a algorith conceived by the authors. The algorithm is programmed into Labview and allows for the setting of the target position, permissible error and also creating working sequences. The paper shows both the SMC version alongside the one created by the authors, including software and the experimental model.

Keywords : pneutronics, positioning unit

1. Introduction

The first pneutronic positioning systems started appearing around the year 1985. Due to the properties of compressed air, it was belived that it will not be possible to create precision pneumatic positioning units. However, the high number of applications that require quick and precise positioning was the justification for research in this field. Such a system (fig.1) is compresied of the following equipments: a pneumatic cylinder *MP*, a position transducer *TP*, a pneumatic proportional directional valve *DPP*, the braking system *DF* and a controller, *C*.

This case applies for a open loop circuit. The current position of the unit is read by using the position transducer, *Tp* and compared to the value on *C*. The cylinder stops when the two values coincide. Better loops allow the system to read the value of the power consumption and also the speed of the system. Thus, a cascading loop control system is obtained.

Such a system can position a load at any point on the cylinder's length. The accuracy of the system depends on the resolution of the position transducer.

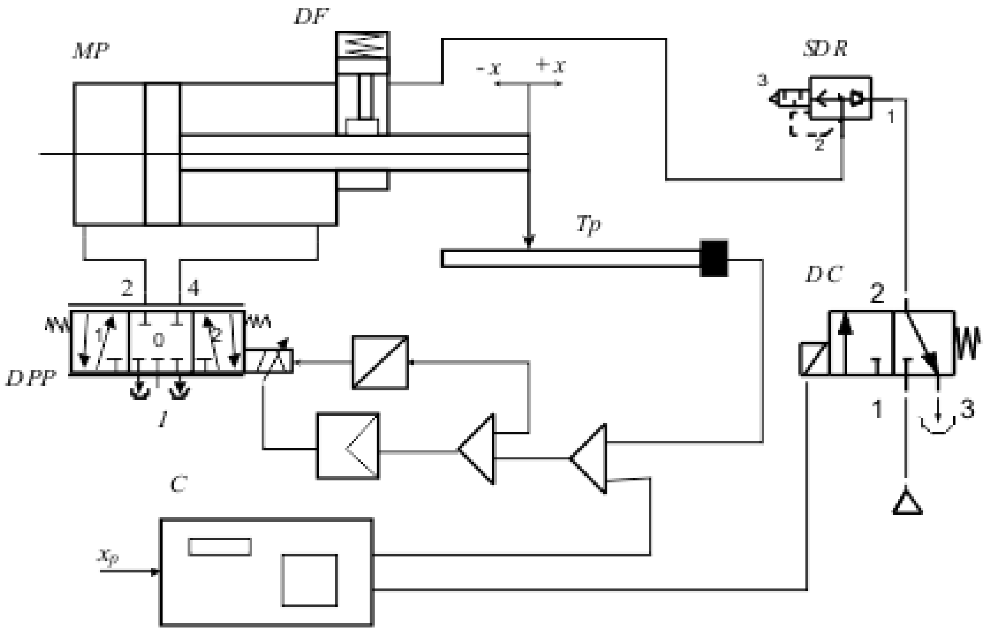


Fig.1

2. Pneumatic positioning system without proportional directional valves – SMC build

Positioning systems like the one above are expensive, the most expensive part of the system being the pneumatic proportional directional valve included in the system. This is the heart of the unit and due to the exceptional conditions under which it must be produced it can only be manufactured by a few companies. Thus, there has always been a desire to lower the price of such a system, while mentaining the precision of the cylinder so that a large number of users could aquire such systems. A solution came from SMC, which markets positioning systems that allow for the workload to be moved to certain points on the cylinder's path using only directional control valves. However, precision can only be obtained in certain points, within a minimum distance of the start point. The structure of such a system, according to the documentation provided by the producing company is presented in figure 2 and is comprised of:

- a CEU2 controller; - a way valve, DA;
- a break way valve DF; - PML, a special pneumatic linear motor, with a incorporated position transducer and a ML2 braking system; - RP_{DA} and RP_{DF} pressure regulators , Dr_1 and D_{r2} one-way flow control valves.

The controller's memory stores a algorithm that allows for the cylinder to be positioned with a certain error. In the *STOP* position, the *DF* way valve activates the pneumatic brake integrated in the cylinder's construction, while the *DA* way valve feeds the same pressure to both of the cylinder's chambers. Movement is possible when the *DF* way valve is activated and *DA* feeds air to one of the cylinder's chambers. At a certain distance from the de target position the controls for *DA* are set to 0 and movement continues due to intertia. When the positioning unit is in the target position, the brake will be activated. If the positioning error is larger than required (this is checked by reading data from the integrated position transducer *Tp*) then the algorithm is repeated and the distance at which the *DA* way valve si deactivated is adjusted automatically.

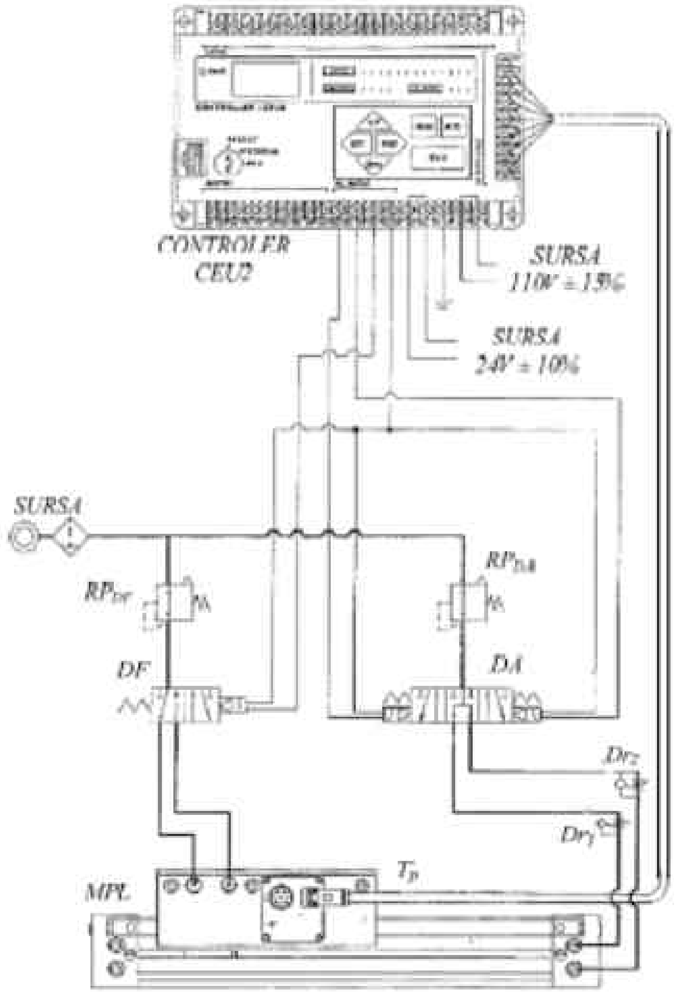


Fig. 2

3. Positioning unit without proportional way valves – own solution

The next variant is the one developed by the authors of this paper. For this solution, the SMC controller was replaced with a data aquisition system connected to the PCI port of a PC with LabView programming enviroment, version 7.1 installed. The control signals had to be amplified using the circuit in figure 3. The circuit uses optocouplers for glavanic protection.

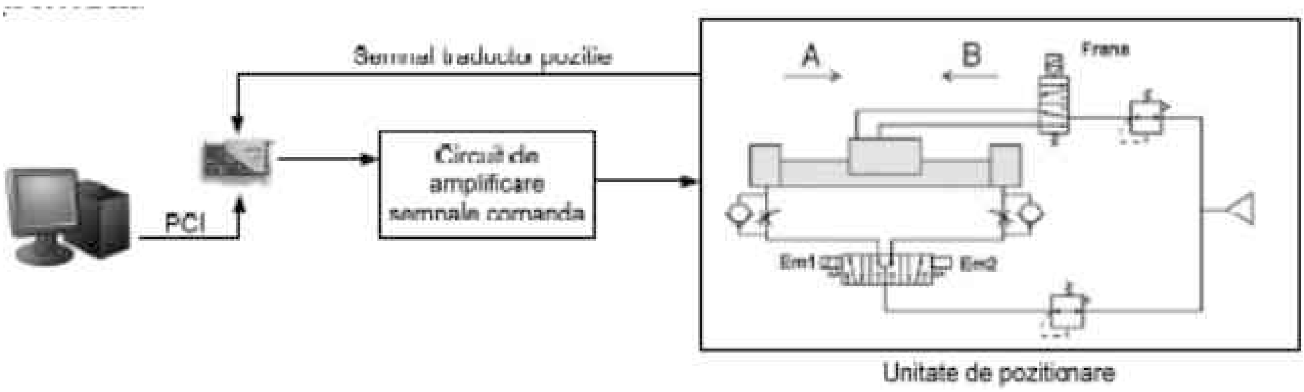


Fig. 3

The structure of the new system is presented in figure 3 while figure 4 is showing a overall view of the experimental model.

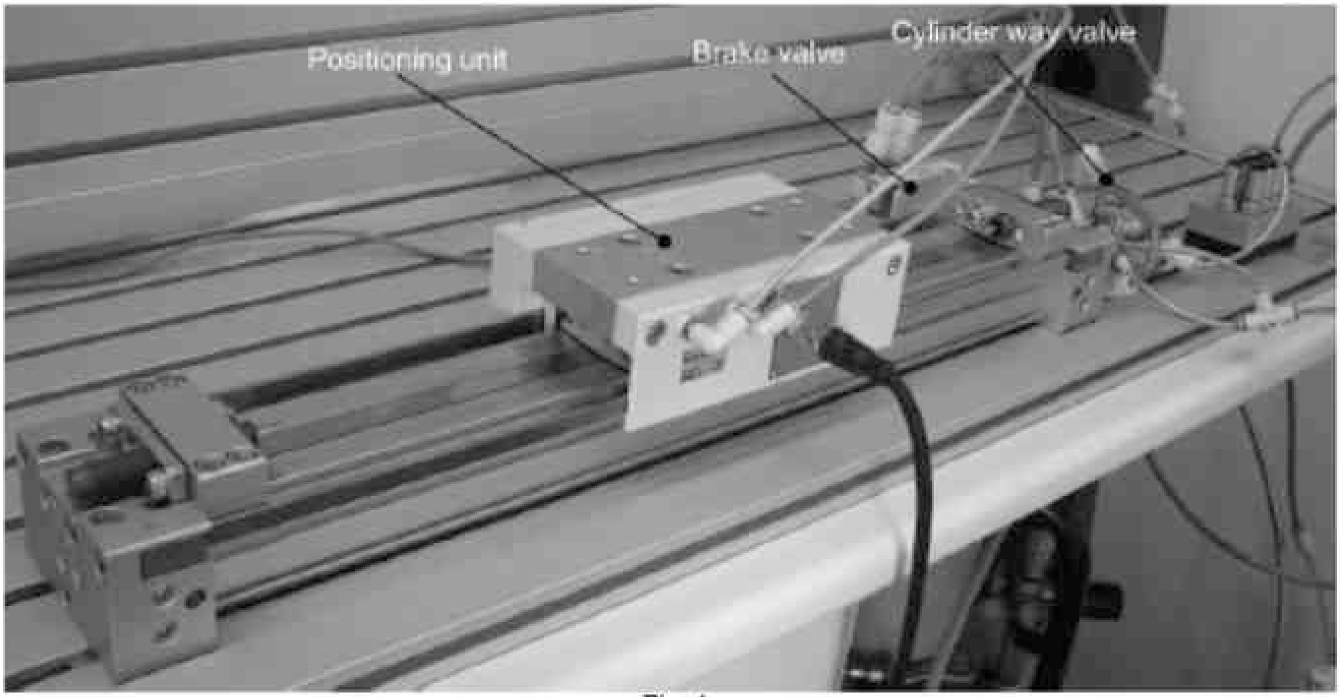
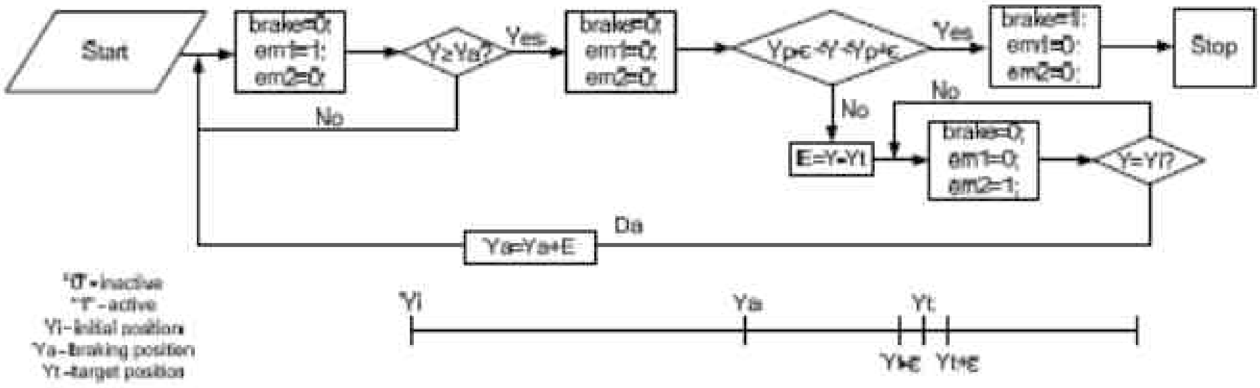


Fig. 4

In order to position the unit a new algorithm was conceived, keeping in mind that it should produce the same results as the one implemented on the SMC controller in the original version of the system. The flowchart for the new algorithm is presented in figure 5.



This algorithm was the basis for the new program.

The program's stages are:

- Start – initialization of the DAQ board, initial control signal verification,
- Start of movement towards the desired position
- The current position of the unit is compared to the braking position at every iteration of the program.
- Locking the brake.
- Stop. The program compares the current position to the desired position: if the two values coincide the program is stopped, otherwise the unit is returned to its inital position and another attempt is made. The Y_a variable is modified to reflect the error of the last unsuccessfull attempt. The system repeats the algorithm until a satisfing result is obtained.

After the unit is moved to the initial position and the program is started, movement begins towards the target position. Using a user inputed value for Y_a for the first attempt a first positioning is done and a first error is obtained. After the first attempt the unit is returned to the start position. The Y_a variable is corrected according to the error obtained in the last try. If after a certain number of retries the unit cannot be positioned within a certain error, that error is incremented with a user-inputted value. The algorithm repeats until a satisfing result is obtained.

The front panel of the application is show in figure 6. As can be observed, the panel allows for intervention on the target position value, the maximum number of retries and initial braking distance. Also, the panel is comprise of indicators that output the current position of the unit, the error and brake information. The program's block diagram is shown in figure 7.

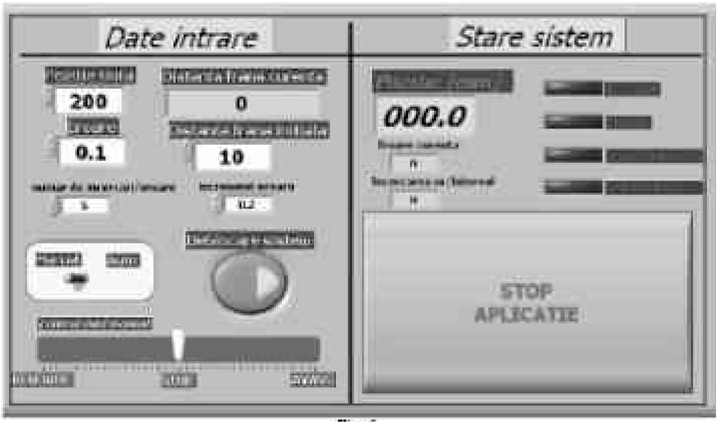


Fig.6

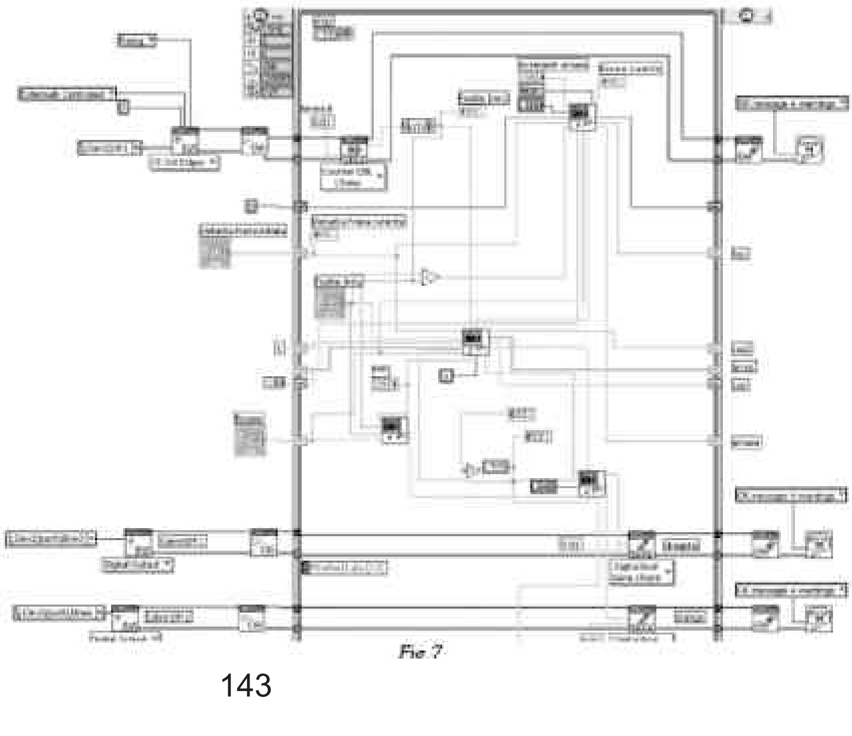


Fig 7

Although it can be argumented that the cost of the NI 6052E DAQ is equivalent to that of the original components the solution was chosen due to its availability. Future development of a dedicated control system would much decrease the overall cost of the system.

4. Conclusions.

After testing the algorithm, the results were similar to those of the original SMC system, allowing for the load to be positioned with a ±0.1mm error. Among the advantages of such a system we would like to underline the user-friendly interface, the posibility to change the parameters of the system while the unit is in the process of positioning a workload and also the option to store and analyise data obtained from the unit.

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RAPID PROTOTYPING THROUGH SELECTIVE LASER SINTERING FOR MECHATRONIC COMPONENTS IN INDUSTRY, ACADEMIA AND RESEARCH

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Abstract:
In this paper we presented a high-tech equipment of last generation. This equipment is the endowment of major research institutes in the world and the largest producers of high quality mechanical parts. Even geometry with a high degree of complexity can be produced on this equipment, within a few hours and fully automatic. Accuracy and detail are excellent roughness and the final piece does not require further processing. The paper is based on the latest literature, which reflects the current state of development area in the country and our world.

Keywords: *mechatronics, biomechanics, rapid prototyping, rapid manufacturing, new materials and processes, 3D modeling, CT scan*

1.INTRODUCTION

1.1 Rapid Prototyping & Manufacturing

Rapid prototyping and manufacturing technologies using materials and processes have developed in recent years in several directions, depending on the material used and the technology of solidification of the material.

Table 1. Synthetic table of the RP & M processes (Rapid Prototyping and Manufacturing) and basic materials used

	Tehnologia de prototipare	Materialul de baza
1	Selective laser sintering (SLS)	Thermoplastics, metals powders
2	Fused deposition modeling (FDM)	Thermoplastics, eutectic metals
3	Stereolithography (SLA)	Photopolymer
4	Laminated object manufacturing (LOM)	Paper
5	Electron beam melting (EBM)	Titanium alloys
6	3D printing (3DP)	Various materials
7	Multi Jet Modeling (MJM)	Photopolymer
8	Polyjet matrix	Photopolymer

Implementation of this new technology took place in the BMR-BIOMEDICAL MECHATRONICS AND ROBOTICS DEPARTMENT from NIRDMMT - National Institute for Research - Development for Mechatronics and Measurement, Bucharest, ROMANIA.

Selective laser sintering equipment (SSL) Version EOSINT M270 Titanium is in compliance with these standards:
- Machinery Directive 98/37/EC, Annex II A;
- Low Voltage Directive 73/23/ECC;
- EMC Directive 89/336/ECC.

NATIONAL INSTITUTE OF RESEARCH AND DEVELOPMENT FOR MECHATRONICS AND MEASUREMENT TECHNIQUE

Currently we are unique in the country in terms of facilities for the Selective Laser Sintering technology for metals.

Selective laser sintering (SSL), or SLS - Selective Laser Sintering is a family of methods that can build a solid body of various types of materials (plastics, metal, ceramics including rare metals or physical and mechanical properties and biocompatibility special) solidified powder material, following exposure to particulate successive layers of different laser powers.
Thus, one can obtain parts, assemblies and subassemblies with any geometric complexity, unachievable by other working. Moreover, the process is fully automated, requires no monitoring and control is achieved by intelligent high-tech equipment.

Also, high-tech technology and equipment conform to the following standards:

- EN ISO 12100-1, Publication date: 2004-04 – Safety of machinery; Basic concepts, general principles for design; Part 1: Basic terminology, methodology (ISO 12100-1:2003); German version EN ISO 12100-1:2003;
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- EN ISO 12100-2, Publication date: 2004-04 – Safety of machinery; Basic concepts, general principles for design; Part 2: Technical principles and specifications (ISO 12100-2:2003); German version EN ISO 12100-2:2003;
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- EN 60204-1, Publication date: 1998-11 – Safety of machinery – Electrical equipment of machines, Part 1: General requirements (IEC 60204-1:1997 + Corrigendum 1998); German version EN 60204-1:1997;
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- EN 60825-1, Publication date: 2003-10 – Safety of laser, Part 1: Equipment classification, requirements and user's guide (IEC 60825-1:1993 + A1:1997 + A2:2001); German version EN 60825-1:1994 + A1:2002 + A2:2001;
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-
- EN 12626, Publication date: 1997-07 – Safety of machinery – Laser processing machines – Safety requirements (ISO 11553:1996 modified); German version EN 12626:1997.

Since 2007, INCDMTM - National Institute - Mechatronics and Measurement Development, Bucharest, is fast growing in terms of RP & M Technologies - Rapid Prototyping and Manufacturing.

With the procurement and operation of such equipment, INCDMTM reached a peak level of equipment that allows participation in the European consortium and / or international in terms of scientific research, technological development and innovation.

Thus, it can successfully face new challenges in terms of innovative technologies in the globalized economy and increased competitiveness.

Laser sintering definition is:

A family of methods that can manufacture parts from metal powder solidification of successive layers deposited on a platform built by exposing each layer of powder to a variable power laser beam.

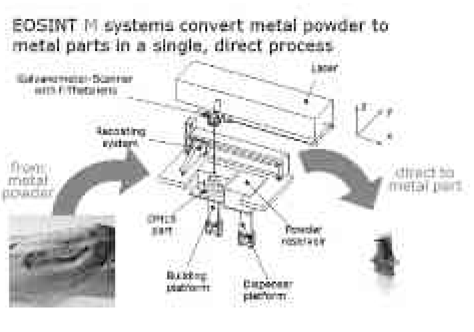
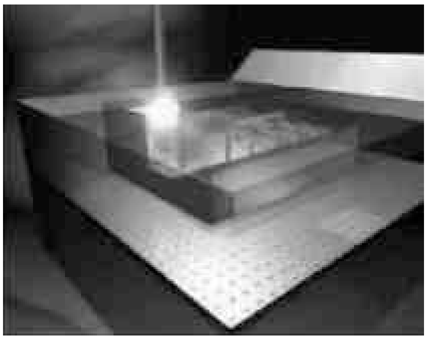


Figure 2. *Working Principle EOSINT M 270*

TECHNOLOGIC PROCESS SEEN STEP BY STEP

METAL POWDER

LASER SINTERING



FINAL PART

1.2. Main categories of materials that can be used for selective metal sintering machine EOSINT M270 TITANIUM VERSION from INCDMTM. This listing is not restricted, various alloy powders are developed continuously

Numele materialului	Tip de material
1. DirectMetal 20 for EOSINT M 270	very fine-grained bronze-based, multi-component metal powder
2. EOS StainlessSteel PH1 for EOSINT M 270	pre-alloyed stainless steel in fine powder form. The chemistry of EOS StainlessSteel PH1 conforms to the compositions of DIN 1.4540 and UNS S15500
3. EOS MaragingSteel MS1 for EOSINT M 270 Systems	This kind of steel is characterized by having very good mechanical properties, and being easily heat-treatable using a simple thermal age-hardening process to obtain excellent hardness and strength.
4. EOS StainlessSteel GP1 for EOSINT M 270	This kind of steel is characterized by having good corrosion resistance and mechanical properties, especially excellent ductility in laser processed state, and is widely used in a variety of engineering applications.
5. EOS CobaltChrome MP1 for EOSINT M 270	excellent mechanical properties (strength, hardness etc.), corrosion resistance and temperature resistance. Such alloys are commonly used in biomedical applications such as dental and medical implants
6. EOS CobaltChrome SP1 for EOSINT M 270	This material is ideal for producing dental restorations. Standard processing parameters use full melting of the entire geometry with 20 μm layer thickness.
7. EOS Titanium Ti64 for EOSINT M 270 Systems (Titanium Version)	This well-known light alloy is characterized by having excellent mechanical properties and corrosion resistance combined with low specific weight and biocompatibility.

Metal powder that can be used include a variety of materials including stainless steel implanted general use, cobalt or nickel superalloys, titanium alloys or pure titanium.

All these materials have outstanding mechanical and physical qualities, better than cast or forged materials, so are suitable for biomedical implants, parts for aerospace or automotive industry.

Biocompatible properties, corrosion resistance and low specific weight, combined with the infinite possibilities of 3D geometric modeling technology recommends this method as a working tool of the future of mechanical engineering, mechatronics and robotics.

Parts obtained by this process can be further processed as desired, if deemed necessary by any known mechanical milling, turning, drilling, boring, tapping, planing, shaping, grinding, broaching, lapping, honing, micro shot-peened.

Also, parts can be further processed by sanding, polishing, welding, shot blasting, metal, electrical and processing by coating.

We are also pleased that there has been extraordinary openness we had from universities and research centers in the European Union and the world.
Thus stands the University of Maribor, Slovenia, Faculty of Mechanical Engineering by Mr. Prof. Univ. PhD. Eng. Igor Drstvensek.

Through this opening we hope to develop an intensive cooperation regarding research area of precision mechanics, mechatronics, robotics and biomedical engineering.
In this regard we are engaged in research on optimization for production of custom implants based on CT scans and media processing and 3D CAD modeling, and analysis by finite element method.
However operators will lead to quicker and better preoperative planning, with direct results on reducing hospitalization time, visual effects and reintegration into society of patients

Together, we want to create a pole of excellence in research at European level with a favorable climate for research and development of new technologies related with CT and MRI medical imaging, 3D geometric modeling osteo-articular structures, mechanical and parameterization of FEM analysis (Finite Element Method - Finite Element Method), computer aided surgery and quantitative evaluation methods and corrective orthopedic surgery.

Metal parts directly from CAD data

A number of different materials are available for use with EOSINT M systems, offering a broad range of e-Manufacturing applications. EOS CobaltChrome MP1 is a multi-purpose cobaltchrome-molybdenum-based superalloy powder which has been optimized especially for processing on EOSINT M 270 systems. Other materials are also available for EOSINT M systems, including a special-purpose cobalt-chrome-molybdenum-based superalloy for dental veneering application, and further materials are continuously being developed - please refer to the relevant material data sheets for details.
The ability to produce such parts very quickly enables flexible and economic manufacture of individual parts or batches, which in turn enables design or manufacturing problems to be identified at an early stage of product development and time to market to be shortened.

This new technology is used in top domains of engineering and medicine, both for civil and military purposes. The most advanced engineering entity, National Aeronautics and Space Administration (NASA), use the EOSINT M270 machine, Titanium Version.

2. HIGH-TECH EQUIPMENT TECHNOLOGY USED

2.1 Superalloy EOS CobaltChrome MP1 for EOSINT M 270

EOS CobaltChrome MP1 is a fine powder mixture for processing on EOSINT M 270 systems, which produces parts in a cobalt-chrome-molybdenum-based superalloy.

This class of superalloy is characterized by having excellent mechanical properties (strength, hardness etc.), corrosion resistance and temperature resistance. Such alloys are commonly used in biomedical applications
such as dental and medical implants (note: widely used in Europe but much less so in North America), and also for high-temperature engineering applications such as in aero engines.
The chemistry of EOS CobaltChrome MP1 conforms to the composition UNS R31538 of high carbon CoCrMo alloy. Parts built from this material are nickel-free (< 0.1 % nickel content), sterilisable and suitable for biomedical applications, and are characterized by a fine, uniform crystal grain structure. They fully meet the requirements of ISO 5832-4 and ASTM F75 for cast CoCrMo implant alloys, as well as the requirements of ISO 5832-12 and ASTM F1537 for wrought CoCrMo implants alloys except remaining elongation. The remaining elongation can be increased to fulfil even this standard by hot isostatic pressing (HIP).

This material is ideal for many part-building applications (DirectPart) such as functional metal prototypes, small series products, individualised products or spare parts. Standard processing parameters use full melting of the entire geometry with 20 µm layer thickness, but it is also possible to use the Skin & Core building style to increase the build speed. Using standard parameters the mechanical properties are fairly uniform in all directions. Parts made from EOS CobaltChrome MP1 can be machined, spark-eroded, welded, micro shot-peened, polished and coated if required. Unexposed powder can be reused.

Typical applications:
- prototype, one-off or small-series biomedical implants, e.g. spinal, knee, hip bone, toe and dental.
- parts requiring high mechanical properties in elevated temperatures (500 - 1000 °C) and with good corrosion resistance, e.g. turbines and other parts for engines, cutting parts, etc.
- parts having very small features such as thin walls, pins, etc., which require particularly high strength and/or stiffness.

2.2 EOS CobaltChrome SP1 for EOSINT M 270

EOS CobaltChrome SP1 is a cobalt-chromemolybdenum-based superalloy powder which has been especially developed to fulfil the requirements of dental restorations which have to be veneered with dental ceramic material and has been optimized especially for processing on EOSINT M 270 systems. Other materials are also available for EOSINT M systems, and further materials are continuously being developed.
EOS CobaltChrome SP1 is a Co, Cr, Mo and W based alloy in fine powder form. Its composition corresponds for type 4 CoCr dental material in EN ISO 16744 standard. It also fulfills the chemical and thermal requirements of EN ISO 9693 for CoCr PFM (porcelain fused metal) of dental materials (Ni content: < 0.1 %, no Cd or Be) and requirements of EN ISO 7504 and EN ISO 10993 regarding the biocompatibility and cytoxity of the dental materials.
This material is ideal for producing dental restorations. Standard processing parameters use full melting of the entire geometry with 20 µm layer thickness.
Standard processing parameters use full melting of the entire geometry with 20 µm layer thickness, but it is also possible to use the Skin & Core building style to increase the build speed.
Typical application:
- dental restorations (crowns, bridges etc.)

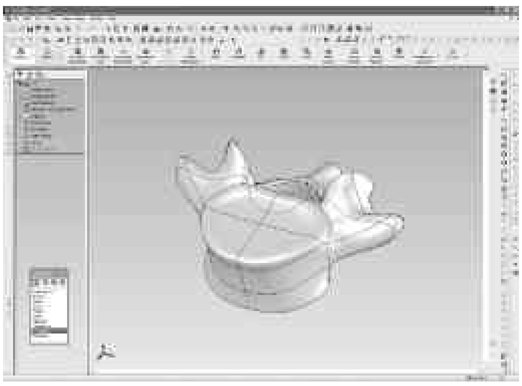
EOSINT M – Advantages

- Net-shape metal parts created directly in one step; no binder removal, generally no post-machining;
- Very high geometric flexibility (e.g. free-forms, deep slots and curved cooling channels);
- Fully automatic operation, high productivity and low personnel costs; low level of training and experience necessary;

– Low material consumption; optimal usage of material, unsintered powder can be reused;
– Compatibility with other processes; parts can be milled, drilled, welded, etc.

3. EXAMPLES OF INDUSTRIAL APPLICATIONS

3.1 Examples of industrial applications from medical and biomedical field



3.2 Examples of industrial applications from mechatronic field

3.3 Examples of industrial applications from precision mechanics field

3.4 Examples of industrial applications from aerospatial engineering field

Titanium alloys offer a unique combination of properties for many biomedical applications. Summary of important biomedical properties:

- Excellent corrosion resistance, biocompatibility and bioadhesion;
- Titanium and its alloys are used for many biomedical and dental applications (implants, screws, crowns...).

Property	Stainless steel	Titanium alloys	CrCo alloys	Nb/Ta
Corrosion resistance	0	++	-	++
Biocompatibility	0	++	-	++
Bioadhesion	0	++		
Price	++	+	-	-

Figure 5. Summary of important biomedical properties

Titanium alloys offer a unique combination of properties for many engineering applications. Summary of important engineering properties:
— Light weight material with high specific strength (strength per weight)
— Ti6Al4V with high strength also at elevated temperatures
— The combination of mechanical properties and the corrosion resistance is the basis for applications in Formula 1 and aerospace.
Various grades of Titanium (alloys) are commonly used in industrial applications.

Table 2: Summary of the most important Ti materials

Material name	Composition	Typical applications
CP Ti grade 1	Ti; O <0.18%; N <0.03%	Medical and dental
CP Ti grade 2	Ti; O <0.25%, N <0.03%	Medical and dental, chemical industry
CP Ti grade 3	Ti; O <0.35%, N < 0.05%	Medical and dental
CP Ti grade 4	Ti; O < 0.40%, N < 0.05%	Medical and dental
Ti6Al4V (grade 5)	Ti; Al 6%; V 4%; O <0.20%, N < 0.05%	Aerospace, motor sport, sports goods, medical and dental
Ti6Al4V ELI	Ti; Al 6%; V 4%; O <0.15%, N < 0.03%	Medical and dental

CP = commercially pure, ELI = extra-low interstitials

Uses of CAD and Rapid Prototyping in medicine

Combined with traditional CT scanning techniques rapid technologies (prototyping and tooling) can be used as instruments for better (three-dimensional) visualization, simulation of procedures and treatment of patients.The CAD models, virtual model of a human body or a part of it can be used to study the problematic area before the actual operation starts. This is especially important in cases where functionality of the body part has to be re-established (orthopaedic surgery). Besides the continuous flow and other FEA methods that are used to calculate required mechanical and physical properties of the implant, the virtual models can also be used to study the surgical procedures, like directions of implantation, required preoperational treatments and preparations, etc.

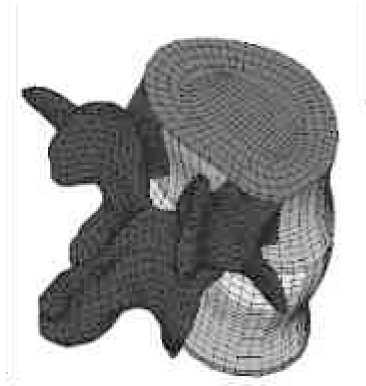


Figure 7. *CAD model on human vertebrae used for FEM analysis*

The easiest way to reconstruct the structure of a patient's bones is to use those CT images that already exist from previous treatments of the patient. A set of CT images can be converted into a three-dimensional, digital model using one of the available conversion software, such as: Mimics (Materialise), RapidForm (Inus Technology), 3D doctor (Able Software), Amira (Marcury Computer), or others. The input to this software is usually in the form of DICOM files and output is predominantly STL (Standard Tessellation Language), which can be directly used in most RP technologies to produce real models (Figure 1).

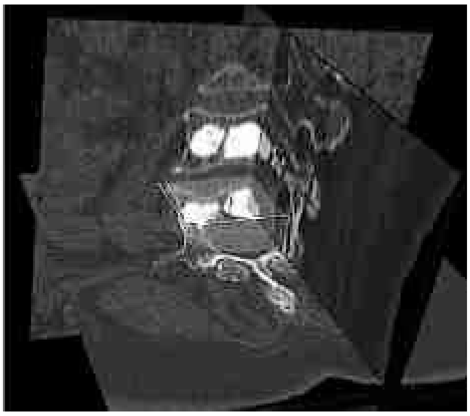


Figure 8. *CT scan used for analysis*

Three dimensional reconstruction of DICOM images in a form of STL file can be further manipulated by several CAD software. The usual 3D modelers based on parametric, volume modeling techniques are not very well suited to the task. Newer versions of these software packages (SolidWorks 2008, Delcam, etc.) enable manipulation of triangulated surface files, but using dedicated software, known from Reverse Engineering fields, such as Magics (Materialise), RapidForm, PolyWorks (InnovMetric), or others is much more effective in terms of time and effort. Using these software and STL models of scanned body parts, missing tissue can be modelled and saved as new STL files. These can be further processed or used for the production of real implant models by means of RP or RM technologies. CAD modelling of the implant was performed using several reverse engineering software packages.

Another interesting idea is to use a combination of CT and RMN images.

3. THE IMPACT OF THE IMPLEMENTATION OF RAPID PROTOTYPING TECHNOLOGY

EOS has successfully produced parts in Inconel alloys on EOSINT M 270.

Description

— Material type

nickel-based superalloy, commonly used for high-temperature engineering applications such as aerospace turbine parts

— Alternatives

can in many cases be substituted by EOS CobaltChrome MP1

— Commercialization status

so far only in R&D

Figure 9. *Example of the complexity of the design*

EOS has successfully produced parts in gold on EOSINT M 270.

Description

— Material type

precious metal, used in various purities / alloys for jewellery, electronics and dental restorations

— Alternatives

currently no comparable commercial material available for EOSINT M

— Commercialization status

so far only in R&D

5.1 Various grades of Titanium (alloys) commonly used in industrial applications

Under the direct supervision of EOS specialist, Dipl. Eng. Deniz Demirtas, we build an impressive amount of difficult parts for neurosurgery and orthopaedic implants. The results were impressive.

Table 3. Mechanical properties of conventional barstock

Material name	Tensile strength (*) [MPa]	Elongation at break (*) [%]
CP Ti grade 1	240	24
CP Ti grade 2	345	20
CP Ti grade 3	450	18
CP Ti grade 4	550	15
Ti6Al4V (grade 5)	895	10

CP = commercially pure, ELI = extra-low interstitials

(*) Source: Euro-Titan Handels AG, Solingen, Germany

EOS Titanium - light alloy materials for prototyping and series production

Characteristics and applications
— Several versions will be available
*EOS Titanium Ti64 (Ti6Al4V)
*EOS Titanium Ti64 ELI (higher purity)
*EOS Titanium TiCP (commercially pure)
— Key characteristics
*lightweight
*high strength
*biocompatibility
— Typical applications
*aerospace and engineering applications
*biomedical implants

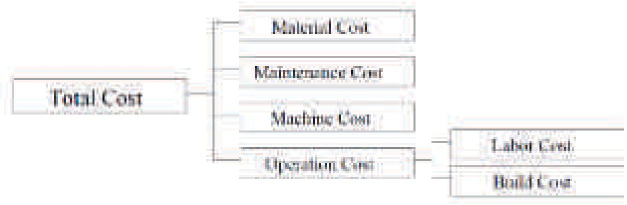


Figure 11. *Parametric cost model*

EOS Titanium Ti64 parts fulfil relevant industrial standards and relevant requirements.

Physical and chemical properties:

— Physical properties
*laser-sintered density: approx. 100 %
*only single pores
— Chemical properties
*laser-sintered parts fulfil requirements of ASTM F1472 (for Ti6Al4V) and ASTM F136 (for Ti6Al4V ELI) regarding maximum concentration of impurities
*oxygen < 2000ppm or 1500ppm
*nitrogen < 700ppm
— Bioadhesion
*cell growth tested with good results

EOS Titanium Ti64 produces parts with excellent mechanical properties.

Property	Value	
Ultimate tensile strength	approx. 1100 MPa	approx. 159 ksi
Yield strength (Rp 0.2 %)	approx. 1000 MPa	approx. 145 ksi
Young's Modulus	approx. 120 GPa	approx. 17 msi
Elongation at break	approx. 8%	
Hardness	approx. 450 HV ≈ 45 HRC ≈ 425 HB	

Figure 11. *Mechanical properties*

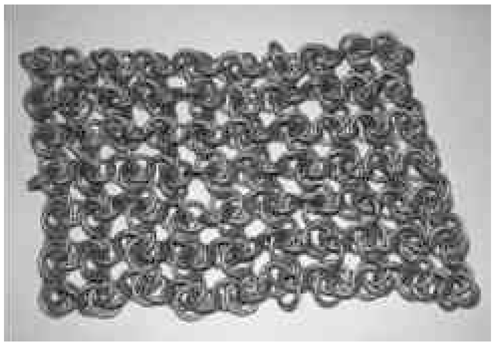


Figure 12. *Example of the complexity of the design*

EOS Titanium Ti64 produces fully dense parts with dendritic, martensitic grain structure.

Metallurgy:
Typically martensitic structure with grains growing from layer to layer
*preferential Z orientation
*grain size >> layer thickness

EOS Titanium TiCP produces fully dense parts with very fine, uniform grain structure.

EOS Titanium TiCP produces parts with excellent mechanical properties.

Property	Value	
Ultimate tensile strength	approx. 567 MPa	approx. 82 ksi
Yield strength (Rp 0.2 %)	approx. 477 MPa	approx. 69 ksi
Young's Modulus	approx. 114 GPa	approx. 15 msi
Elongation at break	approx. 32 ± 5 %	

Figure 13. *Mechanical properties*

5.2 Main advantages of rapid prototyping technology

Finally, to name just a few of the key advantages of this technology:
- no tooling or part-specific tools required
- no tool path generation or design of EDM electrodes necessary
- metal parts created directly in one step
- simple, fully automatic operation
- complex geometries such as freeforms, deep slots and conformal cooling channels
can be produced without additional effort
- unsintered powder can be reused, giving minimal waste.

5. CONCLUSIONS

The functional and design capabilities of a metallic implant material are important with respect to the metal's ability to be formed, machined, and polished. An implant metal must be capable of being utilized with state-of-the-art metallurgical techniques. In addition, the implant device must remain functional during its expected performance life; it must not be degraded with time in the body through fatigue, fretting, corrosion, or impact loading. Titanium and its alloys meet all of these requirements.

Many different kinds of parts have been built in EOS Titanium Ti64.

Figure 15. *Examples of parts built in EOS superalloy CoCr MP1 on INCDMTM*

The principles of design, selection of biomaterials and manufacturing criteria for orthopedics implants are, basically, the same as for any other product that must be dinamically stressed. However, even the replacement of human tissues with materials similar in shape and density seems tempting, in fact this is much difficult task to undertake. That is because the living tissue has some extraordinary caracteristics including the capacity of remodeling both micro structural and macrostructural under the different directions loads.

Figure 16. *Examples of parts built in EOS superalloy CoCr MP1 on INCDMTM for industry*

Orthopedics will emerge as the single most promising source of future investor returns in healthcare, given the confluence of demographics, technology and global expansion. While other healthcare sectors such as cardiovascular devices, cancer or biotech may have been more lucrative in the past, what the American Association of Orthopedic Surgeons (AAOS) calls the "Decade of Orthopedics" provides the best opportunity for future investor profits in healthcare.

Figure 17. *Examples of parts built in EOS superalloy CoCr MP1 on INCDMTM for orthopedy, neurosurgery and maxilofacial implants*

A number of elements will create this opportunity for the next ten years:

- Increased life expectancies, which is a powerful demand driver that uniquely favors orthopedic devices.
- Technological innovation, which will change the entire complexion of the industry.
- Attractive industry economics and profitability.
- Combined, these elements will cause the industry to grow more than twofold, from $30 billion per year to $65 billion in the coming decade, resulting in as much as $40 billion of potential investor profits.

This combination of factors supports sustained, attractive industry valuations.
We must understand that science and innovations are keys to SUCCESS.

6. ACKNOWLEDGMENTS

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GOVERNMENT OF ROMANIA

ANCS
Autoritatea Nationala pentru Cercetare Stiintifica

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DISPOZITIVE MODERNE PENTRU ACUMULAREA DE SARCINĂ ELECTRICĂ ŞI APLICAŢII SPECIFICE

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Rezumat.

Tehnologiile moderne în domeniu componentelor pasive au condus la dezvoltarea de mate**riale cu rezistenţă scăzută, cu suprafaţă utilă mărită,** cu o distanta foarte mica intre doua conductoare ceea ce permite înmagazinarea unei mai energii **sub formă de sarcină electrică** foarte mare. Stocarea sarcinilor în dublu strat este un proces de supraf**aţă, în concluzie caracteristica suprafeţei armăturii influenţează direct capacitatea supercondensatorului**. Tehnologiile actuale de realizare a supercondensatoarelor permit realizarea unor EDLC-uri si a unor condensatoare Litium Ion care au un curent de pi**erderi cu o variaţie în timp destul de mare şi mai ales dependent de temperatura mediului şi a curentului maxim ce poate fi debitat**.

Lucrarea prezinta doua tipuri de condensatoare moderne si aplicaţiile specifice utilizării lor pe un tandem cu un acumulator cu Pb pentru reducerea greutatii/unitatea de energie si costurilor specifice.

1. Introducere

Dezvoltările tehnologice în domeniu componentelor electronice pasive au condus la dezvoltarea de materiale cu rezistenţă scăzută, şi cu suprafaţă utilă mărită, capabile să înmagazineze mai multă energie sub formă de sarcină electrică. Aceste dezvoltări în combinaţie cu aprofundarea teoretică a fenomenelor de transport de sarcină ce apar în materialele de tip dublu-strat au condus la dezvoltarea de condensatoare cu capacitate ridicată, cunoscute ca dispozitive EDLC (**E**lectrochemical **D**ouble-**L**ayer **C**apacitor) si la condensatoare Litiu Ion. In momentul actual EDLC-urile si condensatoarele Litiu Ion au aplicaţii deosebite în domeniul auto şi ca sursă pentru alimentarea unor consumatori cu energie mare instantanee. Au dimensiuni relativ mici in comparaţie cu cantitatea de sarcină înmagazinată (vezi Figura 1.)

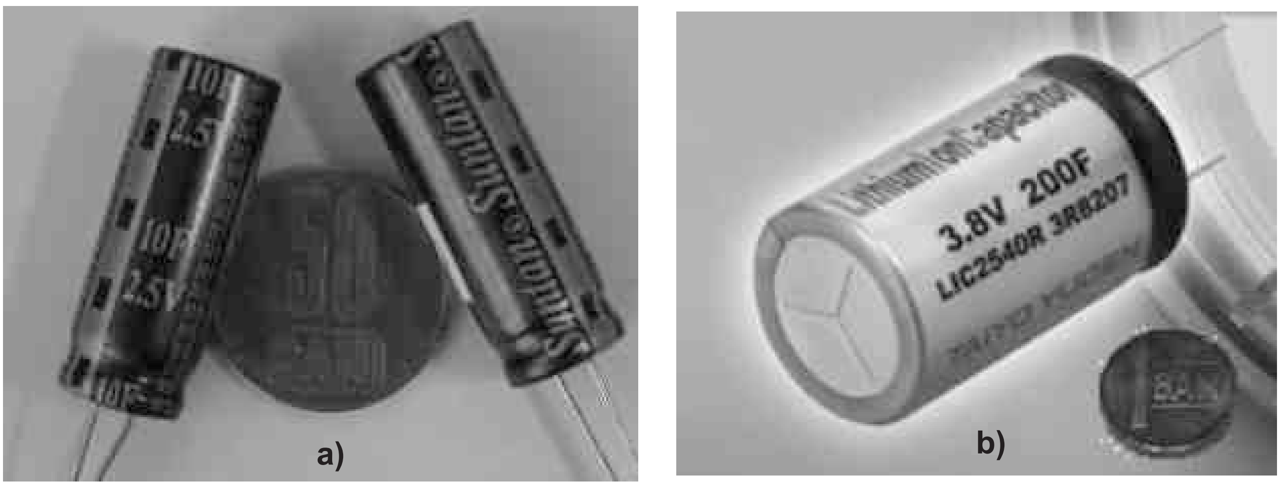

Figura 1. Dispozitive moderne de acumulare de sarcina: (a) Supercondensatoare EDLCs 10 F/2,5V; (b) Condensator Litiu Ion 200F/3,8 V [11]

2. Principiul de funcţionare

Principiul de funcţionare al condensatorilor electrochimici este similar cu principiul de funcţionare al condensatorilor electrostatici (convenţionali).

Condensatorii electrochimici stochează energia într-o manieră similară, doar că sarcina nu este acumulată pe cele două armături. Sarcina se acumulează la interfaţa dintre suprafaţa conductorului şi o soluţie de electrolit, (vezi Figura 2.). Sarcina acumulată formează astfel un dublu strat încărcat electric, separarea dintre fiecare strat fiind de câţiva Angstromi.

O estimare a capacităţii poate fi obţinută din modelul dublu strat propus de Helmholtz în 1853, în care dublul strat este considerat a fi compus din două straturi simple încărcate electrostatic. Un strat se formează pe armătură şi celălalt strat este compus din ionii din electrolit. Capacitatea specifică a acestui strat dublu este dată de ecuaţia de mai jos

$$C = \frac{\varepsilon \cdot A}{4\pi\delta}$$

unde:

C - capacitatea condensatorului

A - aria armăturii

ε - constanta dielectrică a mediului dintre cele două straturi (electrolitul)

δ - distanţa dintre cele două straturi (distanţa dintre suprafaţa armăturii până la centrul stratului ionic).

Armăturile sunt confecţionate din materiale care au suprafaţa efectivă prelucrată pentru a mări suprafaţa stratului dublu, cum ar fi: carbon poros, carbon depus prin procedeul aerogel. În structurile, EDCL se pot obţine densităţi mari de energie datorită capacităţii specifice mari. Aceste capacităţi sunt obţinute prin:

·existenţa interfeţei armătură/electrolit pe toată suprafaţa armăturii

existenţa stratului subţire de separare a sarcinilor, de dimensiuni atomice

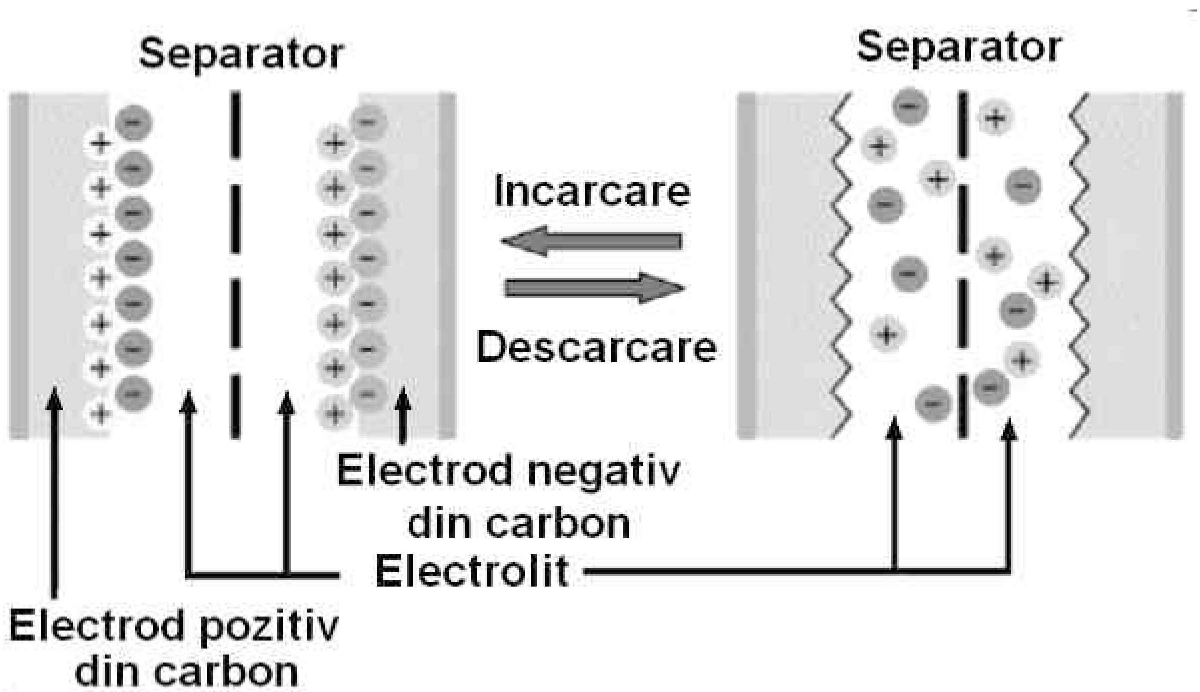

Figura .2. Mecanismul de stocare în condensatoarele electrochimice

3. Parametrii EDLC-urilor

Principalii parametrii a unui EDLC sunt: tensiunea nominală, curentul de scurt circuit şi curentul de pierderi. Ceilalţi parametri sunt prezentaţi in tabelul alăturat:

TABEL 1. Parametrii EDLC-ului

Parameter	Values
Operating temperature	-40 to +70℃
Rated voltage	2.5VDC
Surge voltage	3.0VDC
Capacitance tolerance	-20% to +80%
Temperature Characteristics	+70℃ $\lvert\Delta C/C\rvert \leq 30\%$, ESR≤100% of specified value at 25℃ -40 ℃ $\lvert\Delta C/C\rvert \leq 50\%$, ESR≤400% time of specified value at 25℃
High Temperature load	After 1000 hours, +70 ℃ ± 2, nominal voltage, $\lvert\Delta C/C\rvert \leq 30\%$ of the initial measured value, ESR≤400% of the initial specified value
High Temperature without load	After 1000 hours, +70 ℃ ± 2, nominal voltage, $\lvert\Delta C/C\rvert \leq 30\%$ of the initial measured value, ESR≤200% of the initial specified value
Humidity Resistance	After +40℃±2 · 90-95%RH · 240 hour $\lvert\Delta C/C\rvert \leq 30\%$ of the initial measured value, IL≤200% of the initial specified value,ESR≤4 time of the initial specified value

Parametrii condensatoarelor Litiu – Ion

Model	Max V.D.C	Min V.D.C	Nominal Capacitance	Internal Resistance	Dimensions (mm)			
	(V)	(V)	(F)	(mΩ)	øD	L	ød	P
LIC1235R 3R8406	3.8	2.2	40	150	12.5	35.0	0.8	5.0
LIC1840R 3R8107	3.8	2.2	100	100	18.0	40.0	0.8	8.0
LIC2540R 3R8207	3.8	2.2	200	50	25.0	40.0	1.0	13.0

4. Baterie de supercondensatoare

Deoarece super condensatoarele au tensiuni nominale foarte reduse, (2,5-3,8V) pentru o utilizare mai comodă la tensiunile uzuale din aplicaţii industriale sau de larg consum (5V, 12V, 24V, etc.) este necesară conectarea acestora în serie. Conectarea în serie are şi unele dezavantaje cum ar fi reducerea capacităţii totale, de exemplu pentru 5 condensatoare cu capacitatea de 10F conectate în serie capacitatea echivalentă este C/5=2F. Un alt parametru care este afectat de conectarea serie este rezistenţa echivalentă serie ESR, care este evident că se obţine prin însumarea rezistentelor serie ale condensatoarelor individuale. De asemenea, aici funcţionează principiul „verigii slabe", un condensator defect sau cu o rezistenţă serie crescută afectează tot lanţul de condensatoare.

Pe lângă conectarea în serie, pentru creşterea capacităţii de înmagazinare a energiei, condensatoarele se conectează si în paralel, realizând baterii serie-paralel, care sunt disponibile sub formă de „bancuri" de condensatoare ce prezintă o tensiune nominală şi o capacitate superioară unui condensator individual.

Într-o astfel de combinaţie cel mai important aspect este menţinerea tuturor condensatoarelor în limitele tensiunii nominale. Solicitarea unui condensator la o tensiune ce depăşeşte valoarea pentru care a fost proiectat conduce de cele mai multe ori la deteriorări ireversibile şi în final la distrugerea condensatorului. Aceste consideraţii sunt valabile în general pentru toate tipurile de condensatoare sau de componente pasive, dar trebuie să fie avute în vedere în special pentru supercondensatoare, in vederea protejării lor la supratensiuni. Dacă unui EDLC i se aplică o tensiune mai mare decât cea admisă, electrolitul începe să se descompună, rezultând un produs gazos. Dacă procesul continuă o perioadă de timp mai mare presiunea formată poate deschide supapa de siguranţă a condensatorului. Dacă, în continuare se menţine tensiunea ridicată, o cantitate tot mai mare de electrolit se descompune şi se vaporizează până ce rezistenţa internă a condensatorului creşte şi la limită condensatorul ajunge să fie un circuit deschis.

Pentru a menţine tensiunea egală la bornele condensatoarelor se utilizează rezistenţe, numite rezistenţe de egalizare conectate în paralel cu fiecare condensator ce este conectat în serie. Este posibil să se utilizeze varianta pasivă, clasică, prezentată în 3.a) sau varianta de egalizare activă prezentată în 3.b).

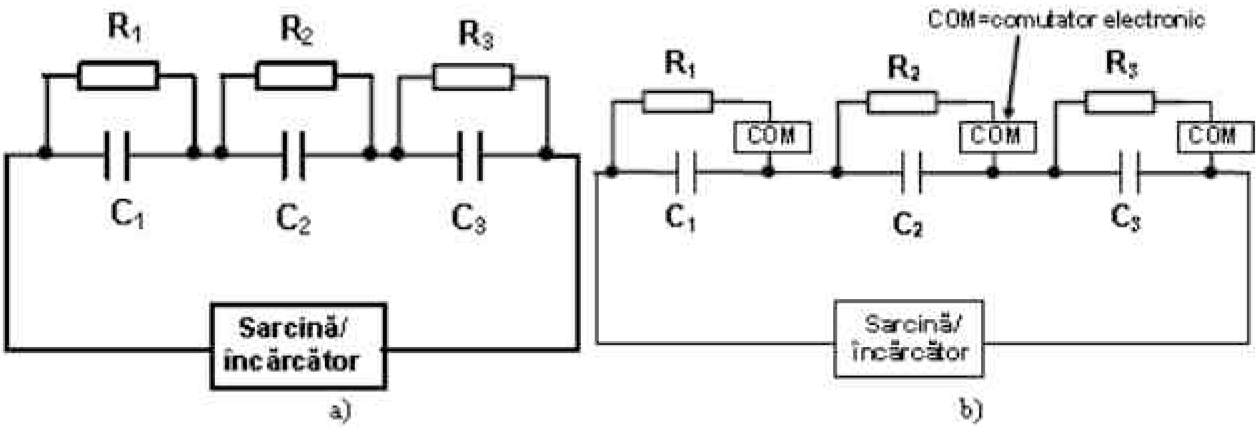

Figura 3. Egalizarea tensiunilor la gruparea serie a condensatoarelor: (a) pasivă (b) activă cu dispozitive de comutaţie electronice [8]

Ambele tehnici au atât avantaje cât şi dezavantaje. La egalizarea pasivă, rezistoarele plasate în paralel trebuie să absoarbă curentul necesar pentru a realiza echilibrarea tensiunilor. Valoarea rezistenţei trebuie aleasă astfel încât prin ea să treacă un curent de 2 ... 10 ori mai mare decât curentul de fugă iniţial al condensatorului I_f, acesta având cea mai mare valoare, după care scade în timp. Acest curent poate atinge 1 ... 3 mA.

Egalizarea pasivă are avantajul preţului redus şi al uşurinţei de punere în practică, principalul dezavantaj fiind că rezistenţele sunt conectate în permanenţă în paralel cu condensatorul, chiar când nu au rol util, soluţia fiind astfel ineficientă din punct de vedere energetic.

Metoda de egalizare activă se bazează pe structura celei pasive cu introducerea unui dispozitiv de comutaţie activ de tipul unui tranzistor bipolar sau MOSFET conectat în serie cu fiecare rezistor.

Comutatoarele sunt controlate de un circuit de detecţie a tensiunii care comandă închiderea comutatorului numai atunci când tensiunea pe condensator se apropie de o valoare periculoasă pentru funcţionarea acestuia, de exemplu 2,68 V pentru condensatorul cu tensiune nominală de 2,7 V. Această tensiune este numită „tensiune prag de bypass”.

In Figura 4 este prezentat un circuit de egalizare activă. Rezistorul de egalizare, R_9, este de tip axial de 2,7-Ω/5-W cu peliculă de oxizi metalici. Tranzistorul comutator, T_2, este de tip BC868 sau alt tranzistor bipolar echivalent de tip NPN în variantă SMD în capsula SOT89. Circuitul integrat IC_1 este o sursă de tensiune de referinţă de precizie, de tipul circuitului TL431, şi este utilizat pentru a stabili valoarea tensiunii de prag (2,68 V) la care tranzistorul T_2 este deschis.

Din punct de vedere al realizării practice circuitul de egalizare este realizat pe o placă de circuit imprimat montată pe contactele de tip şurub ale condensatoarelor, ca în Figura 5

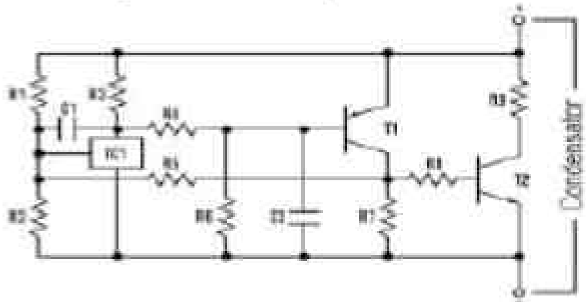

Figura 4. Circuit de egalizare activă [9]

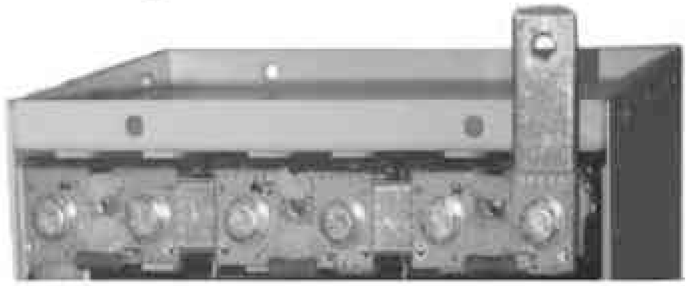

Figura 5. Baterie de supercondensatoare cu modul de egalizare activă

5. Comportarea supercondensatoarelor in timp si temperatura

Tehnologiile actuale de realizare a supercondensatoarelor permit numai realizarea unor EDLC care au un curent de pierderi cu o variaţie în timp destul de mare şi mai ales dependent de temperatura mediului şi a curentului maxim ce poate fi debitat. In Figura 6 este prezentată variaţia tensiunii la bornele unui supercondensator la diferite temperaturi, unde se observă că după 100 ore de la încărcare tensiunea în gol la bornele EDLC scade aproximativ la jumătate deci implicit şi sarcina înmagazinată. Temperaturile peste 30^{0}C duc la o descărcare substanţială, ceea ce în unele aplicaţii este un mare inconvenient. De asemenea, cu cât curentul ce îl poate debita un EDLC este mai mare, cu atât tensiunea în gol la trecerea timpului scade mai rapid.

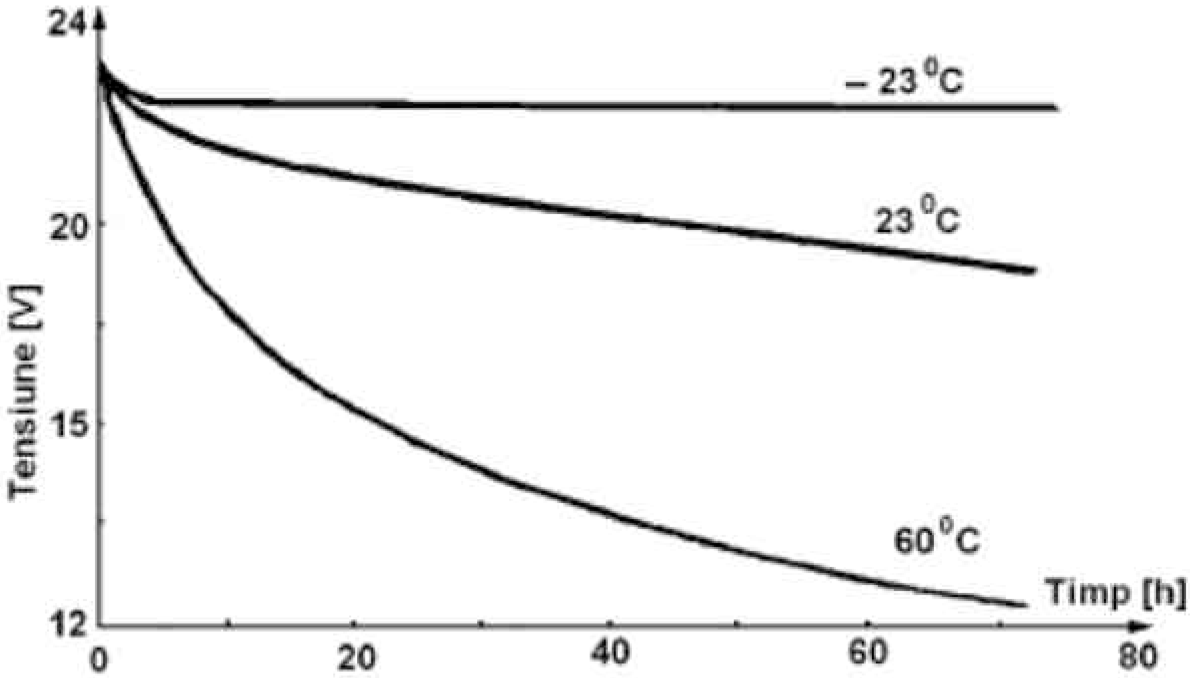

Figura 6.Variaţia tensiunii la bornele unui EDLC in timp şi la diferite temperaturi[10]

6. Aplicaţii in domeniul automobilelor

O baterie de supercondensatoare nu va putea să stocheze suficientă energie pentru regimul de funcţionare cu, curenţi medii pe o perioadă de timp îndelungată. La fel bateria de acumulatori cu plumb ar trebui supradimensionată pentru a putea livra energia necesară funcţionării regimului vârfurilor de curent mari la pornirea unui motor. Supradimensionarea unei baterii de acumulatori cu *Pb* ar conduce la creşterea masei şi a costurilor sistemului. O sursă hibridă formată dintr-o baterie de condensatoare şi o baterie de acumulatori cu *Pb* ar reduce greutatea sistemului cu aproape 60% şi o diminuare semnificativă a costurilor.

Analizând Figura 6 se constă că pe parcurs ce temperatura creşte, energia înmagazinată în EDLC scade foarte mult în timp. Separând cele două fenomene la temperatură joasă şi ridicată, utilizarea supercondensatoarelor într-un sistem, în domeniul auto, se face cu ajutorul unor circuite electronice care separă acumulatorul cu *Pb* de bateria EDLC pe timpul staţionării. Circuitul electronic trebuie să separe momentul de consum mare de putere de timpul cât (de exemplu) un autovehicul rămâne în staţionare. Pentru acesta se impune un circuit care să cupleze (momentul de timp *t*) în paralel pe acumulatorul cu *Pb* bateria EDLC, numai cu câteva secunde (*n*) înainte de actinarea demarorului, pentru a acumula sarcina. In aceste *n* secunde EDLC absoarbe energie din acumulatorul cu *Pb* si ajunge la sarcina maxima. La monentul de timp „*t+n*” secunde sistemul este pregătit să debiteze un curent foarte mare necesar demarorului. Curentul ce acţionează demarorul este luat nu numai din acumulator ci şi din EDLC, care se află cuplat cu acesta în paralel. Acest lucru este necesar pentru că în decursul timpului, adică în staţionare timp îndelungat (în special la temperaturi mari) EDLC-ul pierde sarcină, spre deosebire de acumulator care nu pierde (el chiar are o energie crescută).

Avantajul pe autovehicul al acestui tandem acumulator cu EDLC este reducerea greutatii/unitate de energie. Exemplu se poate folosi în loc de un acumulator de 60A/h care are un curent de circuit de 500A, un sistem format dintr-un acumulator cu *Pb* de 25Ah cu un curent de scurt circuit de 100 A si un EDLC cu un curent maxim de 400 A/h. În acest fel la momentul de timp *t+n*, este disponibil curentul de 100A ai acumulatorului cu Pb plus curentul de 400A ce poate fi livrat de EDLC timp de câteva secunde, suficient pentru a porni motorul, în special motorul diesel. Pornirea motoarelor se face în 1 ... 3 secunde.

Firmele specializate pot produce un astfel de circuit (vezi Figura 3.), circuit ce poate egaliza tensiunea pe EDLC si cel din Figura 7. de supravegherea bateriei EDLC

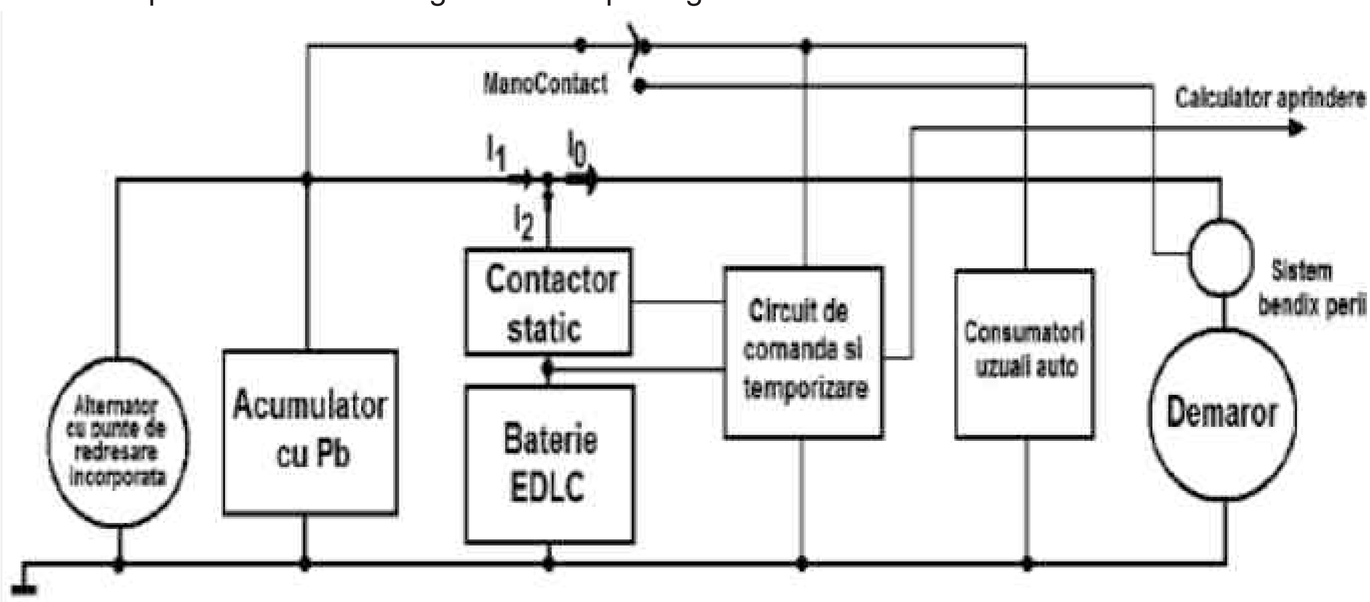

Figura 7. Circuit electronic de comanda al sistemului Acumulator cu Pb si Baterie EDLC

La acţionarea contactului cheie de către conducătorul auto (momentul de timp t), se aplică tensiune nu numai pe consumatorii uzuali de pe auto ci şi la intrarea circuitului de comandă şi temporizare, care va închide contactorul static. Incepe iniţializarea calculatorului de aprindere şi crearea de presiune în sistemul de alimentare. După un timp (n secunde) se trimite o comandă către calculatorul de aprindere, se sting martorii de pe bord si este liber la acţionarea demarorului, bateria EDLC a înmagazinat suficientă energie pentru a compensa sarcina pierdută în timpul staţionării. La acţionarea demarorului curentul avut la dispoziţie (I_0)pentru demaror este I_1 plus I_2. Cum I_1 este aroximativ 100A, I_2 poate fi, in funcţie de tipul de EDLC, aroximativ 300A. Curentul total avut la dispoziţie pentru acţionarea demarorului este de 400A care înlocuieşte curentul de scurt circuit al acumulatoarelor mari de 60 ...70Ah. In timpul funcţionării motorului, maşina electrică (alternatorul) de pe autovehicol încarcă nu numai acumulatorul ci şi bateria EDLC. La o nouă pornire circuitul de comandă şi temporizare măsora în primul moment tensiunea de pe EDLC. Dacă tensiunea este mare, adică a pierdut sarcină în cantitate mică atunci timpul n cât trebuie să stea până la pornire este micşorat cu o constantă de timp, constantă ce se poate deduce de pe caracteristică.

7. Concluzii

1. Elementele constructive ale unui supercondensator ce au un impact direct asupra performanţelor acestuia sunt electrolitul, separatorul şi armăturile.

2. Proprietăţile suprafeţei unui material utilizat la fabricarea armăturii au un impact semnificativ asupra capacităţii specifice, la fel ca şi proprietăţile chimice în cazul în care apare pseudocapacitatea. Momentan, materialele cele mai răspândite pentru fabricarea armăturilor sunt carbonul activ şi polimerii conductori iar oxizii metalici reprezintă o alternativă de viitor.

3. Electrolitul influenţează direct capacitatea specifică şi are un impact direct asupra densităţii de energie. Soluţiile apoase de electrolit au o conductivitate mai bună decât soluţiile organice, dar au o tensiune de străpungere mult mai mică.

4. Proprietăţile separatorului au de asemenea un impact direct asupra performanţelor supercondensatorului

5. Circuitul de comandă şi temporizare trebuie să ia considerare pentru stabilirea timpul de temporizare două probleme : tensiunea existentă pe EDLC la momentul t_0 şi temperatura de lucru a întregului ansamblu. Acest timp poate ajunge chiar si sub o secundă

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HYDRAULIC SYSTEMS FOR HEAVY MACHINE TOOLS

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***Abstracts**: In this paper is presented a hydraulic system used to balance the scenes of heavy vertical lathes and milling machines, fixed or movable gantry (GANTRY). Also, is presented the Hydraulic scheme and the methodology for calculating the static and dynamic emphasis on simulation methods. Finally, experimental results are presented for vertical lathes SC14-33CNC range.*

***Keywords**:* Heavy machine tools, balancing, kinematic advance chain.

1. NECESSITY OF BALANCING

Electromechanical systems for moving large masses vertically, in the presence of high inertial forces, require high power and motion processing elements (usually screw-nut) gauge [1]. For these reasons, price and power consumption have undesirable large values. Kinematic chains used to ensure maximum speed can reach 12 to 15 m / min, and acceleration times and maximum braking times are the order of 0.1 - 0.2 s. From these considerations, the resulted accelerations is the order "g/ 4", accelerations which in presence of masses of tens of tons, lead to significant inertial effects.

The idea behind building a balancing system is taking the moved weight by a different system than the kinematic advance chain. Taking may be wholly or in part or even it can be a so-called super takeover. Taking in part is the most widely used and it usually consists in downloading the kinematic advance chain by 80-85% of the displaced mass. The total taking is more of a theoretical aspect, for calculation, when is considered the 100% takeover of the mass, and not used in practice, due to the fact that at reversals of way can occur the phenomenon of settlement on different sides of the nut, which can result in non-taking the clearance.

If the balance force exceeds the weight, is made more than downloading, a pre-stressing with effects of settlement on the opposite side than the one where sits in the presence of weight.

Balancing systems, in terms of the acting mode are:
- Mechanical, Figure 1;
- Hydraulic, Figure 2.

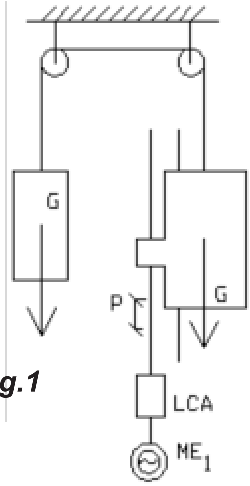


Fig.1

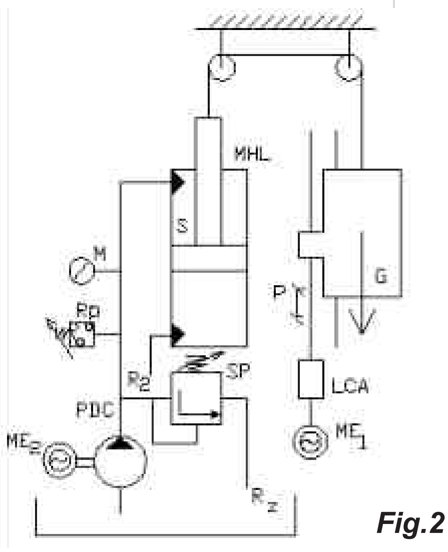


Fig.2

In case of mechanical balance, counterweight balances null load, but it doubles the mass of the system, which reduces the applied accelerations and increases the resistance structure of the machine. In case of hydraulic balancing, the load is balanced by the pressure created in the circuit and applied to a hydraulic motor MHL [2]. Mass increase is insignificant and higher accelerations can be obtained if the hydraulic system responds favorably. Machine-tool construction is "slim" and the gauge is greatly reduced. This is the most common solution for CNC machines.

In the above figures were made the following notations: G-balance weight, ME1-electric motor for driving the advance kinematic chain, R-reducer in the kinematic advance chain, PDC-constant flow pump, ME_2-engine for driving the pump, SP-pressure valve, M-manometer, Rp -pressure relay, Rz-tank, LCA- kinematic advance chain, p-step of driving screw, M-manometer. Diagram in Figure 2 is a schematic diagram, in reality more complicated, as we shall see below.

2. BALANCING THE SCENES AT VERTICAL LATHES AND MILLING MACHINES PORTAL

For vertical lathes and milling machines with portal, in CNC variants [3], the most commonly used scheme is shown in Figure 3.

PDV is vane pump, adjustable flow and pressure regulator, the response time being of the order of 0.1 s. During the phases of and STOP, the regulator provides a maximum pressure of 75 daN/cm^2. For the descent phase, SP-pressure valve provides at consumer constant pressure of 85-90 daN/cm^2. The scheme was completed with a hydraulic accumulator, Ac. It performs many functions: cushioning pulsations, ensure the flow peaks, takes over any changes in volume due to temperature and provides load during the STOP phases [4].
In figure 3, were also noted: Rz-tank, MHL-hydraulic linear motor, with plunger, M1 and M2-pressure gauges, Ss - check valve, ME-electric motor of driving the pump.

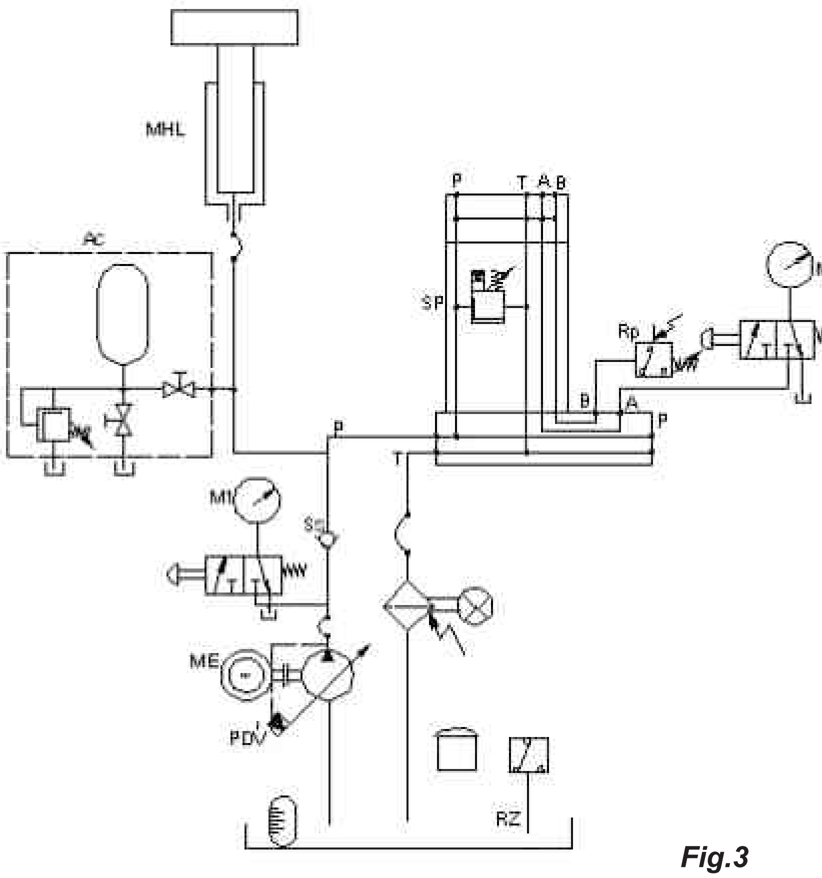


Fig.3

3. MATHEMATICAL MODELING OF HYDRAULIC BALANCING SYSTEMS

The above presented systems are used in heavy machine tools, such as lathe mills, SC14-SC43 range, as well as in boring and milling machines (AFP). In case of lathe mills is balanced the slides (Z axis) and in boring and milling machines the encasings (Y axis).

PDV pump, with pressure regulator, is a variable flow pump, types axial piston or blades pump recommended, that operates according to the characteristic of Figure 4.
If the working pressure p is less than p11, the pump provides maximum flow required. If the pressure exceeds the p11, but is lower that p12, the flow can take any value between 0 and Qmax. Displacement of the balanced load is performed using the kinematic chain of respective axis, as shown in Figure 5 [5].

Electric motor ME, through reducer R, actuates the driving screw SC. Load is so moved by the two systems: kinematic advance chain and balancing installation. Since maximum requests appear when lifting the load, this case will be studied further.

For balanced slide, shown in Figure 5, when lifting in dynamic regime, the following relations can be considered:

$$M \cdot \frac{dv}{dt} + M \cdot g = p \cdot S + F_1 \quad (1)$$

$$Q = S \cdot v + a \cdot p + \frac{V_M}{E} \cdot \frac{dp}{dt} \quad (2)$$

$$Q = \begin{cases} Q_{\max}, p \le p_{11}; \\ Q_{\max} \cdot \dfrac{p_{12} - p}{p_{12} - p_{11}}, p_{11} < p < p_{12} \\ 0, p \ge p_{12} \end{cases} \quad (3)$$

In relationship 1-3, were noted: M - reduced mass of the displaced load, p –instant pressure from balancing installation; S - balancing piston surface; F1 - the force required to driving screw (SC), a - linearized coefficient of flow losses proportional to pressure; VM - the average oil content of the balancing cylinder, E - modulus of oil elasticity,

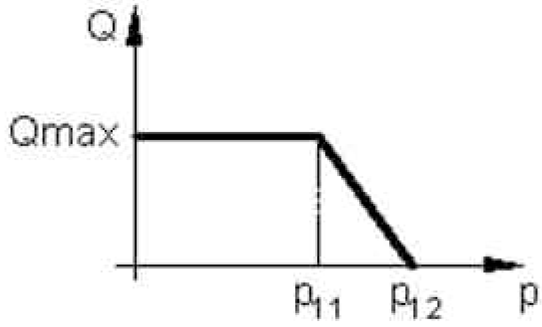


Fig.4

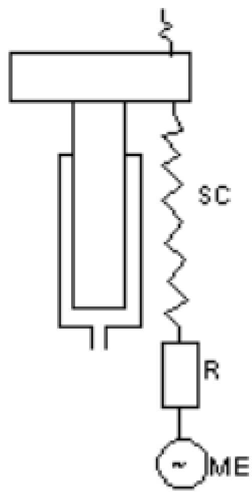


Fig.5

Q - instantaneous flow, Qmax - maximum pump flow, p11 and p12 - pressures that define the behavior of the pressure regulator.

It is considered that the electric motor for driving the kinematic advance chain has an accelerating characteristic of the type shown in Figure 6.
In period t_a you may consider that the engine accelerates linearly from 0 to maximum speed v_{max}. Analytically, behavior of the electric motor can be expressed:

$$v = \begin{cases} a \cdot t, t \le t_a; \\ v_{\max}, t > t_a \end{cases} \quad (4)$$

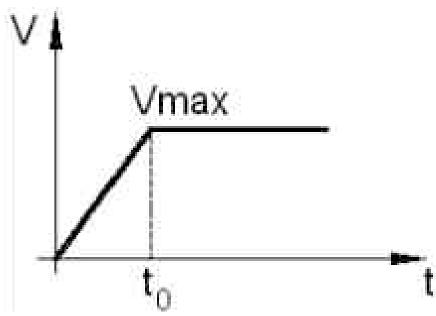


Fig.6

If we note $F_2 = p \cdot S$ to develop a simulation program can be considered for the calculation schematic diagram in Figure 7.

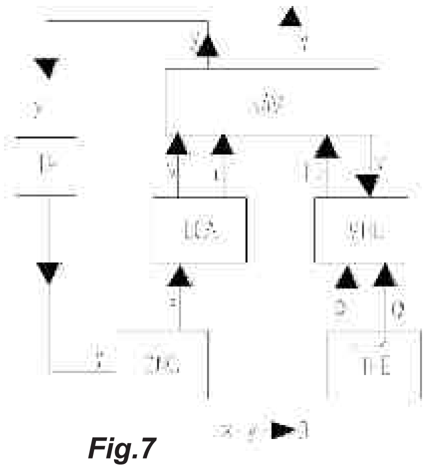


Fig.7

Movable load (RAM) is divided into components F_1 and F_2 taken over by the kinematic advance chain (LCA) and hydraulic balancing installation (IHE). Through the control equipment (CNC), it can be determined the speed (*v*) and displacement (*x*). Real displacement (*y*) is measured by position transducer, type ruler (TP). According to the hydraulic installation characteristics, through the pump and its pressure regulator is determined the dependence of pressure and flow (*p/Q*).

The hydraulic balancing installation, with pump and pressure regulator are recommended for heavy machine tools, which are used for pressures above 80-90 bar. Fast travel speeds for balanced loads can reach without problems 8-10 m / min, which is acceptable to heavy machine tools.

It is recommended the dynamic calculation of balancing systems by simulation. Modeling these systems will take into account the characteristics of the system. In case of machine tools which are great strokes, will take into account the gearing system of pulleys used for stroke demultiplying. Pneumo-hydraulic accumulator maintains system pressure, in STOP phase and provides flow tips and its depreciation.

A secondary role of the balancing hydraulic system is "hydraulic lock" axis in case of maintaining the electric motor on the axis. So there is no need for a lock system with skates or pills.

4. SIMULATION OF BALANCING SYSTEMS OPERATION

To study the operation of balancing systems, presented above, we recommend using the software package AUTOMATION STUDIO. It redraws the hydro schematic diagram leaving only the active elements, as shown in Figure 8.

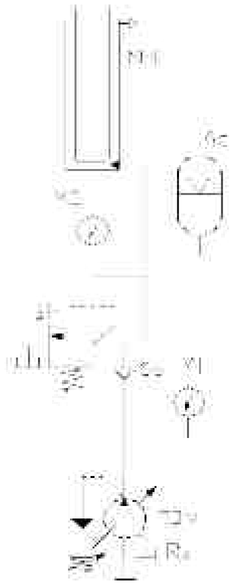


Fig.8

Based on the above schematic diagram can be carried out simulations for the work phases: STOP, ASCENT and DESCENT.

In STOP phase, as shown in Figure 9, the pressure within the system is the one adjusted by the pump regulator, the provided flow being virtually zero.

In STOP phase, as shown in Figure 9, the pressure system is controlled at regulator of the pump, which the provided flow is virtually zero.

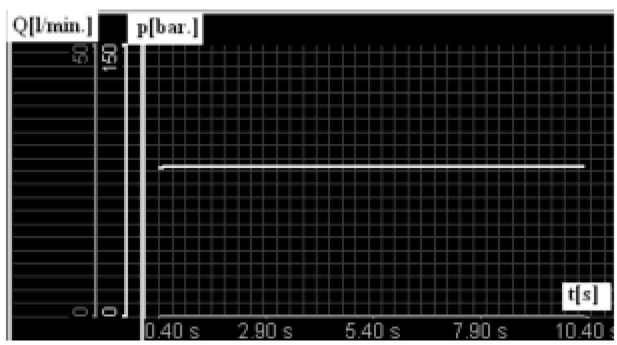


Fig.9

At ascending of the slide, pump and accumulator ensure the consumption of necessary flow, at the linear hydraulic motor, according to the preset speed, as shown in Figure 10.

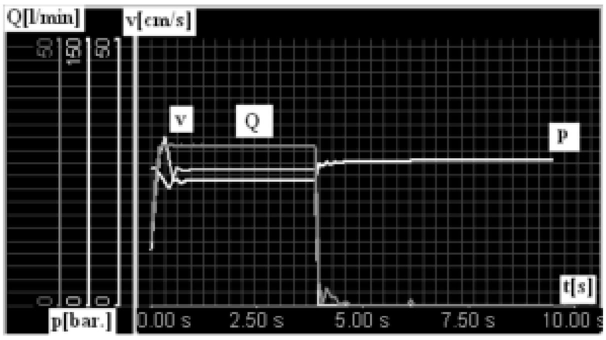


Fig.10

Maximum speed, for the simulated case, is 13cm / s ~ 8m/min.
At descending of the slide, pump is again in zero flow position, the fluid from the hydraulic motor is expulsed through the pressure valve SP, resulting the features from Figure 11.

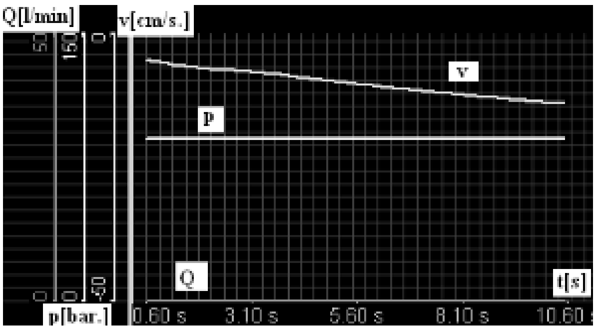


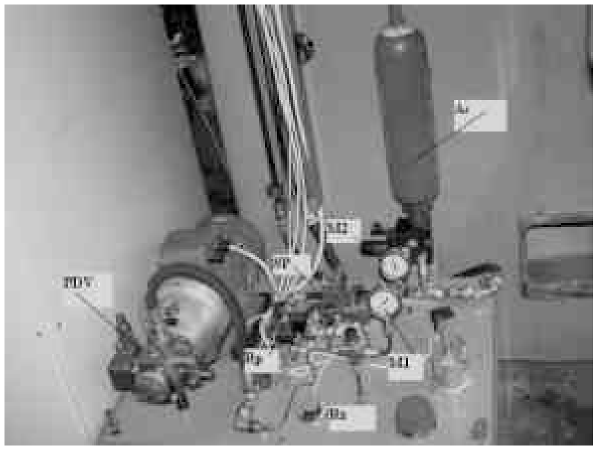
Fig.11

The pressure is the one adjusted to pressure valve SP, the motor speed is that preset for the kinematic advance chain.
Through the simulation may be made a more accurate sizing of hydraulic components, which will be used: pumps, pressure valves, accumulator etc.

5. THE HYDRAULIC INSTALLATION FOR BALANCING OF THE SLIDE

The hydraulic installation, developed frequently for vertical lathes SC14-33CNC range, is shown in Figure 12, where we kept the notations used in Figure 3.

a



b

Fig.12

The tank has a usable volume of 200l and is positioned so that it can be made the supply of the linear hydraulic motor, through the chain system of machine.

6. CONCLUSIONS

In case of heavy CNC machine tools, the using of hydraulic balancing systems represents a modern solution to meet the requirements of accuracy and productivity. By using this solution, instead of counterweight balancing system, the machine-tools are lighter, the its structural deformations are reduce, and achieving the necessary acceleration, for the great speeds, is no longer a problem.
The basic elements for these schematic diagrams are pumps with pressure regulator and pneumo-hydraulic accumulators.

For calculations in static and dynamic regimes, is recommended the using of specialized software, that are working based on libraries updated by hydraulic equipment manufacturers.

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MECHATRONICS & INTEGRONICS GALAXY>> - Intelligent Synergetic Vector for the Development of Industrial Education and Research

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Abstract

The scientific paper approaches the integrative mechatronic micro-engineering used in intelligent manufacturing and automations into a new systemic and synergistic vision and in a new integronized design addressing the global concept of "system / complete product micro-system”, ensuring the innovative priorities and useful and effective solutions for the advanced high-tech domains.

The scientific work exemplifies concrete applications in intelligent manufacturing processes and automation of integrative mechatronic micro-engineering on industrial areas in the manufacturing processes and the processes of measuring, adjustment, control and monitoring.

The scientific paper sets out the future of integrative mechatronic micro-engineering on high-tech fields, for a NEW INDUSTRY, A NEW GLOBALIZED ECONOMY AND A NEW INFORMATION SOCIETY.

Keywords: micro-engineering, integrative mechatronic, intelligent manufacturing, integrative design, system / complete product micro-system, high-tech fields.

1. Introduction

The new concept of integrative mechatronic micro-engineering used in the intelligent manufacture and automation, refers to the synergistic integration of engineering / mechanical precision micro-engineering with other high-tech fields as electronics engineering and computer engineering in the design and manufacture of intelligent products and systems with self adaptability, flexibility, speed work and high decision-making mix with high intelligence and informatization.

The concept approached by the author addressed the use of systemic integration of systems / micro-systems, sensor architecture and actuators, controllers and processors, in the complex processes of programmability, interactive communication, self adjustment, self diagnosis and simulation.

Research conducted by the author in that direction summarizes new integronized concept in a new vision for addressing the global concept of "complete system of products” that provide innovative priorities and useful and effective solutions in the advanced high-tech fields.

New concept, created by the author, has as main objectives:

- improving and upgrading systems / products and processes;
- implementation of management, coordination, evaluation, monitoring and decision software;
- computerization and simulative guiding of system functions and communications and interactive dialogue;
- self diagnosis of states and functions in the complex matrix system and the intelligent and automated process;
- mathematical modeling of flexible generation of movements and interaction with the environment;
- addressing system techniques in information processing and control decision;

·intelligent interface integration between the "governor" and "technological environment", creating the "vital organ" and the "anatomical elements with many senses" for intelligent technology systems and automated; modular and integrated design pf actuators, mechatronic technology devices, hardware system design, intelligent controller, sensor architecture, smart mobile effectors, intelligent electronic units, computer units and software process in an inclusive construction of the overall system structure and new generation on levels of processing and logical decision;

The new concept and systemic and synergistic vision regarding integrative mechatronic micro-engineering used in intelligent manufacturing and in automation, are exemplified in the paper, with practical applications in manufacturing processes and the processes of measuring, adjustment, control and monitoring, setting out the future of HIGH –TECH domain, for a new computerized and globalized industry.

2 Concrete applications of integrative mechatronic micro-engineering in intelligent manufacturing and automation

2.1. INCDMTM Philosophy (National Institute of Research and Development in Mechatronics and Measurement Technique from Bucharest – Romania), identified in the mix of new adaptive and generative engineering concepts and techniques

The essence of "INCDMTM philosophy" synthesized in the Triad Research - Manufacturing – valorification is identified by:

Ø capacity, competitiveness and reliability;
Ø real innovative and effective contributions;
Ø high-tech mechatronic systems and equipments;
Ø maintenance, traceability and dependability;
Ø accuracy, reliability, and resolution;
Ø hardware, software and computerization;
Ø assessment, diagnosis, monitoring and decision;

The mix of new adaptive and generative engineering concepts and techniques [1], [3] is based on the accumulation of new knowledge and discoveries, interactive communication, organic and synergetic integration of components, products and systems, modeling and simulation, expertise and self diagnosis, self-adjustment, management and decision.

2..2. INCDMTM concept of intelligent integrated technology

In its modular structure, new engineering concepts and techniques mix is given in outline in Figure 1.

Elaboration of integrated mechatronic intelligent technologies through the concept "philosophy INCDMTM" based on the mix of new engineering concepts and techniques and adaptive system, based on specialization "mechatronist engineer" now, and/or "integronist engineer" [2] for the future, training started in Romania in the years 1996, although in the world market, it started in 1978 (in Japan).

Therefore, the concept of "INCDMTM philosophy" of making intelligent mechatronic technologies, involves in an engineering structure, synergistic combination and integration of engineering/precision mechanics micro-engineering, through mechanical/micro-mechanical systems/micro-systems, components and technological devices, the execution, elements, sensors/micro-sensors, transducers/micro-transducers, etc., electronics by integrated circuits/micro-circuits, electronic systems/micro-systems, etc., by electro-techniques by electric engines/micro-engines, actuators/micro-actuators, electrotechniques elements/micro-elements, circuits /and information systems/ computing microsystems, processors/ microprocessors, controllers/ microcontrollers, softwares, etc.., all in an architectural correlation with engineering/ materials microengineering, engineering/ industrial microengineering, systems/ biosystems engineering/ microengineering , etc..

This complex structure [4], is made logic and integrated depending on the type of technology/ micro-nanotechnology required by manufacturing processes and conceptual installed in real modulation schemes in accordance with fig.1 to be developed systems/ equipments and technologies/ mechatronic intelligent micro-nanotechnologies with concrete applications in industry.

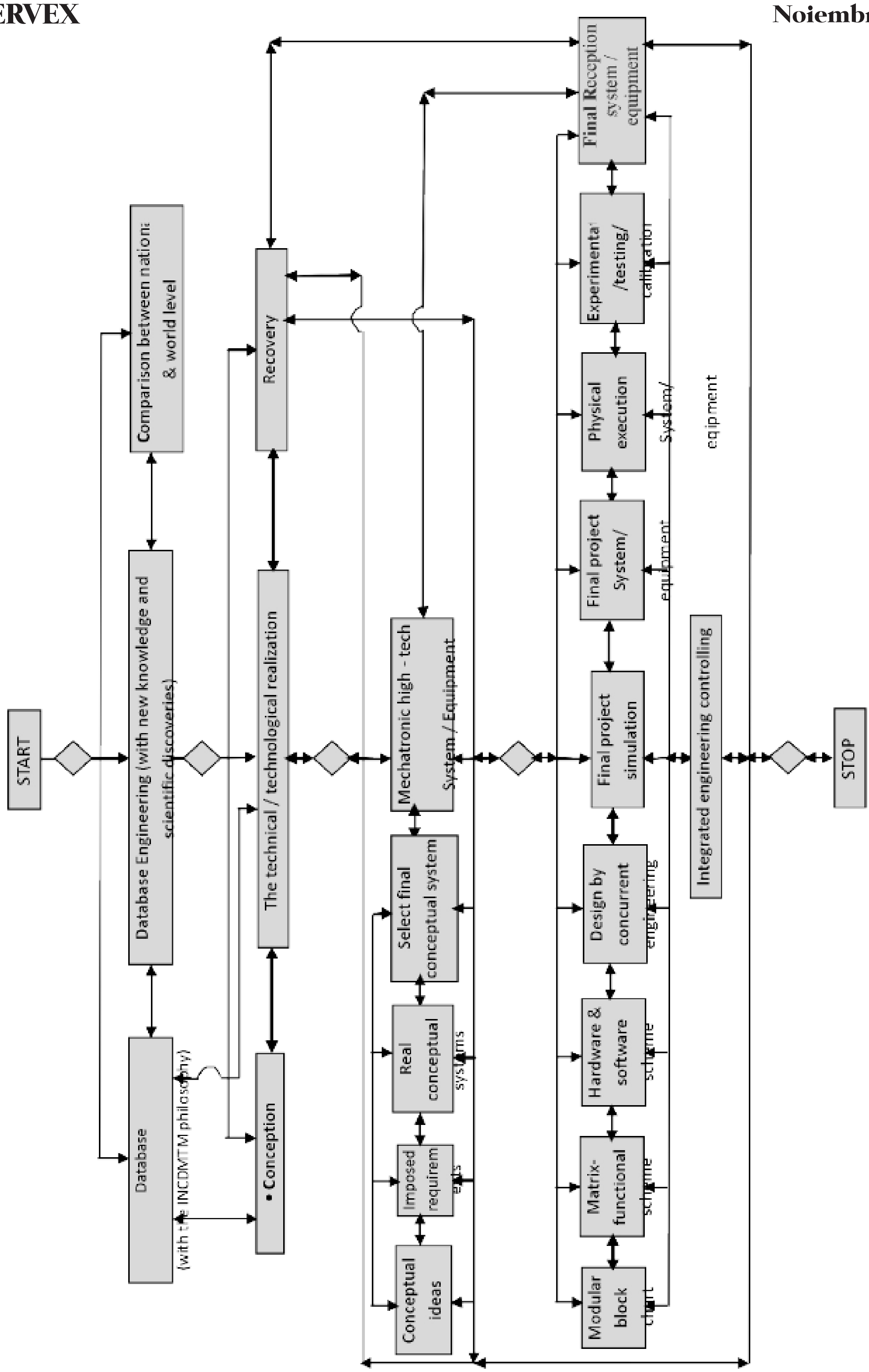

Fig.1 A modular scheme new engineering concepts and techniques Mix

The concept "philosophy INCDMTM" of making integronique intelligent technologies [2], implies in a vision similar to mechatronics, a complete integronized engineering structure of several areas, both technical and scientific areas and exact sciences, social sciences and humanities, in a systemic integrated and synergetic apprehension, cumulating constructive and functional solutions, with other constructive solutions and functional multidisciplinary background and motivation, similar to the human body, speech and behavior of intellectual, physical, moral, social and human state, etc..

2.3. Examples of integrated intelligent technologies into the automotive industry in Romania (SC Automobile Renault - Dacia SA Pitesti and made by INCDMTM)

2.3.1. Technology and mechatronic intelligent equipment [5] to control diameters and axial level from "crankshaft" (Fig.2)

fig.2

Technical-functional characteristics:
Time measurement cycle: max. 50 sec.;
Display Resolution: 0.1 μm;
Measuring Transducers: 24 buc./ZDB103 / race ± 1 mm;
Industrial Computer: Central CMZ 200 ETAMIC / 220 Vca/50 Hz;
Interface Mechanical device -Central: SATELLITE ETAMIC;
Working Programs: Windows Operating System / Measurement Program INCDMTM-Bucharest;
Structure:
Central CMZ 200 ETAMIC with Satellite SMD module;
Grounding and Control Mechanical Systems Control Table.
Calibration and certification:
The intelligent mechatronic equipment was calibrated and metrology certified, achieving parametric grades in accordance with the European rules and standards by the beneficiary company, Renault France.

2.3.2.. Technology and intelligent mechatronic equipment [5], to verify the "skid tumbler" (fig.3)**Technical-functional characteristics:**
The pressure of compressed air supply: 4-6 bar;
Pressure of regulator after work: 3 bar;
Measuring cycle time: approx. 17 sec.;
Display Resolution: 0.1 μm;
Inductive measuring transducer: ZDB103/ETAMIC / ± 1 mm;
Pneumo-electronic measuring transducer: TPE 99 / 1 ETAMIC;
Industrial Computer: Central CMZ 200 ETAMIC 220 Vca/50 Hz;
Mechanical Device-Central Interface: SATELLITE ETAMIC SMD;
Working Programs: Windows Operating System / Measurement Program-INCDMTM Bucharest
Structure:
Control Table;
Grounding and Control Mechanical Systems;
Central CMZ 200 ETAMIC with Satellite SMD module.
Calibration and certification:
Intelligent mechatronic equipment was calibrated and metrology certified, achieving parametric grades in accordance with the European rules and standards by the beneficiary company, Renault France.

fig. 3

2.3.3. Technology and intelligent mechatronic equipment [5], to control the tightness at "Carter Oil S2G – Crude" (fig.4)**Technical-functional characteristics:**
 Power supply: 220 V power ca/50 Hz; compressed air: 6 bar.
 Working Pressure (adjustable on the machine regulator): 5 bar;
 Control Pressure: 0.98 bar- low pressure circuit, 0.98 bar high-pressure circuit.
 Level of waste accepted: 25 cm^3/min;
 Cycle time: 60 sec.
Structure:
 Layer;
 A grounding system of the work;
 Sealing-seal part;
 Marking system;
 ATEQ cell;
 Pneumatic panel;
 Automatic programmable machine Siemens with operator panel;
 Wenglor immaterial barriers for protection;
 Marking system.
Calibration and certification:
Intelligent mechatronic equipment was calibrated and metrology certified, achieving parametric grades in accordance with the European rules and standards by the beneficiary company, Renault France.

fig. 4

2.3.4. Technology and intelligent mechatronic equipment [5], to control the tightness "Carter Oil S2G - Factory" (fig.5)Technical-functional characteristics:
 Power supply: 220 V power ca/50 Hz; compressed air 6 bar.
 Working Pressure (adjustable on the machine regulator): 5 bar;
 Control Pressure: 0.98 bar - low pressure circuit, 2.90 bar high-pressure circuit.
 Level of waste accepted: 25 cm^3/min;
 Cycle time: 60 sec.

Structure:
Layer;
Grounding system;
Systems-sealing closure of the song with pneumatic cylinders;
Marking system;
ATEQ Cell;
Pneumatic panel;
Automatic programmable machine Siemens with operator panel;
Wenglor immaterial barriers for protection;
Marking system
Calibration and certification:
Intelligent mechatronic equipment was calibrated and metrology certified, achieving parametric grades in accordance with the rules and Eruopean standards by the beneficiary company, Renault France.

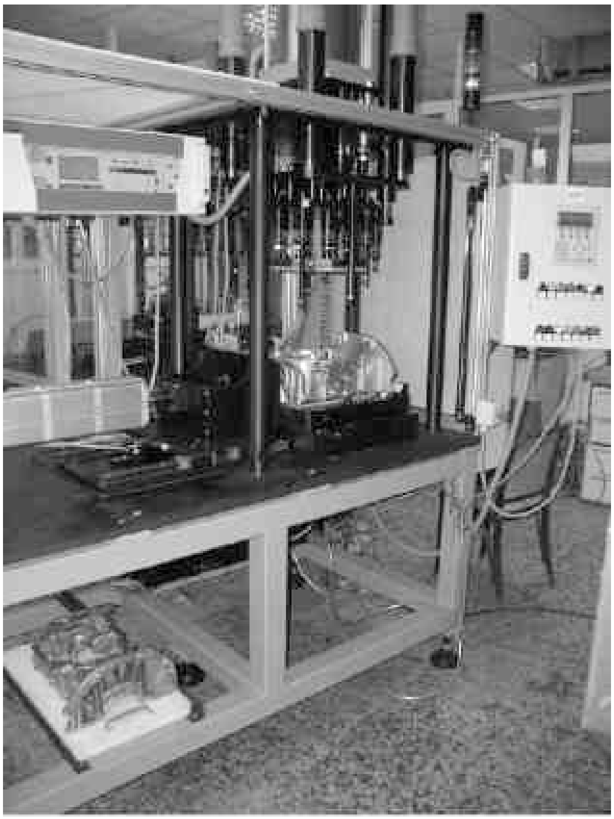

fig. 5

2.3.5. Technology and intelligent mechatronic equipment [5], for inspection and marking tightness "cylinder head" (fig.6)
Technical-functional characteristics:
Power supply: 220 V electricity ca/50 Hz; compressed air 6 bar.
Working Pressure (adjustable on the machine regulator): 5 bar;
Pressure control: 1 bar;
Level of waste accepted: 25 cm^3/min;
Cycle time: 60 sec.
Structure:
Layer;
A grounding system;
Ttravel system of the work in measurement position;
Systems-sealing closure of the work with rolls and pneumatic cylinders;
Marking system;
ATEQ Cell;
Pneumatic panel;
Electronic panel;
Weng immaterial barriers.
Calibration and certification:
Intelligent mechatronic equipment was calibrated and metrology certified, achieving grades are parametric in accordance with the rules and European standards by the beneficiary company, Renault France.

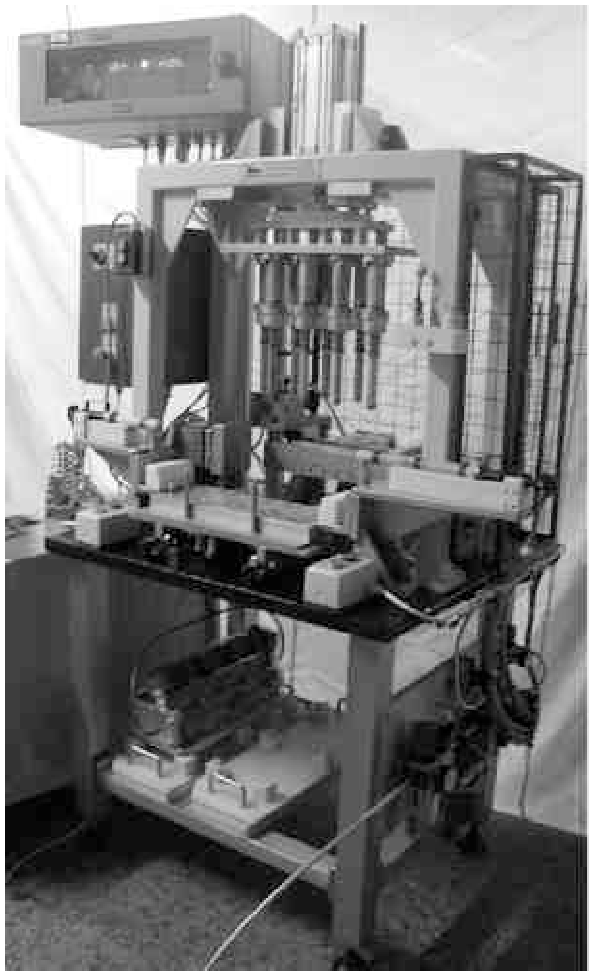

fig. 6

2.3.6. Technology and intelligent mechatronic equipment [5], to control the tightness "cylinder head assembled motor F8Q" (fig.7)

Technical-functional characteristics:

Supply voltage: 220V/50 Hz;
Supply air pressure: 6 bar;
Working pressure (regulator set on the machine): 5 bar;
Pressure control tightness: 1 bar;
Loss tightness admitted: 25 cm^3/min;
Cycle time: 30 sec.

Structure:

Layer;
Grounding system of the work;
Travel system of the work in measurement position;
Systems-sealing closure of the work with pneumatic cylinders;
Marking system;
ATEQ cell;
Pneumatic panel;
Electronic panel;
Weng immaterial barriers.

Calibration and certification:

Intelligent mechatronic equipment was calibrated and metrology certified, achieving parametric grades in accordance with the rules and European standards by the beneficiary company, Renault France.

fig. 7

2.3.7. Technology and intelligent mechatronic equipment [5], for uniformity profiles measured in "gears" (fig. 8)

Technical-functional characteristics:

Measuring range: ± 0.03 mm;
Measurement area: ± 5 mm;
Accuracy: 0.1 µm;
Resolution: 0.01 µm;
Fidelity: ± 0.0025 µm;

Structure:

Mechanically fixing system;
Mechanically grounding system for gears;
Mechatronic systems for accurate measurement (4 units);
Pneumatic drive system;
Information system for processing and displaying data;
Command drive system;
Electronic system of immaterial barrier.

Calibration and certification:

Intelligent mechatronic equipment was calibrated and metrology certified, achieving parametric grades in accordance with the rules and European standards by the beneficiary company, Renault France.

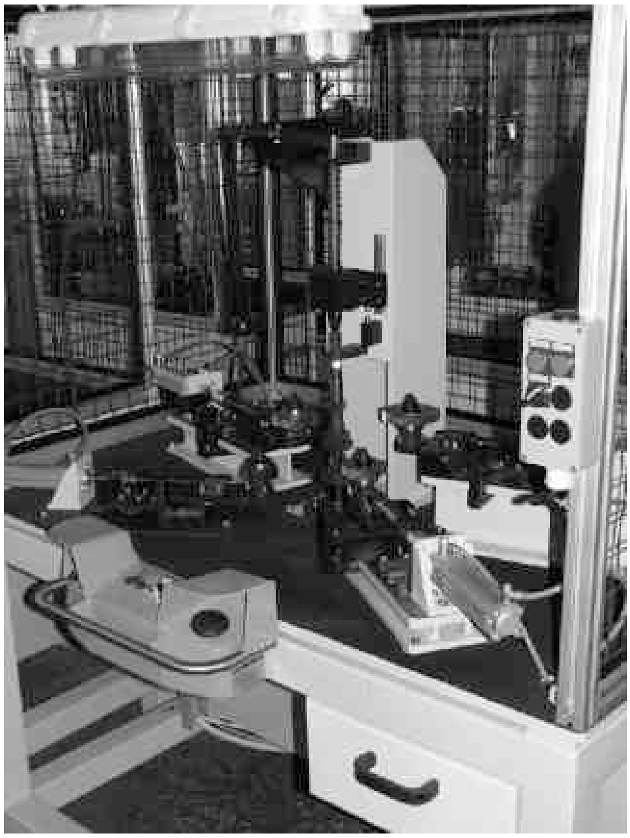

fig. 8

2.1.1. Technology and intelligent mechatronic equipment [5], to verify the tightness of "Carter mechanisms finished piece" (fig. 9)

Technical-functional characteristics:

Power supply: 220 V electricity ca/50 Hz; 6 bar compressed air.

Working Pressure (adjustable on vehicle regulator): 5 bar;

Control Pressure: -0.5 bar;

Level of waste accepted: 25 cm^3/min;

Cycle time: 45 sec.

Structure:

Layer;

A grounding system;

Travel system of the work in measurement position;

Systems-sealing closure of the work with rolls and pneumatic cylinders;

Marking system;

Immaterial barrier of protection;

ATEQ F520 cell with calibrated nozzles;

Automatic programmable machine Siemens with operator panel;

Pneumatic panel FESTO elements;

Calibration and certification:

Intelligent mechatronic equipment was calibrated and metrology certified, achieving parametric grades in accordance with the rules and European standards by the beneficiary company, Renault France.

fig. 9

2.4. Examples of intelligent technologies integrated in Metrology

2.4.1. Micro-nanotechnologies for integrated control of surface topography - roughness and contour (fig. 10)

Micro-Nanotechnologies for intelligent control of surface topography are developed through intelligent equipments type „Form Talysurf 120 Taylor Hobson", special software for ultraprecise determinations of the surfaces roughness (microgeometry), shape (macrogeometry) of revolution surfaces, of areas liniarity/ perpendicularity and parallelism and high metrological characteristics, such as high-resolution on Z axis (about 17 nm), detector high-resolution (about 8 nm/ 0.5 mm), areas of measurement [for x, z: 120/28 mm (for contour) for x, z; 120/1mm (for roughness)].

fig. 10

Maximum error of intelligent mechatronic equipment presented was metrologically determined in the following value matrix:

Maximum error 0.05 μm 1.8 μin	Maximum uncertainty ±0.025μm ±1.00μin
Mean Derived Radius 12.5000 mm 0.49213in	Maximum uncertainty ±0.025μm ±1.00μin

Applicability of intelligent control micro-nanotechnologies of surface topography - roughness and contour, is found in industrial processes and laboratory for measuring and verifying the roughness and contour for axes, guides, rings of rolling bearings, gears, etc.. In different industrial media: aeronautics, autotronic, mechatronics, machines construction etc..

3. Conclusions

Mechatronics integrated microengineering used in the intelligent manufacture and in automation, is based on the mix of new engineering concepts and techniques adopted and generational, containing for each specific intelligent mechatronic equipment presented, intelligent systems and subsystems, with appropriate functions, as follows:

systems / subsystems and components of high precision micro-nanomechanics microengineering [microconductors / microsensors / etc.];

systems / subsystems and microcomponents from microelectronics microengineering and microelectrotehniques [integrated circuits /microengines /microactuators / microcontrollers /micro digital displays / microconvertors A /D and D /A, etc. ..];

systems / subsystems and microcomponents of informatics microengineering [microhardware / peripherals microequipments / software / etc.];

systems / subsystems and microcomponents of advanced micromaterials microengineering;

structures / microstructures, principles and functions in other areas: physics, chemistry, mathematics, etc.. (as exact sciences), economics, psychology, sociology, etc. (as other sciences);

Mechatronics integrated microengineering used to realize engineering / microengineering systems /subsystems of intelligent manufacturing and automation, uses, into a new systemic and synergistic vision and in a new integronized design, innovative solutions, useful and effective, with high added-value and high intelligence.

4. References

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[3] **Gheorghe Ion, Gheorghe :** Ingineria Instrumentaţiei Inteligente şi Informaţionale, Ed. CEFIN – 2005 – ISBN 973-87042-4-3

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[5] **Catalog INCDMTM:** Fişe tehnice, Echipamente mecatronice şi integronice inteligente pentru măsurări, verificări şi control integrat.

Remote Monitoring of Decentralised Wastewater Technology - Focus on Small Wastewater Treatment Plants (SWWTP)

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Small wastewater treatment plants have been recognised as a permanent solution for wastewater treatment in the decentralised domain. In the future, they will remain an important part of wastewater treatment in Europe. In the long run, up to 20 million small wastewater treatment plants are expected in the EU. The development status of the employed treatment techniques achieved in the past years has reached so far, that attainable cleaning capacities of small wastewater treatment plants hardly differ from those of large wastewater treatment plants anymore.

Requirements for the application of small wastewater treatment plants as a permanent solution for the treatment of domestic wastewater include, besides the basic efficiency, a proper construction and operation as well as the monitoring and maintenance of the plants. Against the background of increasing numbers of mechanical-biological small wastewater treatment plants in Germany, in 2009 there were 2 million plants only in Germany, as well as Europe-wide, the maintenance and monitoring of small wastewater treatment systems is gaining in significance. Considering the high amount of small wastewater treatment systems, a mobile and comprehensive monitoring system is only feasible at high costs. In practice, official inspections are therefore made only on a strongly limited basis.

Overall, deficits in the operation and monitoring of the plant can be lead back to a lack of motivation and knowledge on the operator side as well as a lack of time on the side of the responsible authorities. This leads to failures not being repaired immediately, which can result in required efficiencies of the small wastewater treatment plants not being achieved.

A possibility to overcome these deficiencies is the continual remote monitoring of small wastewater treatment plants. Advantages include that the effort and responsibility of the operator on site are reduced, maintenance is more effective and efficient and official on site inspections can be replaced. All in all, ecological and economical benefits arise, which justify increased costs in systems engineering.

The PIA was supporting the Society for the Promotion of Applied Computer Science (GFaI -Gesellschaft zur Förderung angewandter Informatik e.V.) with practical plant knowledge and the execution of test runs for the development of an intelligent system for the remote monitoring and mobile maintenance support of small wastewater treatment plants.

This is an adaptable monitoring system on the basis of information regarding the construction of the plant (machine elements and aggregates, e.g. containers and compressors), the applied technology for the plant control and the treatment technology with the according process steps including the chronological flow parameters.

Process parameters are determined by signals from the existing plant control which can be derived from outside as well as by the employment of external sensors. They are then sent to a central server via the telephone network. To document the operation, relevant process data (process images from the perspective of the monitoring, recognised errors/warnings) and additional activities of the operator (reactions to errors, conducted maintenance, etc.) are collected in a tamper-resistant manner and archived for a preset time frame. Occurring errors are classified into the following basic categories: general plant errors (e.g. electricity failure), instrumental errors (single aggregates), process errors (errors of the plant control) and warning messages due to statistical analyses (e.g. exceeding the allowed operation time). In conclusion, reports are made which show the gathered data in a form desired by the user. A connection to digital maintenance protocols is possible.

It needs to be emphasised that the monitoring system does not directly intervene with the plant control. The plant should rather be regarded as an independent component, which can be added on to any arbitrary small wastewater treatment system type.

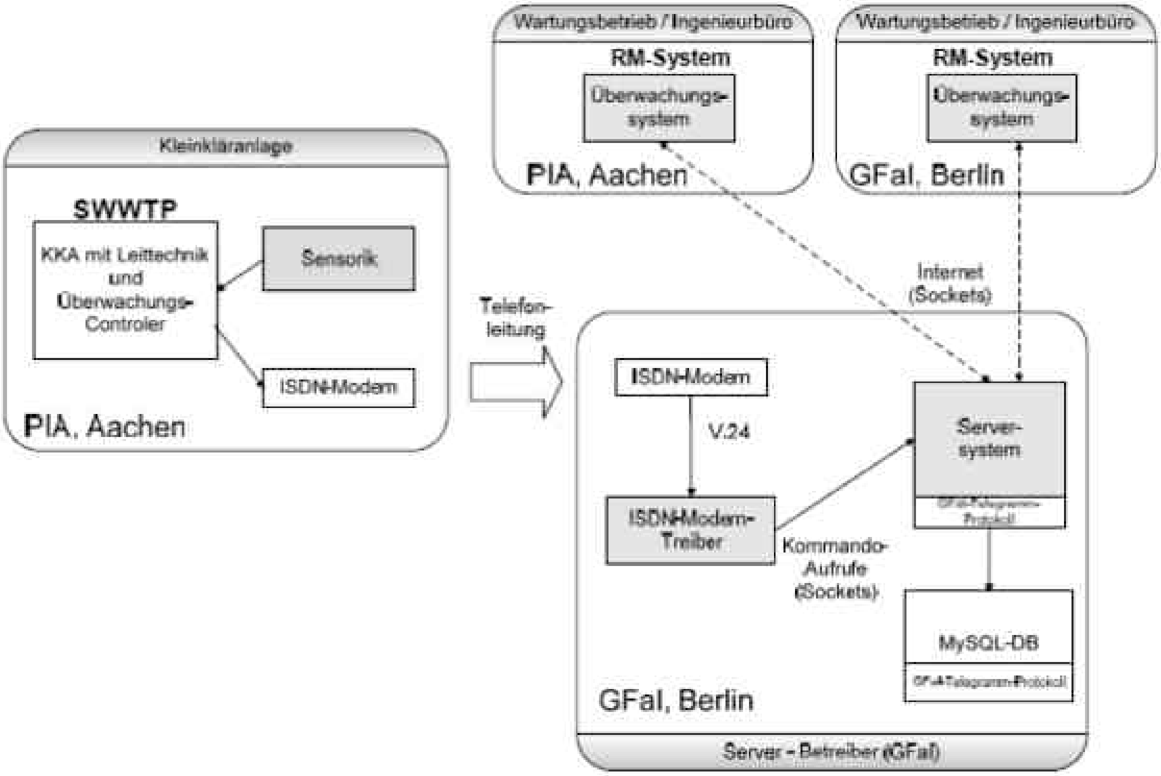


Fig 2:*System architecture of the monitoring system*

ADVANCED ALGORITHM FOR OPTIMAL DIMENSIONING OF A SIEVING EQUIPMENT FOR WASTEWATER WITH A FIXE CYLINDRICAL FINE SCREEN

Victor-Viorel **Safta**, Georgeta **Haraga**, Magdalena-Laura **Toma**

**University POLITEHNICA of Bucharest*

Abstract

The sieving equipments are technological objects of the wastewater treatment plants which ensure the separation of the large suspended solids (branches, leaves, papers, plastic-textile-metallic materials, garbage) carried by the wastewater stream at the surface or inside of it. In the paper it is presented an advanced algorithm for the determination of the main parameters, dimensional, kinematics, dynamics and energetic of a sieving equipment with a fixe cylindrical fine screen.

Keywords: waste water treatment plant, large suspended solids, sieving equipment and dimensioning algorithm.

1. Introduction

To the entrance of the preliminary treatment in the wastewater treatment plants there are foreseen sieving equipments which remove from the wastewater the large suspended solids, such as branches, leaves, papers, plastic-textile-metallic materials, garbage which are carried by the wastewater stream, inside or at the surface. The modern sieving equipments for wastewater are complex units which firstly separate the large suspended solids from the wastewater, and then extract the water from the retained material, compact and evacuate them in closed containers. The most of the modern sieving equipments have an automatic working process which ensures a precise, safe and hygienic functioning.

In the paper it is presented an advanced algorithm for the determination of the main parameters, dimensional, kinematics, dynamics and energetic of a sieving equipment with cylindrical screen.

The algorithm is conceived for implementation in practice of the sieving equipments like ROTAMAT Fine Screen Ro1 framed by Huber Edelstahl, Germany [2]. The sieving equipments ROTAMAT Ro1 are made in a typo dimensional series with 12 steps of the diameter of the cylindrical drum screen between 600 3000 mm. Every dimensional step may be provided with drum screens with the bar spacing of 6 mm or 10 mm. The typo dimensional series ROTAMAT Ro1 is designed to process a wide range of influent flows of wastewater between 200 2800 dm^3/s. In the figure 1 is presented the basic diagram of the sieving equipment ROTAMAT Ro1.

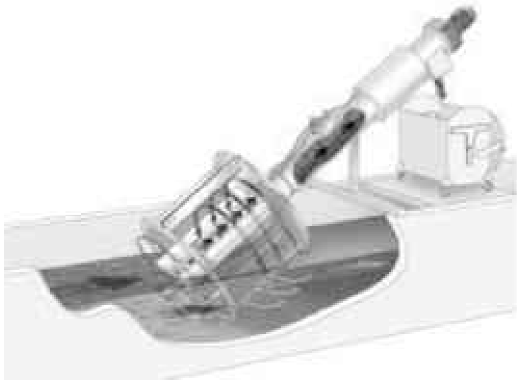
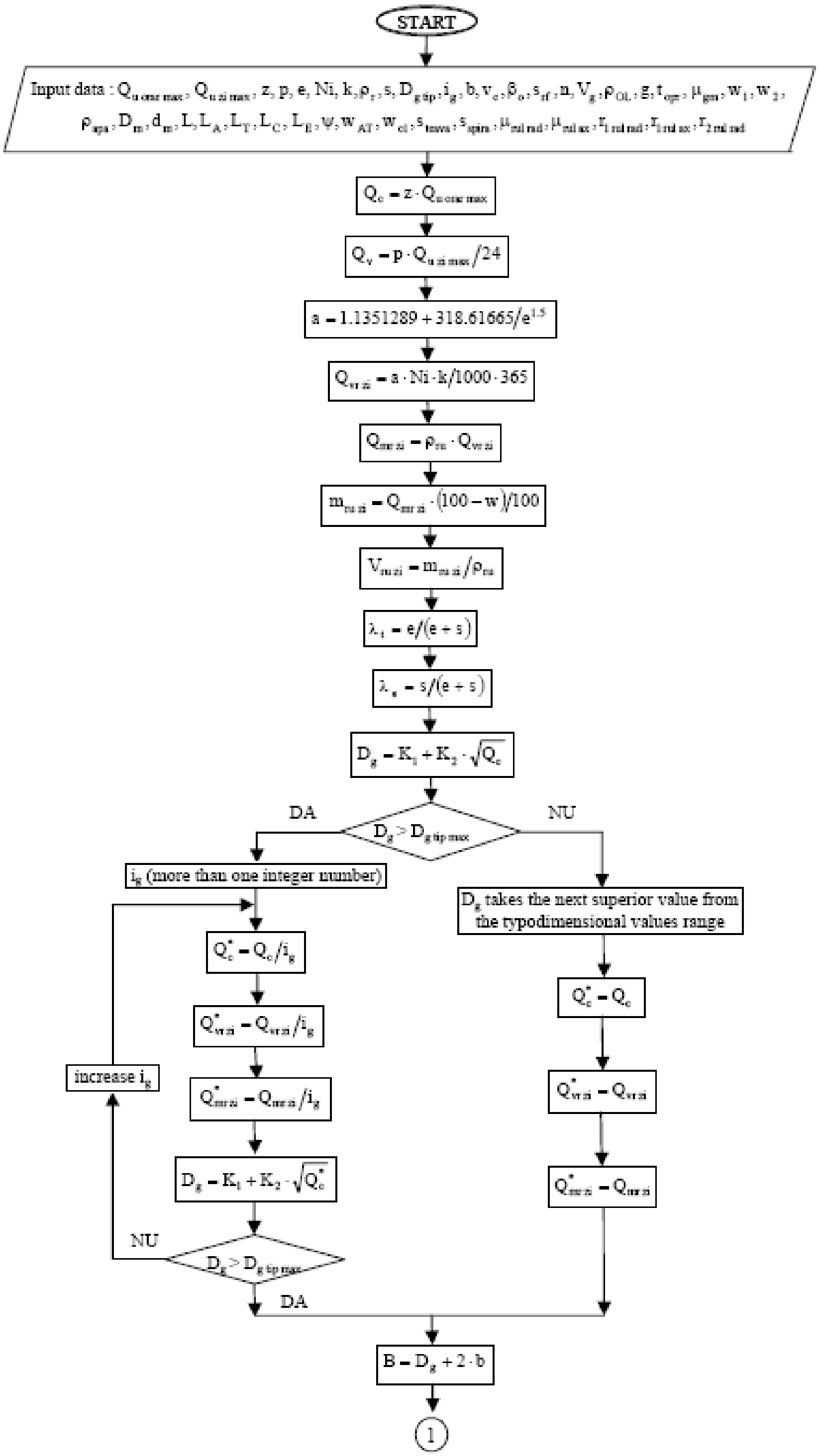


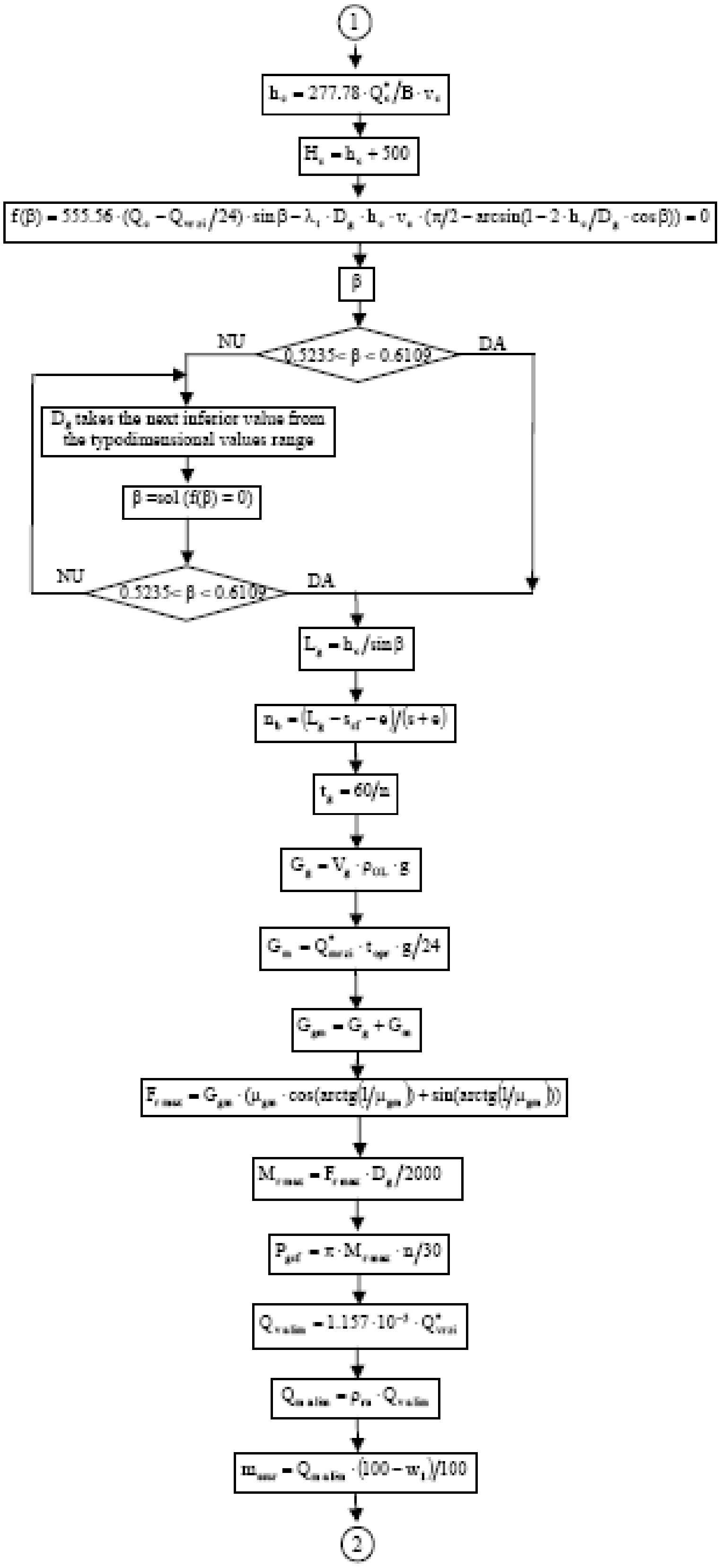
***Fig. 1** Basic diagram of the sieving equipment ROTAMAT Ro1*

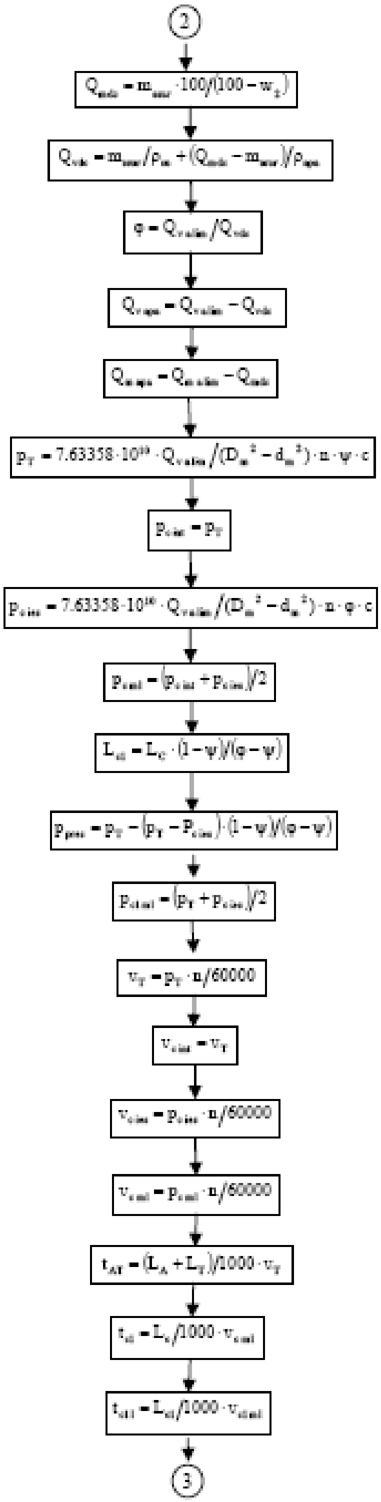
2. Advanced Algorithm for Optimal Dimensioning of the Sieving Equipment with Fixe Cylindrical Fine Screen

In order to select the optimal dimensional step from the typo dimensional series ROTAMAT Ro1 for a certain value of the wastewater influent flow and for the determination of the dimensional, kinematics, dynamics and energetic parameters of the main ensembles of the waste water sieving equipment in this

situation, it was conceived an advanced algorithm [1].The structural diagram of this algorithm is presented in figure 2. Based on this algorithm it was accomplished an interactive program that allows a rapid and convenient the determination of the values of all the parameters of the sieving equipment.
Thus it can be analyzed easily different constructive alternatives of the sieving Equipment in order to find the optimal alternative.
For the easy identification of the sieving equipment parameters, in table 1 is given their complete list, the symbols how they are encountered in the algorithm basic diagram and as the case stands their characteristic values.




1
$h_s = 277.78 \cdot Q_s^* / B \cdot v_s$
$H_s = h_s + 500$
$f(\beta) = 555.56 \cdot (Q_s - Q_{wsi}/24) \cdot \sin\beta - \lambda_1 \cdot D_g \cdot h_s \cdot v_s \cdot (\pi/2 - \arcsin(1 - 2 \cdot h_s / D_g \cdot \cos\beta)) = 0$
β
NU
$0.5235 < \beta < 0.6109$
DA
D_g takes the next inferior value from the typodimensional values range
β =sol ($f(\beta) = 0$)
NU
$0.5235 < \beta < 0.6109$
DA
$L_g = h_s / \sin\beta$
$n_b = (L_g - s_{sf} - e)/(s + e)$
$t_g = 60/n$
$G_g = V_g \cdot \rho_{OL} \cdot g$
$G_m = Q^*_{mrsi} \cdot t_{opr} \cdot g/24$
$G_{gm} = G_g + G_m$
$F_{r\,max} = G_{gm} \cdot (\mu_{gm} \cdot \cos(\mathrm{arctg}(1/\mu_{gm})) + \sin(\mathrm{arctg}(1/\mu_{gm})))$
$M_{r\,max} = F_{r\,max} \cdot D_g / 2000$
$P_{gsf} = \pi \cdot M_{r\,max} \cdot n/30$
$Q_{v\,alim} = 1.157 \cdot 10^{-5} \cdot Q^*_{vsi}$
$Q_{m\,alim} = \rho_{m} \cdot Q_{v\,alim}$
$m_{sus} = Q_{m\,alim} \cdot (100 - w_1)/100$
2


2
v_T = p_T · n/60000
t_AT = (L_A + L_T)/1000 · v_T
3

3

$$m_{TAT} = Q_{m\,alim} \cdot t_{AT}$$

$$m_{Tcl} = Q_{m\,alim} \cdot t_{cl}$$

$$G_{TAT} = m_{TAT} \cdot g$$

$$G_{Tcl} = m_{Tcl} \cdot g$$

$$F_{TAT} = w_{AT} \cdot G_{TAT} \cdot \cos\beta + G_{TAT} \cdot \sin\beta$$

$$F_{Tcl} = w_{cl} \cdot G_{Tcl} \cdot \cos\beta + G_{Tcl} \cdot \sin\beta$$

$$P_T = F_{TAT} \cdot v_T + F_{Tcl} \cdot v_{cl\,ml}$$

$$V_{ab} = \pi \cdot 10^{-9} \cdot s_{teava} \cdot (d_m - s_{teava}) \cdot L$$

$$m_{ab} = V_{ab} \cdot \rho_{OL}$$

$$m_{sp\,ct} = 10^{-9} \cdot \rho_{OL} \cdot (D-d)/2 \cdot s_{spira} \cdot (L_A + L_T) \cdot \left(1/\cos\left(\mathrm{arctg}\left(\pi \cdot d/p_T\right)\right)\right)$$

$$m_{sp\,var} = 10^{-9} \cdot \rho_{OL} \cdot (D-d)/2 \cdot s_{spira} \cdot L_C \cdot \left(1/\cos\left(\mathrm{arctg}\left(\pi \cdot d/p_{Cmd}\right)\right)\right)$$

$$m_{sp} = m_{sp\,ct} + m_{sp\,var}$$

$$m_{melc} = m_{ab} + m_{sp}$$

$$L_{cm} = \left[m_{ab} \cdot L/2 + m_{sp\,ct} \cdot (L_A + L_T)/2 + m_{sp\,var} \cdot (L_A + L_T + 2 \cdot L_C/3)\right] / \left(m_{ab} + m_{sp\,ct} + m_{sp\,var}\right)$$

$$G_{melc} = m_{melc} \cdot g$$

$$R_{2n} = G_{melc} \cdot (L - L_{cm}) \cdot \cos\beta / L$$

$$R_{1a} = G_{melc} \cdot \sin\beta$$

$$R_{1n} = L_{cm} \cdot G_{melc} \cdot \cos\beta / L$$

$$M_{f1} = 10^{-3} \cdot (\mu_{rulment} \cdot R_{2n} \cdot r_{1rulment} + \mu_{rulment} \cdot R_{1a} \cdot r_{1rulment})$$

4

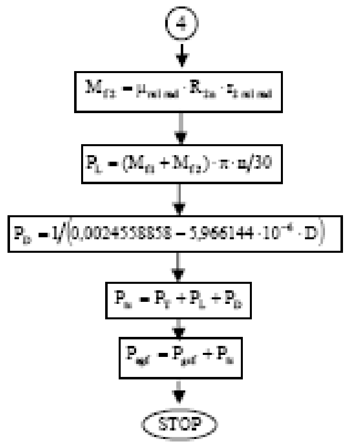


Fig. 2 *The structural diagram of the algorithm*

Table 1

Parameter	M.U.	Symbol	Characteristic values
Dimensioning waste water flow	m^3/h	Q_c	
Coefficient which considers the non-uniformity of the flow introduced in the waste water treatment plant		z	2 - 4
Maximum hourly waste water flow	m^3/h	$Q_{h\,orar\,max}$	
Verifying waste water flow	m^3/h	Q_v	
Coefficient that depends on the number of inhabitants of the populated centre		p	
Maximum daily waste water flow	m^3/day	$Q_{h\,zi\,max}$	
The distance between the screen bars	mm	e	6, 10
Specific quantity of captured suspended solids on the screen	l/inhab·year	a	
Daily on screen captured suspended solids volume flow	m^3/day	$Q_{vr\,zi}$	
The number of inhabitants of the populated centre		N_l	
Daily variation of the captured suspended solids flow		k	2 - 5
Daily captured suspended solids on screen weight flow	m^3/day	$Q_{mr\,zi}$	
Captured suspended solids density (with 80% humidity)	kg/m^3	ρ_r	750 - 950
Daily dry substance weight of captured suspended solids	kg/day	$m_{m\,zi}$	
Humidity of the captured suspended solids on screen	%	w	80%
Daily dry substance volume of captured suspended solids	m^3/day	$V_{m\,zi}$	
Captured suspended solids dry substance density	kg/m^3	ρ_m	1600 - 2000
Screen bars section depth	mm	s	4 - 8
Screen bars section width	mm	l	20 - 40
Ratio between the waste water passing surface and total screen surface		λ_s	
Ratio between the bars surface and total screen surface		λ_g	
Cylindrical screen diameter	mm	D_g	
Coefficient for the cylindrical screen diameter calculus		K_1	45.150039 for e = 6 mm 126.43973 for e = 10 mm
Coefficient for the cylindrical screen diameter calculus		K_2	33.123859 for e = 6 mm 29.018932 for e = 10 mm
Typo dimensional range of the mobile cylindrical screen diameter	mm	$D_{g\,tip}$	600,780, 1000, 1200, 1400, 1600, 1800, 2000, 2200, 2400, 2700, 3000
Number of active cylindrical screen sieving equipment		i_g	more than one integer number
Dimensioning waste water flow for one active cylindrical screen sieving equipment	m^3/h	Q_c^*	
Daily on screen captured suspended solids volume flow for one active cylindrical screen sieving equipment	m^3/day	$Q_{vr\,zi}^*$	
Waste water canal width	mm	B	
Security space between the exterior surface of the cylindrical screen and vertical wall of the canal	mm	b	50 - 100
Height of the waste water current	mm	h_c	
Height of the canal	mm	H_c	
Waste water current average speed	m/s	v_c	0.7 - 0.9
Inclination angle of the screen	rad	β	0.5235 - 0.6109

Length of the cylindrical screen	mm	L_g	
Number of the screen bars		n_b	
Width of the frontal cylindrical frame of the screen		s_{rf}	15 - 30
Speed of the scrapper	rpm	n	3 - 15
Time period for one scrapper rotation	s	t_g	
Scrapper heaviness	N	G_g	
Scrapper volume	m^3	V_g	
Scrapper material density	kg/ m^3	ρ_{OL}	7850
Load heaviness	N	G_m	
Period between two successive functioning of the scrapper	h	t_{esr}	0.1 - 0.5
Loaded scrapper heaviness	N	G_{gm}	
Maximum resistance force at the loaded scrapper moving	N	$F_{r\,max}$	
Friction coefficient between the loaded scrapper and the screen		μ_{gm}	0.9 - 0.11
Maximum resistant moment at the scrapper acting	Nm	$M_{r\,max}$	
Acting power of the scrapper	W	P_{act}	
Conveyor-press charging volume flow	m^3/s	$Q_{v\,alim}$	
Conveyor-press charging weight flow	kg/s	$Q_{m\,alim}$	
Dry substance of the suspended solids charged in the conveyor-press specific mass	kg/s	m_{ssr}	
Humidity of the suspended solids charged in the conveyor-press	%	w_1	80%
Dewatered and compacted conveyor-press material weight flow	kg/s	Q_{mdc}	
Humidity of the dewatered and compacted suspended solids	%	w_2	60%
Dewatered and compacted conveyor-press material volume flow	m^3/s	Q_{vdc}	
Dewatered and compacted suspended solids density	kg/ m^3	ρ_{mr}	1600 - 2000
Density of the water obtained from dewatering	kg/ m^3	ρ_{apa}	1000
Volume variation coefficient during the compaction		φ	
Water volume flow obtained by dewatering and compaction	m^3/s	$Q_{v\,apa}$	
Water weight flow obtained by dewatering and compaction	kg/s	$Q_{m\,apa}$	
Total length of the conveyor-press	mm	L	3500 - 6000
Length of the charging zone	mm	L_A	$L_A = L_g$
Length of the transport zone	mm	L_T	$L_T + L_A = (60 - 70\%)\cdot L$
Length of the compaction zone	mm	L_C	$(25 - 30\%)\cdot L$
Length of the discharging zone	mm	L_E	$L_E = D_m$
Exterior diameter of the helical conveyor	mm	D_m	
Interior diameter of the helical conveyor	mm	d_m	
Closed warm conveyor trough section filling coefficient		ψ	0.1 - 0.35
Helical conveyor inclination coefficient		c	
Auger of the helical conveyor at the entrance in the compaction zone	mm	$p_{c\,int}$	
Auger of the helical conveyor at the end of the compaction zone	mm	$p_{c\,ies}$	
Average auger of the helical conveyor at the end of the compaction zone in case of linear variation of the auger in the compaction zone	mm	$p_{c\,ml}$	
Length till the material fill the hole section of the closed warm conveyor trough in the compaction zone	mm	L_{C1}	
Auger of the helical conveyor corresponding to the Length till the material fill the hole section	mm	p_{pose}	
Average auger in case of linear variation of the auger in the compaction zone	mm	$p_{C1\,ml}$	
Material speed in the transportation zone of the helical conveyor	m/s	v_T	
Material speed at the entrance of the compaction zone	m/s	$v_{C\,int}$	
Material speed at the end of the compaction zone	m/s	$v_{C\,ies}$	
Average speed of the material in the compaction zone in case of linear variation of the auger	m/s	$v_{C\,ml}$	
Period of time in which the material crosses the charging and transport zones	s	t_{AT}	
Period of time in which the material crosses the compaction zone in case of linear variation of the auger	s	t_{Cl}	
Period of time in which the material crosses the zone defined by the length L_{C1} in case of linear variation of the auger	s	t_{C1l}	
Maximum material mass transported in the charging and transport zones	kg	m_{TAT}	
Maximum material mass transported in the zone defined by the length L_{C1} in case of linear variation of the auger	kg	m_{TC1}	
Maximum material heaviness transported in the charging and transport zones	N	G_{TAT}	
Maximum material heaviness transported in the zone defined by the length L_{C1} in case of linear variation of the auger	N	G_{TC1}	
Resistance force at the material transport in the charging and transport zones	N	F_{TAT}	
Resistance force at the material transport in the zone defined by the length L_{C1} in case of linear variation of the auger	N	F_{TC1}	
Necessary power for the material transport by the helical conveyor	W	P_T	
Helical conveyor mass	kg	m_{melc}	

Helical conveyor shaft mass	kg	m_{arb}	
Helical conveyor shaft volume	m^3	V_{arb}	
Pipe width of the helical conveyor shaft	mm	s_{perete}	
Mass of the helical conveyor fillet	kg	m_{sp}	
Mass of the helical conveyor fillet in the constant auger zone	kg	$m_{sp\ ct}$	
Mass of the helical conveyor fillet in the variable auger zone	kg	$m_{sp\ var}$	
Distance between the mass centre of the helical conveyor and its prior end	mm	L_{cm}	
Helical conveyor heaviness	N	G_{melc}	
Normal reaction from the prior bearing of the helical conveyor	N	R_{1n}	
Axial reaction from the prior bearing of the helical conveyor	N	R_{1a}	
Normal reaction from the hinder bearing of the helical conveyor	N	R_{2n}	
Moment of friction in the prior bearing of the helical conveyor	Nm	M_{f1}	
Friction coefficient in the prior bearing of the helical conveyor on radial direction		$\mu_{rul\ rad}$	
Average prior bearing rolling radius on radial direction	mm	$r_{1\ rul\ rad}$	
Friction coefficient in the prior bearing of the helical conveyor on axial direction		$\mu_{rul\ ax}$	
Average prior bearing rolling radius on axial direction	mm	$r_{1\ rul\ ax}$	
Moment of friction in the hinder bearing of the helical conveyor	Nm	M_{f2}	
Average hinder bearing rolling radius on radial direction	mm	$r_{2\ rul\ rad}$	
Necessary power for defeating the friction resistance forces in the bearings	W	P_L	
Necessary power for dewatering and compaction of the material	W	P_D	
Necessary power for acting the conveyor-press	W	P_{tc}	
Necessary power for acting the fixed cylindrical screen sieving equipment	W	P_{esf}	

Conclusions

The waste water sieving equipments with cylindrical screen are modern equipment with an automatic working process which assures a safe, precise and hygienic exploitation and which requires only circumstantial supervision and maintenance assistance when it is necessary.
In the paper it is presented an advanced algorithm for the determination of the main parameters, dimensional, kinematics, dynamics and energetic of a

sieving equipment with cylindrical screen that constitutes a very useful instrument for the designers in this sphere.

Based on the presented calculus algorithm, it was realized an interactive program which allows a very fast and comfortable determination of the main parameters values needed at the sieving equipment designing. Due to the simplicity and rapidity of the program utilization, it can be analyzed a multitude of constructive alternatives in order to find the optimal alternative.

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2. **** ROTAMAT Fine Screen Ro1* Brochure of HUBER-EDELSTHL (Germany)

RENEWABLE ENERGY RISK MANAGEMENT

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Abstract:
Renewable Energy represent a necessity in a modern society. To meet the needs of food, environment, housing, lighting, transport and freight and goods requires, information technology, is necessary to supply with good energy.
Energy sector affects the evolution of whole societies. Currently conceived cannot be a developed economy, with an adequate social sector in Europe 21 century, without an efficient energy sector.The industry of Energy was the fourth large area exposed to risks in 2008. Humanity is increasingly dependent on energy sources, making the concern for ensuring the long-term sources is now an important component of political strategy at national and international level.
The energy system is exposed to natural hazards, operational and commercial risk who leading to the generation of social risk in case when the risks resulting from uncontrolled energy can lead to disaster energy. Manifestation of social risk has a significant negative impulse to the entire economic and social system. The paper aims to determine the renewable energy risks (RER) and control this, using risk management's technique in order to have a minimum social risk and social crisis.The procedures for risk management in energy are presented in accordance with ISO 31000 which will be launched on the market in June 2009.

Key-Words: - renewable energy risk, risk management, social risk, social crisis.

1 Introduction

The risk? Nothing more simple and also somewhat more complex to identify and especially to control. From dawn of history, risks have been one of the biggest and most exciting challenges for the human race. In the opinion of the Economic and Social Committee on the definition of an energy policy for Europe it reiterates that: “Energy is a necessity in modern society. To meet the needs of food, environment, housing, lighting, transport and freight and goods requires, information technology, is necessary to supply good energy. But how they meet these needs, can and should be changed” [6].

2 Renewable Energy Risk Management

2.1 Characterization

Renewable Energy is part of Industrial Ecology which is the study of material and energy flows through industrial systems. The global industrial economy can be modeled as a network of industrial processes that extract resources from the Earth and transform those resources into commodities which can be bought and sold to meet the needs of humanity. Industrial ecology seeks to quantify the material flows and document the industrial processes that make modern society function. Industrial ecologists are often concerned with the impacts that industrial activities have on the environment, with use of the planet's supply of natural resources, and with problems of waste disposal.

Industrial ecology is a young but growing multidisciplinary field of research which combines aspects of engineering, economics, sociology, toxicology and the natural sciences.
Risk is defined as an uncertain element, but possibly, appear in the technical events, human, social, political, reflecting the distribution of the possible variations, probability of occurrence of the subjective and objective, with possible damaging effects and irreversible [1].
Risk management is defined as the management of uncertain events, in order to success [3].
Risk management has the feature all of the methods and means that risk is managed to achieve the objectives described in the event, social, human and political analysis, with uncertainly as the major risk factors.
Renewable energy risk management is defined as renewable energy management, considering uncertain events existing in a normal order of global socio-economic life [2].
Energy Crisis: Energy is vital for any functioning economy. Moreover, the period during which the received energy, safe and inexpensive ended. Besides the dependence of increasing imports and prices and higher energy, humankind is facing the challenges posed by climate change, caused largely by the increasingly higher energy. If conduct normal activities, the dependence of EU energy imports will fall from 50% of, its total energy is currently at 65% in 2030. It is expected an increase in dependence on gas imports from 57% to 84% by 2030 and from 82% to 93% for oil imports. This presents a risk of political and economic. World energy resources are under extreme pressure [5].
Social crisis: Energy affects the entire society fundamental developments. Currently designed cannot be a developed economy, with an adequate social sector in Europe of the XXI century without an effective energy sector. National energy sector has to face major challenges that are manifested at intern and global level: security of energy supply, increase economic competitiveness and reduce environmental impact.

These challenges are particularly important under the conditions in which Romania has to catch up economic performance compared to developed countries of the EU.
Resolving these problems is to use optimal energy and derived respectively by reducing energy consumption from the design of and ending with their re-use.

2.2 Renewable Energy Risks
Principles for renewable energy risk management (RERM) are:
a) creates value
b) integral part of organizational commitment
c) part of decision making
d) explicity addresses uncertainty
e) systematic, structured ant timely
f) based on the best available information
g) tailored
h) takes human and cultural factors into account
i) transparent and inclusive
j) dynamic, iterative and responsive to change
k) facilitates continual improvement and enhancement of the organization

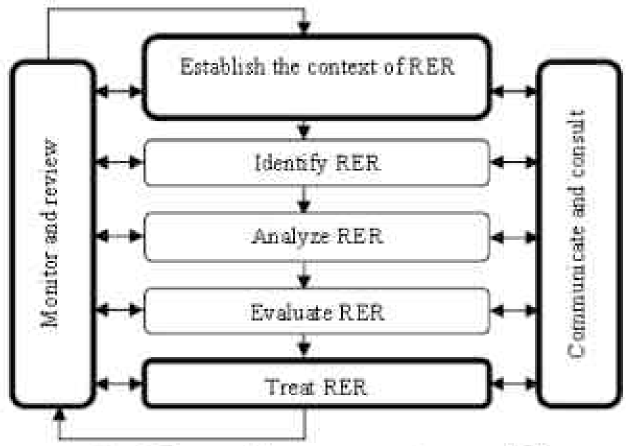

Fig. 1 Energy risk management process [5]

The Stages of RERM following generic stages of the process of risk management are:
Establish context: strategic context determination, organizational management and risk, and to structure analysis and the criteria on which risks will be assessed, identification of affected parties / stakeholders and policy of communication and consultation;

Hazard identification: identification as a basis of subsequent analysis, what can happen, why and how, including the dangers and consequences associated;
Risks analysis: risk analysis in terms of probability and severity, possibilities of control and the control measures the seriousness of the consequences, likelihood of producing and the gravity can be combined in order to estimate the level of risk;
Risk assessment: search involves the systematic risk factors in the event to be achieved;
Treat risks: develop and implement a management plan should include considerations on the allocation of financial resources and other and deadlines for action;
Communication and consultation: consultation and communication with affected parties / stakeholders, internal and external every step of the process for the risk management;
Monitoring and review: aims to implement strategies and monitor the response that these changes bring them in the event analysis.
In order to have a continuous improvement of the energy risk management is establish the fooling diagram according ISO:

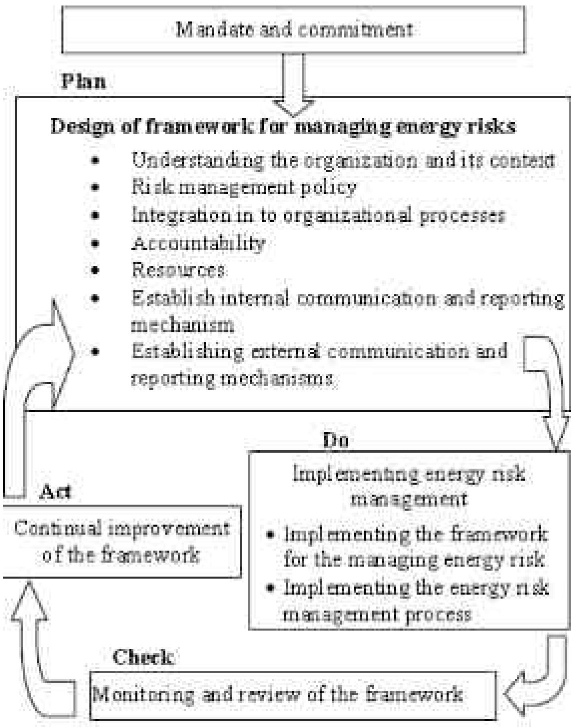

Fig. 2 Continuous improvement of the energy risk management [4]

2.3 Effects of Renewable Energy Risks
Economic and financial risks that the effects of energy risk:
Financial resources and raw energy are limited. To carry out large projects in energy are necessary funds to finance large, whose recovery presents a significant risk, whereas investment takes place on long time. In this regard the financing in the energy sector is a complex issue.
Social risks effects on renewable energy risk:
Social risks are defined as those circumstances which may trigger the reduction of income or increasing of costs. Legally, both internally and at international level social risks are defined, usually as: old age, sickness, disability, motherhood, the legal protection of labor rights, unemployment, etc. These risks are covered by Social Convention 102/1952 of International Labor Organization.
Political risks versus renewable energy risks:
Political risks consist of social and political events, beyond the purchaser's solvency and it prevents to honor payment obligations towards the supplier (war, strikes).
Political risks can be generated and the various measures taken by the government of the state where the partner, materialized in effect as: restriction of imports, limiting the transfer rate, seizure or confiscation of goods belonging to the trader, etc. [7]

3.Modeling and Simulation Financial - Economic Crisis Due To Risk Energy

3.1 Modeling Economics Risks
In practice, achieving an energy project is an economic model associated bazic with two parameters - income and risk.
Pairs can be estimated income - risk for a concrete depending on the configuration of a set of internal and external factors.
For a given distribution of income (income pairs - Risk) calculating typical characteristics to be used for decision modeling:
average income:

$$E = \sum_{i=1} p_i V_i \qquad (1)$$

square mean deviation of income σ:

$$\sigma^2 = \sum_{i=1} p_i (V_i - E) \qquad (2)$$

where:
pi - probability of achieving income Vi;
n- the state (income) possible;
σ - square mean deviation of income;
Vi – income;
Characteristics are used to distinguish the governor to incline toward risk the governor with risk aversion. The propensity to prefer risk variants that have large amounts of income, but with low probability of achieving, so those with a dispersion (σ) than.
Total risk is divided as follows:
the possibility of reducing its components:

$$rT = r_{sist} + r_{spec} \tag{3}$$

rT- total risk;
r_{sist} - systematic risk which can not be removed and is generated by a number of macroeconomic factors (interest level).
r_{spec} - specific risk be reduced through appropriate techniques:
the origin of risk:

$$rT = rB + rF \tag{4}$$

rB - energy business risk given the nature of the activity in which the investment;
rF - financial risk of energy given the way in which the business is financed.
Modeling risk for a company producing electricity is :

$$\sigma\ R_{financial} = \sigma\ R_{economic} + \sigma\ (R_e - R_d)\ g_{ic} \tag{5}$$

$$\sigma\ R_{economic} = \sigma\ R_{interest} + \sigma\ .\ (R_m - R_d)\ .S_{af} \tag{6}$$

$$S_{af} = (g_{ic}\ .\ S_{ci} + S_{cp}) / (1 + g_{ic}) \tag{7}$$

In wich :
$\sigma\ R_{financial}$ = financial risck ;
$\sigma\ R_{economic}$ = economic risk; Rd = rate;
g_{ic} = degree of indebtedness of the company's electricity;
S_{af} = sensitivity of portfolio assets related design - realization that exploitation;
R_m = rate of return on the market of products investigated;
S_{ci} , S_{cp} = sensitivities rates of return over equity (cp) and borrowed (ci).
Discussing solution design - implementation - operation targets energy se make light of the updated net income (VNA) and the internal rate of making financial (RIRF).
Conditions of acceptance of the solution proposed by the energy project can thus write:
VNA > 0 and RIRF > opportunity cost of capital.

These indicators complement each other whereas VNA reflects the total achievable and RIRF reflect reported profits. These guidelines may be applied when we do not have restrictions on financing energy projects. In case of restrictions on capital and the projected duration of development have different, then correlating indicators and VAN and RIRF is so graphic, and analytical.
Analytical, calculated coefficients of variation for VAN and RIRF şi determine the general influence that includes both (VNA and RIRF) as :

$$F_g = \frac{VNA}{I}\left\{[C_v(VNA)]^{\gamma} + [C_v(RIRF)]^{1-\gamma}\right\} \tag{8}$$

$$\gamma = \frac{I_{sursa\_proprii}}{I_{capital\_total\_proiect}} \tag{9}$$

$$C_v(VNA) = \frac{\sigma_{VNA}}{VNA} \tag{10}$$

$$C_v(RIRF) = \frac{\sigma_{RIRF}}{RIRF} \tag{11}$$

$$\sigma_{VNA} = \left[\sum_{j=1}^{n}(VNA_j - VNA)^2 \cdot p(VNA)\right]^{1/2} / \left[\sum_{j=1}^{n} p(VNA_j)\right]^{1/2} \tag{12}$$

$$\sigma_{RIRF} = \left[\sum_{j=1}^{n}(RIRF_j - RIRF)^2 \cdot p(RIRF)\right]^{1/2} / \left[\sum_{j=1}^{n} p(RIRF_j)\right]^{1/2} \tag{13}$$

in wich: Cv, σ = coefficients of variation (v) and standard deviation (σ)
Return lead to financial risk if the actual deviations from those calculated written under the following forms:

$$R_f = R_e + (R_e - R_d) \cdot g_{ic} \tag{14}$$

$$\sigma(R_f) = \sigma[R_e + (R_e - R_d) \cdot g_{ic}] \tag{15}$$

In wich: σ (R_f) estimated risk level profitability by using financial irregularity standard (σ).
Risk can be divided into risk matchlessly
(σ R_{fns}) symmetric and risk (σ R_{fs}) as shown in the following relationship:

$$\sigma(R_f) = (\sigma \cdot R_{fns} + \sigma \cdot R_{fs}) = R_1^{controlabil} + R_2^{non-controlabil}) \tag{16}$$

Control is achieved by the decision that can oversee the performance of projects, efficiency sources of funding, end time and delivery of projects including campaign strategy. The risk that escapes the control decision is made conditional on external factors of such as customs and tax policies, technological process, economic and social issues and political (competition, economic recession, the cost of capital, etc).

Starting from the economic profitability (Re) Financial risk is defined σ(Rf) the relationship of the form:

$$\sigma(R_f)=\sigma(R_e)\cdot(1+g_i^c) \tag{17}$$

$$R_e=R_d+(R_m-R_d)\cdot S_{ap} \tag{18}$$

S_{ap} = sensitivity of assets in projects
R_d = loan interest rate without risk (guaranteed by the State)
R_m = rate of return on the market;
S_{ap} (R_m - R_d) = risk premium
With these relations can write such a financial risk:

$$\sigma(R_f)=\sigma\left[R_d+S_{ap}-(R_m-R_d)\right](1+g_i^c) \tag{19}$$

$$S_{ap}=(S_{cp}+S_{ci}\cdot g_i^c)\cdot g_i^c \tag{20}$$

In wich: Scp , Sci = sensitivity rates of return from capital (cp) and borrowed capital (ci).
Dynamic Control of energy projects for their structuring in terms of profitability can be done quickly by applying the method of analysis markoviene. The functions of the operating performance markoviană analysis are: updated net income; the internal rate of financial return; generalized function (fg), that the coefficient of variation (Cv).
These functions can define the system analyzed. In this perspective it quantifies sizes VNA, RIRF, Cv both as initial values (0), and the extreme maximum values (max) and minimum allowable in terms of return on fixed capital in the project. The internal rate of return on the initial (RIRF)0 is the marginal cost of capital, and (RIRF) is minimum opportunity cost of capital reflected by the maximum incremental value is expected in the analyzed (life of the project). The states associated with the development of Markov analysis is defined as:

$$\begin{cases} VNA > VNA_{min} \Rightarrow 2 \\ VNA \in \left[VNA_0, VNA_{min}\right] \Rightarrow 1 \\ VNA > VNA_0 \Rightarrow 0 \end{cases} \tag{21}$$

$$\begin{cases} RIRF > RIRF_{min} \Rightarrow 2 \\ RIRF \in \left[RIRF_0, RIRF_{min}\right] \Rightarrow 1 \\ RIRF > RIRF_0 \Rightarrow 0 \end{cases} \tag{22}$$

$$C_v \Rightarrow \begin{cases} C_v > C_{vmax} \Rightarrow 2 \\ C_v \in \left[C_{v0}, C_{vmax}\right] \Rightarrow 1 \\ C_v < C_{v0} \Rightarrow 0 \end{cases} \tag{23}$$

All these dimensions of state may be associated in the form S1, S2, S3. These conditions characterize each stage of the evolution of the system from the initial (S1, S2, S3)0 feasibility study and moving to states (S1, S2, S3)k (k = 1….n). Retain favorable states that do not contain the digit 0 in the structure. Each state is affected by both intrinsic probability and the probability of transition between states by passing. If the transition probability matrix is stationary, then to solve the problem is apelează stationary Markov Models, otherwise turn to the Markov models of nonstationary discrete variable and continuous, by case.
Probability field Cp (k) = p1(k), p2 (k), p3(k) knowledge structure is determined by the transition matrix.

4 Conclusions

Renewable Energy, whatever its form, is an indispensable necessity for society, both in terms of human comfort, and as a factor of production. The degree of economic and social development is greater with both increasing and demand for energy.
Issue cover energy demand is included in all development strategies of governments, but these strategies must take account of energy resourcese which show a great volatility in the price reference and a multitude of risks associated with production and trading. In recent years, the issue of exhaustion of energy resources and energy security agendas dominate the world stage actors. Competition for energy resources in the contemporary world remains an important source of crises and conflicts, with a particular role of polarization and / or catalizare forces, as long as demand grows to much faster than supply, and major oil reserves are located in areas characterized profound political-economic in balances and instability.
U.S., EU, China and Russia are both in relationships of competition, and cooperation in the process of access, control and exploitation of these resources. .

Polarization attention on these areas often leads to disputes between energy consumers competitors. Also, ecological interdependence, and not energy independence appears to be the most viable way of solving the consumption ever higher.

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INSTALAȚII DE USCARE CONVECTIVĂ CU INDEPENDENȚĂ ENERGETICĂ BAZATĂ PE BIOMASĂ ŞI PANOURI FOTOVOLTAICE

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Rezumat

În lucrare se prezintă o analiză structurală şi energetică pentru uscătoare convective mobile cu independență energetică totală destinate zonelor izolate şi montane. Energia termică se produce din biomasă iar energia electrică cu un panou fotovoltaic.

Uscătoarele din familia USCMER au fost optimizate constructiv pentru a se reduce consumul de energie electrică sub 2% din energia termică.

S-a ales un sistem de încălzire a agentului de uscare cu abur produs de un cazan de foarte joasă presiune (0,5 bar) încălzit cu un modul energetic de gazeificare a biomasei de tip TLUD alimentat cu biomasă locală sau cu pelete. Energia electrică necesară funcționării uscătorului este produsă cu un panou fotovoltaic care încarcă la 12 Vcc o baterie de acumulatoare.

S-au studiat două tipuri uscătoare USCMER, cu 4 şi 10 m^2 suprafață de casete, care necesită modificări minime pentru regimul de independență energetică.

Cuvinte cheie: uscare, biomasă, fotovoltaic, independență energetică, abur

1. Introducere

Flora spontană produce o mare diversitate de fructe, ciuperci etc. cu o mare valoare nutritivă şi medicinală şi care se pot valorifica şi prin uscare în zonele de recoltare.

Din considerente tehnologice, economice şi ecologice, în prezent se constată o deplasare a instalațiilor de uscare spre zonele de producție şi recoltare pentru a se reduce din costurile de transport şi manipulare. Ca urmare se propagă o continuă decentralizare a operațiunilor de deshidratare, ceea ce cere realizarea cu prioritate a uscătoarelor cu capacități de producție mici şi mijlocii, uşor de deplasat şi amplasat în zonele de producție.

Multe dintre aceste zone sunt izolate, nu au acces la rețeaua de energie electrică şi ca urmare se pune problema independenței energetice a instalațiilor de uscare, adică a producerii de energie termică şi electrică din resursele locale.

Lucrarea are ca obiectiv analiza structurală şi energetică a unei instalații de uscare convectivă, mobilă, cu independență energetică totală. Această cerință se poate realiza prin utilizarea biomasei disponibilă local ca sursă de energie termică nepoluantă şi ecologică, pentru alimentarea instalațiilor de uscare cu capacități de producție mici. [4], [6] şi [7].

Pentru alimentarea cu energie electrică a uscătoarelor mobile se va utiliza un panou fotvoltaic, pliabil, cu care se generează energie electică la 12 Vcc cu care se încarcă o baterie de acumulatoare cu bilanț nul de CO_2.

Pentru a se produce o concentație redusă de CO şi de particule materiale (PM) s-a ales varianta de gazeificare a biomasei cu procedeul Top Lit Up-Draft, denumit TLUD, la care procesul de ardere este cuplat direct la ieşirea din procesul de gazeificare [1], [3], [8] şi [9].

2. Energie termică din biomasă

Uscătorul convectiv este un client ideal pentru o instalație de cogenerare deoarece consumul de energie termică este mult mai mare de cât cel de energie electrică în raport de minim 20/1. Pentru scopul propus, s-au proiectat uscătoare convective care să funcționeze cu un raport de energii - electrică/termică - cât mai mic [10].

Instalația de uscare convectivă are un schimbător de căldură (SC) apă caldă/aer şi un ventilator acționat electric, la 240 Vca, cu turaţie fixă, corespunzătoare unei viteze medii a agentului de uscare de 2 m/s, valoare care s-a dovedit a fi optimă pentru o mare categorie de produse agricole. Menţinerea tensiunii de alimentare de 240 V ca a fost adoptată din considerentul că aceste uscătoare să poată funcţiona şi în locaţiile în care este disponibilă o reţea electrică monofazică.

Modulul energetic este format dintr-un cazan de abur de foarte joasă presiune, la 0,5 bar, încălzit cu gazele de ardere produse de unul, sau mai multe, module TLUD alimentate cu biomasă lemnoasă locală, mărunţită sub 50 mm, sau cu pelete. Aburul produs este trimis în SC unde se condensează şi încălzeşte agentul de uscare. Apa rezultată din condensare este trimisă înapoi în cazan cu o pompă de condens. Astfel se elimină pompa de circulaţie, iar pompa de condens la 0,5 bar consumă foarte puţină energie electrică.

Un avantaj al gazogenelor TLUD constă în faptul că ele se realimentează rapid în şarje, au o perioadă foarte scurtă de pornire şi puterea termică produsă se poate regla eficient prin controlul debitului de aer de gazeificare. Aceste aspecte au determinat ca pentruproducerea energie termice din biomasă să se aleagă modulul energetic TLUD [1], [3] şi [8].

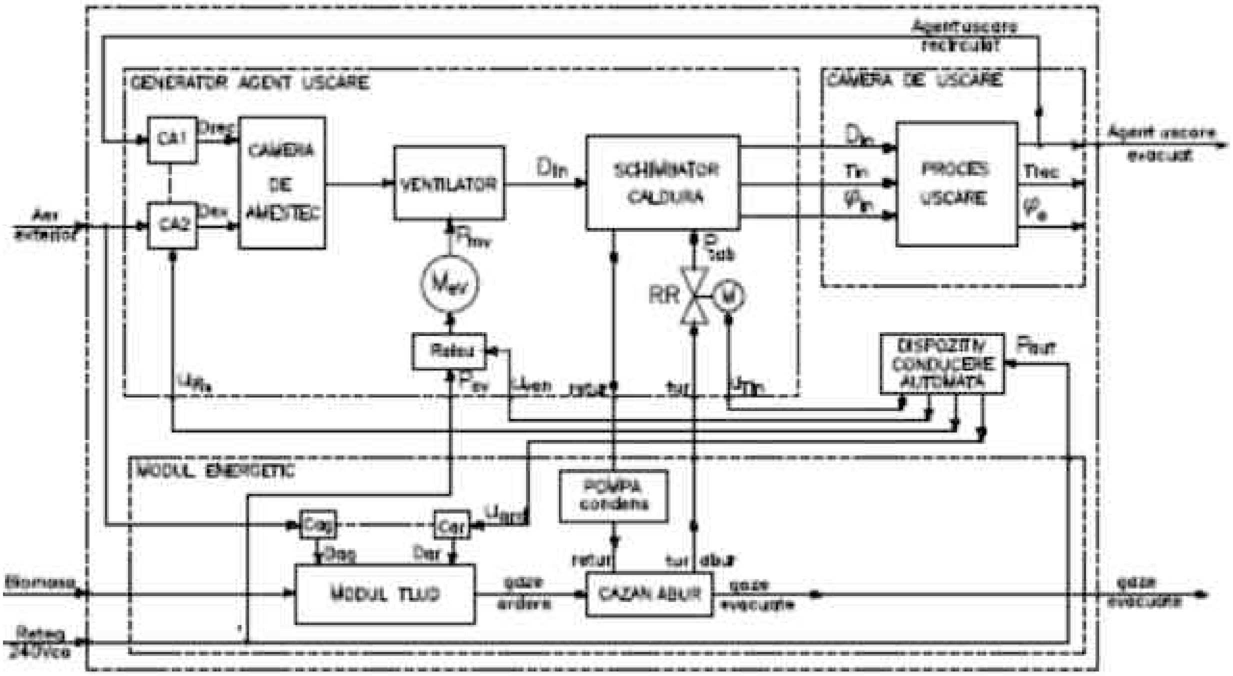

Fig.1 Schema bloc a uscătorului alimentat cu energie termică din biomasă

În figura 1 este prezentată schema bloc a unui uscător convectiv, din seria USCMER-IDE, alimentat cu energie electrică de la reţeaua de 240 Vca şi cu biomasă pentru producerea de energie termică. La aceste instalaţii a fost optimizat aerodinamic traseul de circulaţie a agentului de uscarfe, aerul cald, pentru a se reduce cât mai mult pierderile de presiune şi ca urmare să se obţină o putere minimă pentru ventilatorul acţionat electric şi deci şi pentru puterea electrică necesară funţionării normale a uscătorului.

S-a obţinut, în regim nominal de funcţionare, un raport de puteri electrică/termică de 1/50, dar cu creşterea secţiunilor de trecere şi deci a gabaritului şi a greutăţii uscătoarelor; aspecte acceptate pentru a se putea realiza o independenţă energetică totală în condiţii de funcţionare dificile.

În timpul uscării unei şarje în instalaţie intră aer din exterior pentru ardere şi pentru compensarea debitului de agent de uscare umed evacuat, precum şi biomasă pentru producerea de energie termică.

Din instalație ies: debitul de agent de uscare umed evacuat şi gazele arse evacuate din cazanul de abur.

În tabelul 1 sunt prezentate datele tehnice ale uscătoarelor analizate pentru obținerea unei independențe energetice totale, USCMER-4/8IDE şi USCMER-10/20IDE. S-au ales aceste tipuri de uscătoare deoarece USCMER-10/20IDE are o capacitate de producție dublă comparativ cu USCMER-4/8IDE, împreună acoperind domeniul de capacități de producție 20...100 kg material de uscat pe o şarjă, domeniu care acoperă masele loturile de material recoltate zilnic.

Se observă ca raportul P_{en}/P_{tmed} este de maxim 1,5% ceea ce indică că aceste uscătoare pot funcționa eficient economic şi alimentate cu energie electrică produsă fotvoltaic.

Tabel 1 Caracteristici tehnice uscătoare convective alimentate cu biomasă

Mărime	U.M.	USCMER 4/8 IDE	USCMER 10/20 IDE
Suprafața de poziționare pe casete	mp	**4.00**	**10.00**
Putere termică specifică	kWt/ m².cas	2.00	2.00
Putere electrică acționare ventilator	We	80	200
Putere electrică alimentare PLC	We	10.00	10.00
Putere consumată de traductor	We	5.00	5.00
Putere consumată de servomotor	We	5.00	5.00
Număr traductoare	buc	1.00	2.00
Număr servomotoare	buc	1.00	1.00
Putere electrică automatizare uscător	We	20.00	25.00
Putere electrică necesară Pen	We	100	225
Putere termică nominală Ptn	kWt	**8.00**	**20.00**
Putere termică minimă uscare - 20% Ptn	kWt	1.60	4.00
Putere termică medie uscare Ptmed=50% Ptn	kWt	4.00	10.00
Consum mediu energie termică	MJ/h	11.52	28.80
Raport puteri: Pen /Ptmed	-	1/40	1/41
Raport puteri: Pen /Ptn	-	1/80	1/82
Generator energie termică - TLUD	buc	**1**	**1**
Randament mediu cazan abur (minim)	-	0.8	0.80
Randament conversie TLUD (minim)	-	0.75	0.75
Putere termică nominală cazan abur	kWt	8.00	20.00
Putere nominală modul TLUD	kWt	**10.00**	**25.00**

Tabel 2 Consumurile de biomasă locală şi pelete

Marime	U.M.	USCMER-4/8 IDE		USCMER 10/20 IDE	
Tip biomasă		tocătură	pelete	tocătură	pelete
Generator energie termică - TLUD	buc	**1**	**1**	**1**	**1**
Putere nominală modul TLUD	kWt	**10.00**	**10.00**	**25.00**	**25.00**
Putere calorifică inferioară biomasă	MJ/kg	13.50	16.00	13.50	16.00
Consum orar maxim biomasă	kg/h	3.56	3.00	8.90	7.50
Consum orar mediu biomasă	kg/h	1.78	1.50	4.45	3.75
Timp mediu sarjă uscare	h	6.00	6.00	6.00	6.00
Număr sarje zilnic	şarje/zi	2.00	2.00	2.00	2.00
Masa combustibil/şarjă	kg/şarjă	10.67	9.00	26.67	22.50
Consum zilnic biomasă	kg/zi	21.33	18.00	53.40	45.00
Densitate strat biomasă	kg/dm³	0.20	0.45	0.20	0.45
Volum încărcătură biomasă	dm³	55.60	20.00	131.40	50.00
Diametru reactor TLUD	mm	250.00	250.00	330.00	330.00
Înălțime strat biomasă în TLUD	mm	1100.00	500.00	1500.00	600.00

Cazanul cu abur funcționează la o presiune foarte joasă, nepericuloasă, de 0,5 bar. El are o putere maximă egală cu puterea termică necesară uscătoarelor în regim nominal şi este alimentat cu energie termică de la module TLUD cu puteri nominale de 10 şi 25 kWt, care pot asigura funcționarea normală a uscătoarelor analizate.

S-au luat în considerare două variante de alimentare cu biomasă:

A. Biomasă recoltată local, uscături căzute, crengi uscate etc., tocată în bucăți cu lungimi mai mici de 50mm. Inițial, biomasa se recoltează şi se toacă, apoi este lăsată la uscare naturală cel puțin 3 zile însorite până ajunge la maxim 20% umiditate. Acest combustibil este ieftin deoarece se obține local în aria de recoltare a produselor de uscat şi nu necesită transport. Această variantă este considerată ca biomasa de bază pentru uscătoarele utilizate în zonele izolate sau. montane.

B. Pelete din biomasă lemnoasă sau agricolă care au o putere calorifică mai mare fiind o biomasă compactată; sunt uşor de depozitat şi de manipulat, dar au un preț de 4...5 ori mai mare decât biomasa preparată local. Avantajul funcțional constă în faptul că un modul poate funcționa fără realimentare 12 ore, deci o zi de lucru.

În tabelul 2 este prezentată o analiză a consumului estimat de biomasă locală tocată şi de pelete pentru funcționarea celor două tipuri de uscătoare analizate. Se constată că la utilizarea biomasei locale tocate consumul zilnic este de maxim 22...25 kg iar pentru pelete de 18 kg pentru uscătorul USCMER-4/8IDE, precum şi de 55...60 kg tocătură şi 45 kg pelete pentru uscătorul USCMER-10/20IDE.

Aceste valori indică că se poate asigura relativ uşor şi sigur funcționarea uscătoarelor în cazul utilizării biomasei disponibilă local. Trebuie să se reîncarce reactorul modulului energetic TLUD pentru fiecare nouă şarja de uscare; sau să se utilizeze două module TLUD, variantă care simplifică operațiile dar creşte valoarea investiției inițiale.

S-a optat pentru un acelaşi tip de modul TLUD atât pentru utilizarea biomasei locale tocate cât şi a peletelor pentru a creşte gradul de independență față de tipul de biomasă disponibilă în zona în care va funcționa uscătorul. Astfel se pot utiliza două tipuri de module TLUD cu diametrul reactorului de 250 mm şi 330 mm şi înălțimea de 1100 mm şi 1500 mm.

Se constată că în cazul utilizării peletelor este necesară o singură realimentare la două şarje, adică maxim o dată pe zi.

3. Alimentarea cu energie electrică

Pentru producerea energiei electrice necesare funcționării uscătoarelor cu independență energetică totală s-a adoptat varianta utilizării unui panou fotovoltaic rigid sau flexibil care încarcă continuu, în funcție de nivelul de iluminare, o baterie de acumulatoare de 12 Vcc [2].

În figura 2 este prezentată schema bloc a unui uscător convectiv cu independență energetică totală bazată pe biomasă şi panouri fotovoltaice. Se observă că în structura instalației de uscare apate un panou fotovoltaic cu modulul său de cuplare la o baterie de acumulatoare

În prezent sunt două tipuri de structuri pentru panourile fotovoltaice: cristaline şi amorfe; fiecare cu avantaje şi dezavantaje specifice. În această lucrare nu s-a propus s-a sealeagă sitipul de panou fotovoltaic, ci să se demonstreze că soluția structurală propusă este viabilă tehnic, economic şi ecologic.

În tabelul 3 sunt prezentate datele referitoare la alimentarea cu energie electrică a uscătoarelor cu independență energetică totală. Se constată că pentru uscătorul USCMER-4/8IDE este necesară o suprafață 1,5 m^2, iar pentru uscătorul USCMER-10/20IDE o suprafață 3,0 m^2. Aceste valori sunt determinate de puterea specifică nominală a panourilor fotovoltaice care a fost aleasă sub valoarea din specificațiile firmelor producătoare la 150 W/m^2. Deoarece operațiunile de uscare se fac in timpul verii şi începutului de toamnă s-a putut estima că iluminarea medie poate fi aproximată la 2/3 din cea pentru regimul nominal.

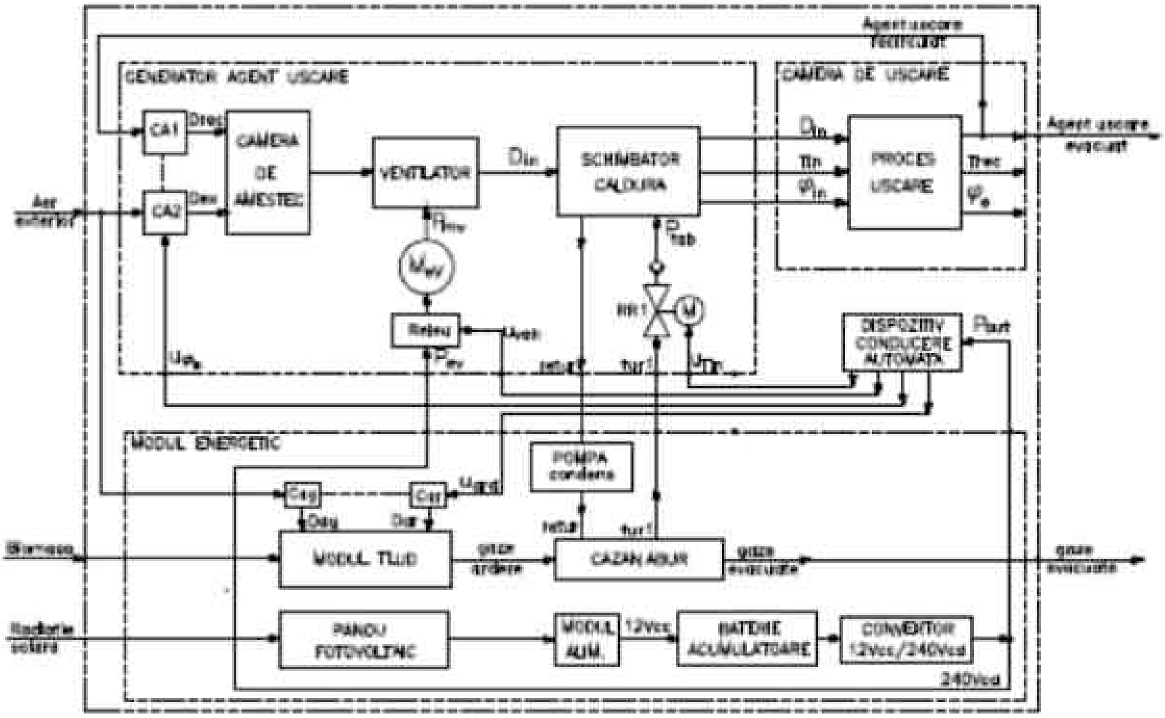

Fig.2 Schema bloc a uscătorului cu independență energetică

Tabel 3 Regimul de funcționare al uscătoarelor cu independență energetică

Marime	U.M.	USCMER 4/8 IDE	USCMER 10/20 IDE
Generator energie termică - TLUD	buc	**1**	**1**
Putere nominală modul TLUD	kWt	**10.00**	**25.00**
Putere electrică uscător	We	100.00	245.00
Putere electrică ventilator TLUD	We	6.00	10.00
Putere electrică automatizare TLUD	We	8.00	10.00
Putere electrică necesară (240 Vca)	We	114.00	265.00
Randament convertor 12Vcc/240Vca		0.92	0.92
Putere electrică necesară (12 Vcc)	We	124.00	288.00
Nivel de iluminare panou FV	%	66.00	66.00
Putere specifică medie panou FV	We/m²	150.00	150.00
Suprafață necesară panou FV	mp	1.25	2.90
Suprafață panou FV	mp	1.50	3.00

4. Concluzii

S-a studiat posibilitatea realizări de instalații de uscare convectivă cu independență energetică totală destinate zonelor izolate şi a celor montane.

S-a ales un sistem de mixt de producere a energiilor necesare: energia termică cu module energetice TLUD în care se utilizează biomasă locală sau pelete; energia electrică se produce cu un panou fotovoltaic cuplat la o baterie de acumulatoare.

S-a analizat structura şi funcționarea uscătoarelor din familia USCMER-IDE, cu capacități mici de producție, 4 şi 10 m^2 casete, care au un consum foarte redus de energie electrică, maxim 1,5% din puterea termică nominală.

Pentru producerea de energie termică se utilizează două tipuri de module TLUD: de 10 kWt şi de 20 kWt.

Pentru alimentarea cu energie electrică s-a utilizat generatoare fotovoltaice cu suprafețe de 1,5 şi 3 m^2 cu care se poate asigura o funcționare continuă şi sigură în regim de independență energetică totală.
S-au realizat programe de calcul a bilanțurilor energetice pentru variantele analizate rezultând că se poate realiza o funcționare continuă şi sigură a variantelor studiate.
Pentru producerea de energie a fost luată în considerare, în principal, biomasa locală, recoltată, tocată şi uscată liber, cu care se poate realiza o independență energetică reală în aproape orice tip de locație.

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CONSIDERATIONS REGARDING THE CLIMATIC CHANGES FROM ROMANIA

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Abstract
Are presented the following considerations regarding the climatic changes:
- *Characteristics of the floods from 2005 and their consequences.*
- *The evolution of the climate and weather for the year 2005.*
- *Comparison between historical flood and the flood in 2005.*
- *The prevention and fight against the effects of the climatic changes.*
- *The adjustment to the climatic changes.*

The national strategy of Romania regarding the climatic changes is adopted by governemntal decision HGR 645/2005 and continued by systematic research studies which to substantiate the endeavours for diminishing the effects and generate public awareness and active participation.
***Key words**: f*lood, climate, weather, promotion, effects control.

1. Introduction

Characteristics of the floods from Romania (1970-2004)

The floods represent the major factor of risk which implies the fact that the land is covered by water which by its amount and duration devastates the environment and disorders the social economic activities from the affected zone.

The floods are provoked by three kinds of factors:

a) aleatory generated by natural phenomena (by river overflows, too heavy rainfalls or the fast snow melt);

b) accidental phenomena (slope slides, deterioration of hydrotechnical constructions, earthquakes);

c) human activities : wrong operations, civil engineering performed in the wrong zones, breaks in the safety dams).

2. Material and method

The most frequent causes of the floods are overflows, which generally occur in spring, when the snow melts and there are heavy rains or in summer, their intensity varying. In the present article is analyzed the period 1970-2005 connecting the frequency of the overflows with the climatic changes.

Very big overflows caused catastrophic floods on the entire surface of Romania, starting from 1970. In 1975 Transylvania was affected by heavy floods and in 1991 the pluviometric phenomena from May- July caused floods with very serious social- economic consequences in Moldavia. A series of less powerful floods took place in 1983,1988.

The approach of the damming engineering works puts into evidence the connection between the frequency of floods with the climatic changes, being one of its major effects.

The overall flooded surface from Romania was of about 2,12 mil.ha from which 1,89 mil.ha agricultural land. The damming enginnering works are divided in the following categories of, after their social economic importance (table 1).

Table 1

Categories of importance for the damming engineering works

The name of the work	The protected area [ha]	Category of importance
Land damming	> 20.000	2
Land damming	5000-20.000	3
Land damming	< 5000	4

3. Results and discussions

The frequency of the floods in 2005

In 2005 took place six catastrophic overfloods, during 7 months (March-Sept). These represent an effect of the global climatic changes.

Tens of deceases and significant material damages (which costed over 1,5 billions euros) were recorded. This means that is required a change of the conception and modality of action in what relates to the fight against natural calamities and the management of the climate heating.

The first steps towards the implementation of a national, unitary action for limiting the emissions of toxic gases which cause greenhouse effects and the potential effects of the climatic heating which will take place anyway, were substantiated in the national strategy of Romania regarding the climatic changes. Romania adopted by governmental decision no.645-2005 this Strategy which represents the framework for implementing the policies of Romania in the domain of climatic changes during 2005- 2007. The document was elaborated under the direct supervision of the Ministry of Environment and Water Management in collaboration with other ministries, through the instrumentality of The National Office for Climatic Changes.

The evolution of certain climatic aspects from Romania in 2005

The geographic location of Romania determined its general climatic belonging and its forms of relief determined its local peculiarities. Romania belongs to) the temperate zone of the Northern emisphere located between latitudes 30°N and 60°N.

However the air masses which circulate and mix daily monthly and annualy have their origin in the warm climate zone (located between Ecuator and 30°N) and the cold zone located between 60 °N.

The temperate climatic zone is characterized by the most instable weather and the most significant climatic variations. This zone is the only one characterized by four seasons, between equinox and solstice. In this wide geographic and climatic frame is concentrated a huge number of people, here being located many urban and industrial metropolies.

The evolution of the weather froma day to another represents a change of meteorological aspect, precisely determined, expressed by the lowering or raise of the day temperature of the amounts of rain falls, heavier wind blows, fogs, snow storms or other meteorlogical phenomena.

Climate represents a more abstract notion to that of weather. The climate of a certain place, country, zone or entire globe may be defined as a synthesis on a big interval of time of the weather from a day to another.

The International Organization of Meteorology defined it in 1984 as follows: *Climate represents the synthesis of the weather conditions from a certain zone, on the base of a series of monitoring activities min. 30 years of reference of the atmospheric variable (see the Guide of the climatologic practices 1984).*

The statistic methods, the annual averages of the temperature values amounts of rain falls pressure wind speed etc represents just the instrumentary with which climatology which is one of the branches of meteorology operates in processing the punctiform data of observation.

Comparison between the historical overflows and those from 2005

For most hydrographic basins the overflows that took place in 2005 had a character of historical overflows, justified by the value of the main parameters of the overflow waves, top flows and flow volum.

On Olt river the overflow from 2005 had moderate values (Qmax = 397 m^3/s) comparing it with the previous biggest overflow from 1975 with Qmax = 950 m^3/s.

After a period of pause in June the floods restarted in July in the hydrographic basins from the South and East. In the basin of river Vedea in which the monitoring stations where Alexandria and Teleorman took place a very powerful overflow with a volum value very close to that from 1972.

The prevention and fight against the effects of climatic changes

A very important reference for fighting and preventing the effects of the climatic changes in Romania is represented by the programs and policies of the EU in this field.

The European program referring at the climatic changes, elaborated by the EU, stipulates a series of actions policies and measures at the level of the entire EU in what regards the fight against and the prevention of the gases with greenhouse effect among which we mention as prioritary the following ones:

- establish some comprehensive schemes of negociation and trade of CO_2 in the EU;

- revise subventions for energy in the member states taking into account their compatibility with the objectives referring at the climatic changes;

- support the use of renewable sources of energy and the process of liberalization;

- apply the market tools for example taxes on energy and other categories of eco taxes;

- promote the concept of saving energy in buldings;

- intensify the activities of research and development and coordination of research in the meber states in the field of climatic changes.

Adaptation at the climatic changes

Although this process is difficult or even impossible the results of the research studies performed and of certain policies regarding the environment, put into evidence the following aspects:

- the requirement for a better preparedness for combating or removing the negative effcets of the extreme meteorological phenomena;

- improvement of the urban plannings, enlarging the green spaces and use materials which may maintain better micro climat inside buildings.

For Romania the climatic changes represent a provocation taking into account the fact that the rich countries can adapt more easily to these changes and answer in a better and more efficient way to their negative effects but the countries in course of development are more vulnerable and adapt with difficulty.

On international scale it is well known and acknowledged the fact that poorness represents one of the main polluter factor and its lessening contributes to the improvement of the economic social and even natural environment at generating new opportunities for business and human development.

4. Conclusions

In what regards the overflows and floods can be concluded that:

- the overflows from 2005 lasted about 7 months from March to September affecting most of the hydrographic network of the country;
- although in the past 30- 40 years took place overflows in most of the hidrographic basins what is characteristic for the year 2005 is that it has never happened before that time in the last 100 years to last for such a long period the overflows and floods;
- such kind of phenomena it is known that took place in 1615 when it rained continously fro, 22 May to 26 July, in 1618 when it rained from June to July and 1831 when it rained from May to September;
- the protocole from Kyoto from 1997 having as main issue of debates the reduction of the emissions of toxic gases and the Agreement from 2005 from Vientiane aim to promote the technologies with are not harmful for the environment;

The national strategy of Romania relating to the climatic changes and adopted by governmental decision HG 645-2005 take into account the interval 2005 - 2007 and refers to the ensurance and completion of the international commitments assumed by our country by the Framework convention and the Protocole from Kyoto and respectively the elaboration and implementation of the objectives and activities related to these.

It should be granted special concern to the improvement of the use of soil and land in accordance with the climatic changes (should be used plants which are resistant at drought and frost, ecologic system of irrigation, technologies of producing artificial rains and combat frost, desertification , plant new forests.

The study of all the implications of the climatic changes in our country should be continued by systematic research.

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CERCETARI PRIVIND EHIPAMENTELE PERFORMANTE PENTRU FERTIRIGATIE

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REZUMAT

In prezent, in conditiile existentei unei piete concurentiale in toate domeniile economiei, agricultura a fost nevoita sa gaseasca noi metode moderne eficiente care sa conduca la o crestere a productiei concomitent cu scaderea cheltuielilor de productiei. In acest sens, o atentie deosebita s-a acordat fertirigatiei, care este un concept modern de tehnică agricolă, reprezentand metoda prin care substanțele fertilizante sunt distribuite plantelor concomitent cu apa de irigat.

Principalele avantaje ale metodei sunt:

-înlocuieşte sistemul clasic de administrare a îngrăşămintelor chimice, care presupune existența unor sisteme de maşini complexe, consumuri energetice şi de forță de muncă semnificative, cu un coeficient de uniformitate a distribuției redus, etc;

-facilitează accesul rapid al substanțelor fertilizante la sistemul radicular al plantelor, la momentul oportun;

-înlătură fenomenul de stationare a îngrăşămintelor chimice la suprafața solului;

-permite dozarea foarte precisă a componentelor soluției fertilizante, în funcție de cerințele de nutriție ale plantelor, determinata de analizele chimice ale solului;

-echipamentul mobil de fertirigatie se branseaza in paralel cu tronsoanele conductei de irigatie prin intermediul unor robineti, fluidul- apa- actioneaza asupra multiplicatorului de presiune cu membrane si prin antrenarea alternativa a acestuia realizeaza aspiratia si refularea (injectia) ingrasamantului lichid in conducta. Multiplicatorul este subansamblul cel mai important al instalatiei avand rolul de motor si pompa. In functionare, aspira ingrasamantul si injecteaza o cantitate constanta le fiecare cursa in apa de irigatie. Deasemenea, are posibilitatea de a regla numarul de injectii in unitatea de timp in functie de necesitata concentratiei amestecului apa – ingrasamant. Din acest motiv, cercetarile sunt axate in principal pe acest subansamblu;

Cuvinte cheie: echipament fertirigatie, membrane, multiplicator

1. DOMENIU DE UTILIZARE

In scopul obinerii unor productii mari in legumicultura si horticultura fermele agricole au utilizat in ultimele decenii o noua metoda eficienta de aplicare a ingrasamintelor – fertirigatie - care este un concept modern in tehnică agricolă, constand in faptul ca substantele lichide fertilizante sunt distribuite plantelor concomitent cu apa de irigat.

Avantajele acestei metode sunt următoarele:

- micsoreaza cheltuielile de productie prin eliminarea utilajelor care sa administreaza ingrasamint lichid, de combustilbil şi de forță de muncă, creste gradul de uniformitate in sol, etc.

- accesul rapid al substanțelor fertilizante la plante in perioada cand este necesara udarea culturilor. Din studiile efectuate s-a constatat că în sistemul clasic de fertilizare, în anii normali din punct de vedere al precipitațiilor plantele valorifică cca. 65% din substanțele nutritive aplicate sub forma de îngrăşăminte, pe când în anii secetoşi nu pot valorifica decât 40%;

2. DESCRIEREA INSTALATIEI HIDRAULICE DE FERTIRIGATIE

Sistemul se administrare continua se caracterizeaza prin aceea ca se aplica cantitati de injectie egale dar pulsatoriu permanent in apa de irigat in instalatiile de udat.

Frecventa pulsatiilor este reglabila prin modificarea debitului de apa care actioneza multiplicatorul injector.
In general o instalatie de fertirigatie are elementele componente prezentate in fig.1:

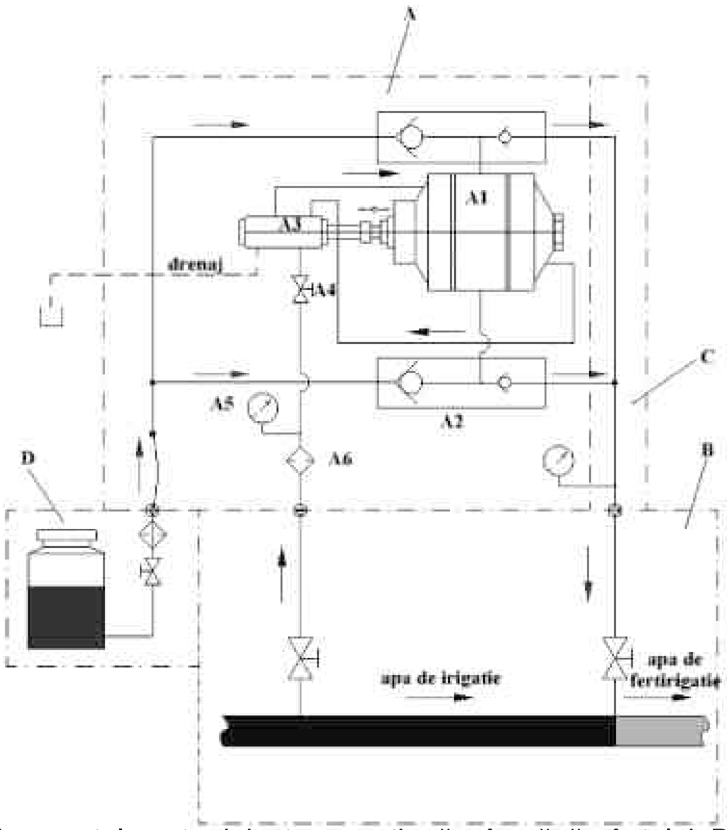

Fig.1. A-echipamentul pentru injectare continuă a îngrăşământului, B-tronson conducta de irigat, C-sistem de monitorizare parametrii lichidului de injectie, D-recipient de ingrasamant cu acesoriile aferente

Echipamentul pentru injectie A se branseaza la inceput pe tronsonul de irigatie B in zona in care se va face fertirigatia iar apoi la acesta se conecteaza vasul cu ingrasamant lichid D. Se deschid robinetii de pe aceste circuite astel ca lichidul sub presiune, dupa deschiderea robinetului A4, va patrunde pe una din caile distrbuitorului A3 in camerele multiplicatorului cu membrane – fig.2;

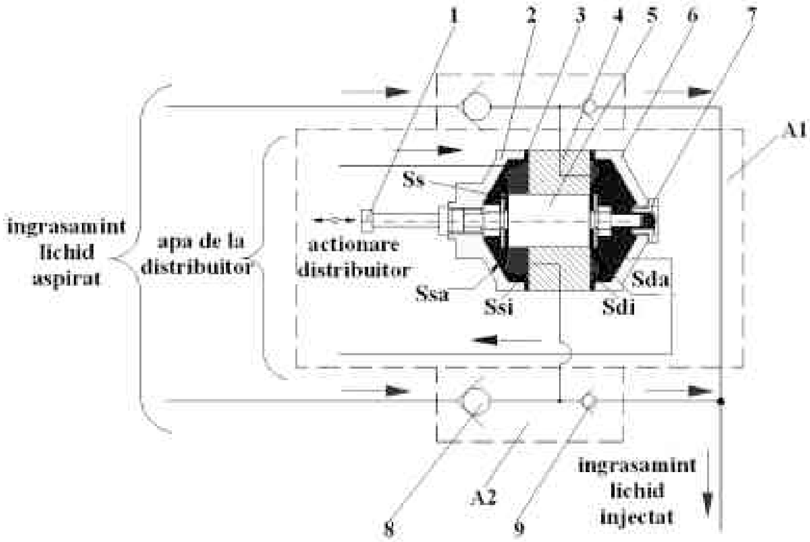

Fig.2. Schema hidraulica a multiplicatorului: 1-tija actionare axiala, 2-capac stanga, 3-membrana, 4-carcasa, 5-sertar, 6-capac dreapta, 7- dop, 8-supapa admisie, 9-supapa refulare.
- Ssa, Sda – suprafetele circulare stanga, respectiv dreapta pe care actioneaza apa;
- Ssi, Sdi – suprafetele circulare stanga respectiv dreapta pe care actioneaza ingrasanatul lichid;
- Ss – suprafa circulara a sertarului;

In cazul in care apa sub presiune se afla in camera din dreapta, subansamblu format din cele doua membrane, tija si sertar se vor depasa spre stanga, va injecta ingrasamantul prin supapa de injectie existenta la partea superioara din figura, ca urmare a presiunii exercitate de apa pe suprafata Sda. In acelasi timp, ingrasamatul este aspirat din vas prina supapa de sens, 8, tija 1 va actiona asupra distribuitorului A3 schimbandu-i pozitia iar operatia de injectare se va repeta identic in partea stanga a multiplicatorului.

Dupa cum se poate observa ,,pompa de injectie" nu are nevoie de alta sursa de energie astfel ca aceasta metoda se poate aplica in zone izolate in care nu este instalata energie electrica. In general, din punct constructiv multiplicatoarele cu injectie au doua camere motoare si doua camere de pompare – solutia prezentata mai sus – dar exista si varianta cu o camera motoare si alta folosita ca injectie.

3. ACTIONAREA ALTERNATIVA A MULTIPLICATORULUI

In ceea ce priveste distibuitorul hidraulic care comanda miscarea altenativa a multiplicatorului de injectie exista, de asemenea, mai multe variante constructive. In figurile 3 si 4 este prezentat un distribuitor cu inchidere frontala cu etansare din elastomeri.

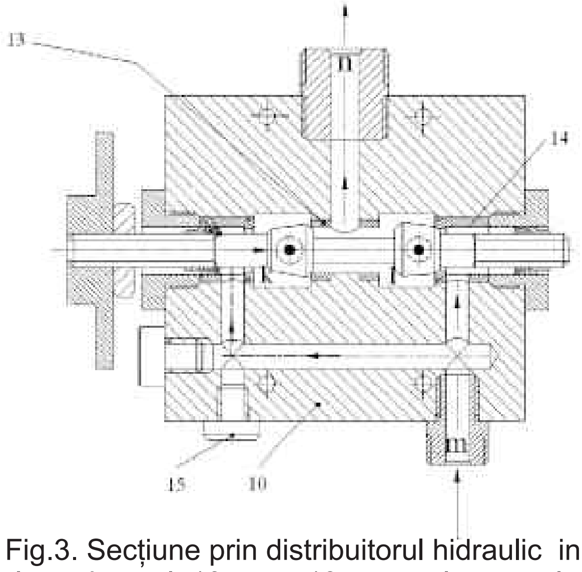

Fig.3. Secțiune prin distribuitorul hidraulic in plan orizontal: 10-corp, 13-scaunele centrale, 14-scaunele laterale, 15 - dop, m-racord de alimentare cu apă sub presiune, n-racord de evacuare

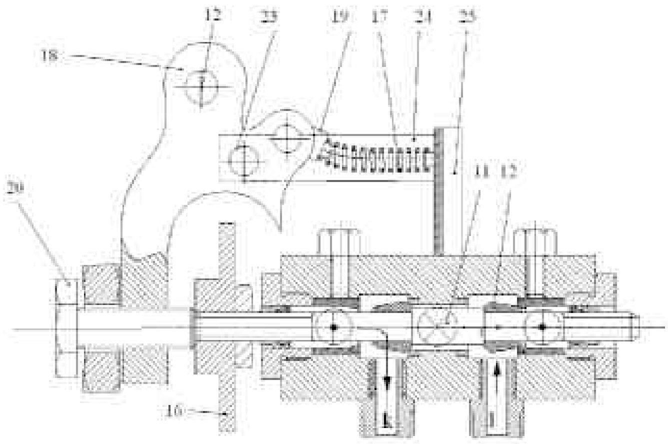

Fig.4. Secțiune prin distribuitorul hidraulic in plan vertical: 11-ax; 12-supape fixe, 16-bucşă prin care axul este acționat de comanda mecanică, 17-arc basculant, 18-furcă, 19-cuplă de rotație, 20-şurub reglabil, 23-ax, 24-suportul furcii, 25-profil sustinere comandă mecanică, m-racord de alimentare cu apă sub presiune, n-racord de evacuare, k,l- cosumatorii distribuitorului care actioneaza multiplicatorul.

La finalizarea cursei multiplicatorului, tija 1 actioneaza printrun sistem de parghii furca 18 care basculeaza arcul 17, schimband pozitia sertarului distribuitorului si implicit sensul de actionare a presiunii in camerele membranelor. Dezavantajul acestei actionari consta in faptul ca in timp, caracteristicile arcului imbatranesc si bascularea arcului este ratata.

Si reglajul frecventei de injectare a multiplicatorului prezinta un dezavantaj major, reglarea debitului prin intermediul robinetului A4 se face conform droselizarii: pentru micsorarea debitului prin inchiderea robinetului cadere de presiune creste existand riscul ca la o presiune minima din camerele membranelor multiplicatorul sa nu mai functioneze.

4. PRODUS INOVATIV CA REZULTAT AL CERCETARILOR

Analizand deficientile echipamentelor de injectie existente in prezent, cercetatorii de la IHP- Bucuresti si – au propus si realizat un produs nou – fig.5- cu urmatoarele caracteristici:

· constructie simpla bazata pe subansamble atasabile;
· durata de viata mare
· domeniul de utilizare la presiuni mici din instalatiile de irigat, aproximativ 1 bar;
· mentenanta predictibila cu cheltuieli reduse;
· gabarit si greutate reduse;

rezistenta chimica a materialelor echipamentului la toate ingrasamintele chimice utilizate in agrucultura;

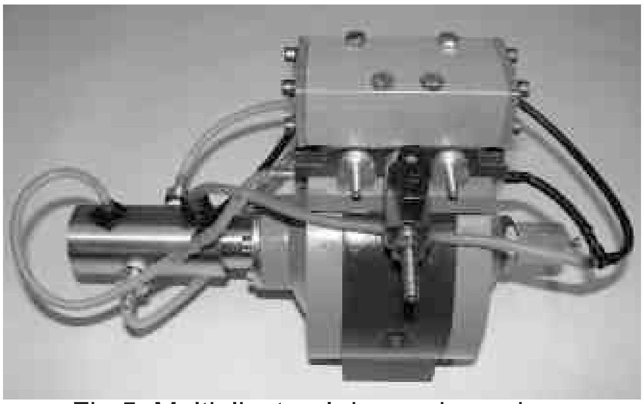

Fig.5. Multiplicatorul de presiune si injectie – produs inovativ

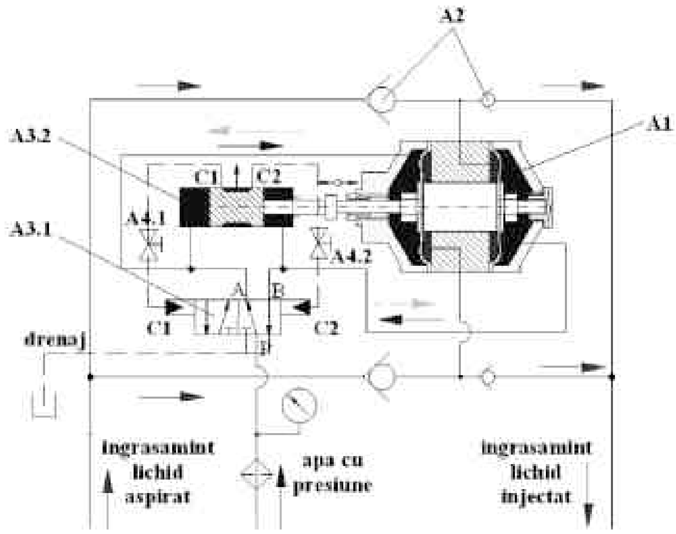

Fig.6. Schema hidraulica in varianta inovativa: A1- multiplicator, A2- bloc supape de sens, A3.1- distribuitor de actionare, A3.2- distribuitor de urmarire, A4.1;A4.2- robineti miniaturizati, C1,C2 camerele de comanda (pilotare) ale distribuitorului de actionare

Caracteristici tehnice generale

-Presiunea maxima de lucru.......................... P = 6 bar;
-Debitul de ingrasamant lichid injectat.................. Q = 2...4 l / min;
-Cursa totala de injectie .... c = 18 mm;
-Aria suprafeţei de lucru .... S = 61 cm^2;
-Raportul volumelor motor / pompa........................ I = 2 / 1;
-Pierdera de presiune din circuitul de alimentare .... Δp = 0,02 bar;
-Dimensiuni de gabarit.................................. 303 x 146 x 300 mm;

Schema hidraulica a multipicatorului este prezentata in fig. 6, in care se poate observa ca tija multiplicatorului actioneaza direct axial sertarul distribuitorului de urmarire A3.2 care comanda hidraulic distribuitorul de actionare A3.1. Constructia elimina modul de actionare complicat cu parghii si arc care necesita in plus si o serie de reglaje mecanice.

Un alt avantaj este acela ca reglajul numarului de injectii se efectueaza prin intermediul robinetilor miniaturizati A4.1, A4.2, montati pe circuitele de comanda care modifica debitele mici de pe circuite, efectul de drosel fiind diminuat.

Echipamentul de injectie se poate utiliza si in alte domenii, de exemplu in transvazarea lichidelor corozive.

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CONSIDERENTE PRIVIND INFLUENȚA PRESIUNII DIN PNEU ASUPRA REDUCERII ENERGIEI NECESARE LA DEPLASAREA VEHICULELOR TERESTRE

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Rezumat

Presiunea aerului din pneu are o influență deosebită asupra rezistenței la rulare a pneului, asupra aderenței pneului, asupra deformării acestuia, respectiv asupra consumului de combustibil necesar deplasării vehiculului terestru pe calea de rulare. O presiune prea mică sau prea mare a aerului din pneu va determina o creştere a costurilor kilometrice necesare exploatării anvelopei. Performanțe precum randamentul kilometric, confortul, transmiterea efortului de tracțiune sau de frânare sunt influențate de presiunea din pneu. O presiune inferioară generează o flexare exagerată a carcasei pneului, conducând la încălzirea exagerată a pneului, la creşterea rezistenței la rulare şi la uzarea prematură sau chiar la distrugerea anvelopei. O presiune superioară face ca anvelopa să devină mai puțin aderentă şi se uzează neuniform şi mai rapid, în special pentru cazul roților motoare.

Cuvinte cheie: vehicul terestru, roată, pneu, presiune, energie, monitorizare presiune

1. Considerente generale

Presiunea din pneu are o importanță deosebită asupra formei suprafeței de contact dintre pneu şi calea de rulare şi implicit asupra distribuției tensiunilor în sol (Fig. 1). Pentru diferite condiții de sol (tip de sol, umiditate, etc.), în funcție de presiunea din pneu, pot fi obținute diferite distribuții ale tensiunilor în sol.

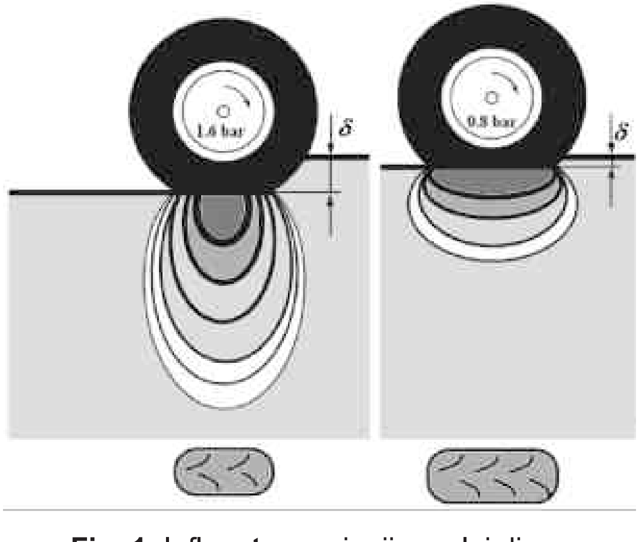

Fig. 1. Influența presiunii aerului din pneu asupra formei suprafeței de contact şi asupra distribuției tensiunilor în sol

De asemenea, valoarea presiunii din pneu are o importantă influență asupra caracteristicilor de rulare şi de aderență a roților, influențând decisiv consumul energetic pentru deplasarea vehiculelor terestre.

Fig. 2. Influența presiunii din pneu asupra deformației acestuia [12]

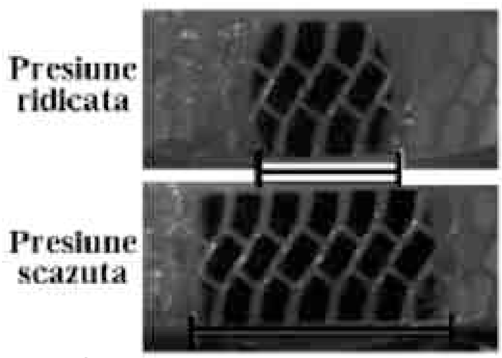

Fig. 3. Influența presiunii din pneu asupra petei de contact cu calea de rulare [12]

În figura 2 este prezentat modul cum se deformează pneul în funcție de presiunea din interiorul acestuia. Astfel, în cazul în care presiunea din pneu este prea mare (Fig. 2.a) suprafața de contact cu calea de rulare este mai mică (Fig. 3), rezistența la rulare este scăzută, însă este semnificativ diminuată aderența roții, iar compactarea căii de rulare, în special în cazul vehiculelor de teren, este accentuată. În figura 2 c este prezentat modul de deformare a pneului atunci când presiunea aerului din interiorul acestuia este prea scăzută. Aici, suprafața de contact cu calea de rulare este mare (Fig. 3), conferind o aderență ridicată, o presiune pe pata de contact mai scăzută dar o rezistență la rulare mare, ceea ce implică un consum de energie necesar deplasării vehiculului mai mare. În figura 2 b este prezentat cazul pneului pentru care presiunea este corespunzătoare.

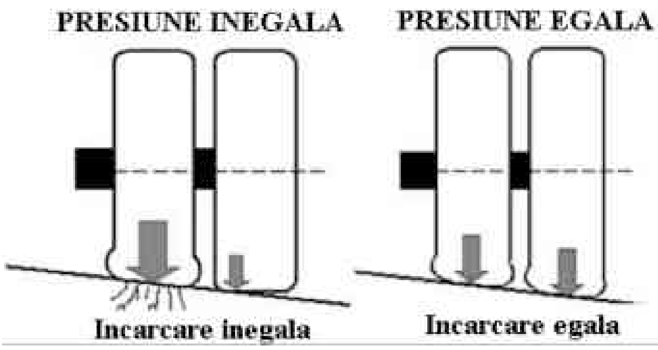

Fig. 4. Influența presiunii din pneu asupra comportării roților în tandem [12]

În cazul roților în tandem (pereche), aşa cum se întâlnesc la autocamioane sau la tractoare de mare putere, presiunea egală din pneuri este foarte importantă pentru ca solicitările celor două roți să fie egale (Fig. 4), respectiv pentru ca durabilitatea pneurilor precum şi comportarea la rulare să fie egală.

Datorită acestor considerente au apărut în ultimii ani sisteme de monitorizare a presiunii din pneu (Fig. 5) şi chiar sisteme automate de reglare a presiunii aerului din pneurile vehiculelor terestre.

Fig. 5. Sistem de monitorizare a presiunii din pneu [13]

În figura 6 este prezentată dependența dintre presiunea aerului din pneu şi economia de combustibil ce se poate obține la deplasarea vehiculelor pe calea de rulare.
Se observă că cu cât presiunea din pneu este mai scăzută cu atât economia de combustibil are valori mai mici.

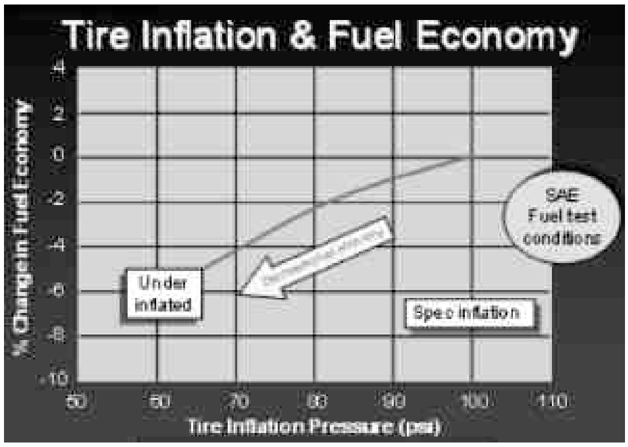

Fig. 6. Legătura dintre presiunea din pneu şi economia de combustibil [11]

2. Considerente teoretice

Sub acțiunea sarcinii exterioare (greutatea pe roată) *F*, un pneu se deformează ca în figura 7 iar conform formulei lui Hedekel deformația pneului se poate calcula [9]:

$$f = \frac{F}{2 \cdot \pi \cdot p_i \cdot \sqrt{R \cdot r}} \quad \text{[mm]} \qquad (1)$$

în care: *F* – reprezintă sarcina verticală ce acționează asupra roții, [N]; p_i – presiunea aerului din interiorul pneului, [Mpa];
R – raza liberă a roții, [mm]; *r* – raza căii de rulare a pneului în secțiune transversală, [mm].

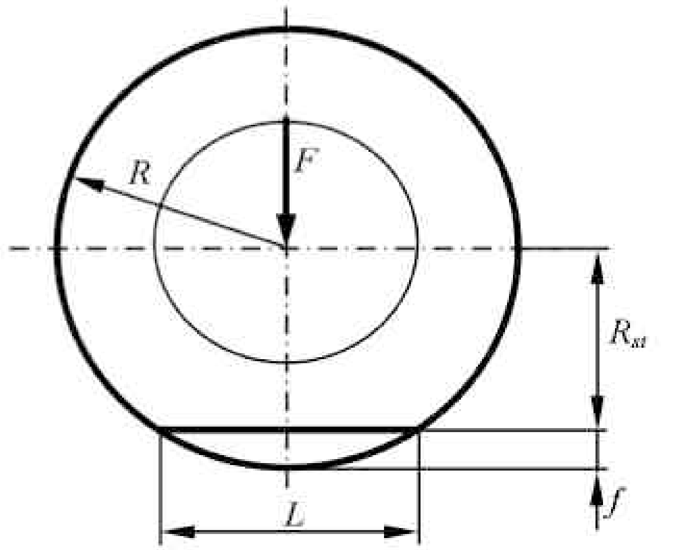

Fig. 7. Deformația pneului sub acțiunea sarcinii exterioare

Raza statică a pneului se calculează:

$$R_{st} = R - f \quad [\text{mm}] \tag{2}$$

iar lungimea coardei de contact:

$$L = 2 \cdot \sqrt{R^2 - R_{st}^2} \quad [\text{mm}] \tag{3}$$

Suprafața de contact dintre organul de rulare şi sol poate fi calculată cu aproximație:

$$S = L \cdot B \quad [\text{mm}^2] \tag{4}$$

iar presiunea constantă exercitată de organul de rulare asupra solului se poate calcula:

$$p = \frac{F}{S} \quad [\text{N/mm}^2] \tag{5}$$

In tabelul 1 sunt date caracteristicile principale ale roților tractorului U-650.

***Tabel 1** - Caracteristici ale tractorului U-650*

Caracteristici	Roata față	Roata spate
Dimensiuni pneu, ["]	6,5-20	14-38
Masa pe punte [kg]	1170	2210
Lățime pată de contact, [mm]	180	367

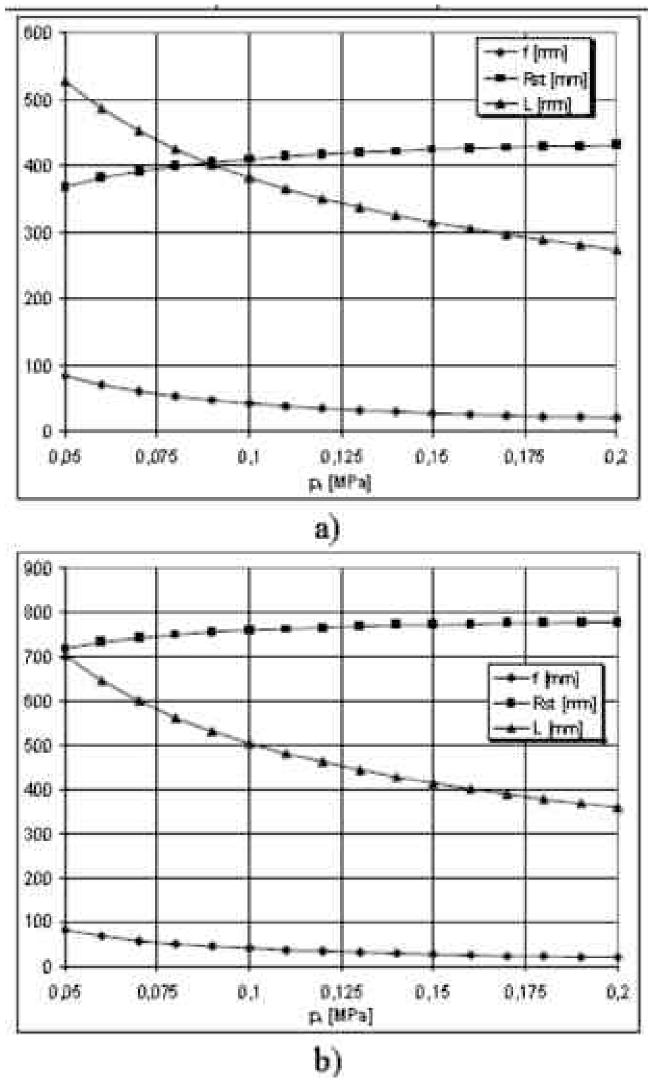

***Fig. 8.** Influența presiunii din pneu asupra caracteristicilor dimensionale ale rotilor*

În figura 8 este prezentata influența presiunii din pneu asupra caracteristicilor dimensionale ale roții (Fig. 7), respectiv deformația pneului *f* (Ec. 1), raza statica R_{st} (Ec. 2) si lungimea coardei de contact *L* (Ec. 3), pentru roata fata (a), respectiv pentru roata spate (b).

Aşa dupa cum rezulta din ecuatia (5), presiunea cu care pneul actionează asupra căii de rulare este influențată de presiunea aerului din pneu. În figura 9 este prezentată această dependență atât pentru roata din față (f) cât şi pentru roata din spate (b).

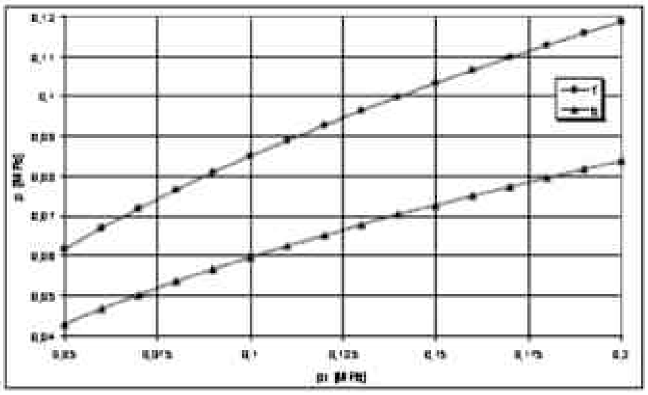

Fig. 9. Influența presiunii din pneu asupra presiunii de contact

În figura 10 este prezentată influența valorii presiunii din pneu asupra distribuției tensiunilor în sol, pentru roțile din față şi spate ale unui tractor de 65 CP.

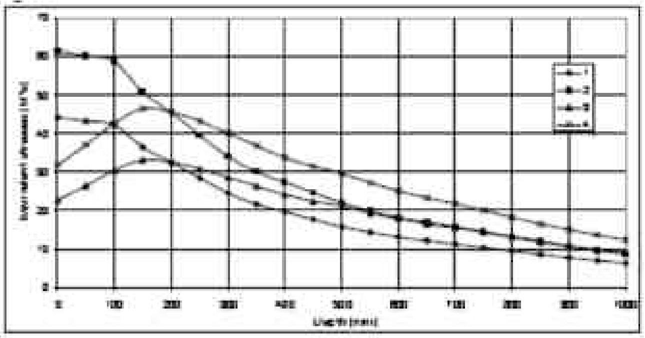

Fig. 10. Variatia pe adancime a tensiunilor echivalente în sol
1-pneu fata (0,8 bar), 2-pneu fata (1,6 bar), 3-pneu spate (0,8 bar), 4-pneu spate (1,6 bar)

În figura 11 este prezentat modul de deformare radială a pneului la interacțiunea cu calea de rulare nedeformabilă. Se consideră că pe fiecare element de suprafață a pneului ($B \cdot dx$) ce intră în contact cu calea de rulare, acționează o forță elementară de comprimare radială ($p_F \cdot B \cdot dx$). Rezistența la rulare a pneului poate fi calculată:

$$R_{r1} = B \cdot R \cdot p_F \cdot (1-K) \cdot \frac{\sin^2 \alpha_0}{2} \qquad (6)$$

în care B -este lățimea pneului, R –raza pneului înainte de a intra în contact cu calea de rulare (raza liberă), p_F –presiunea pe anvelopă în zona anterioară, K –raportul (subunitar) dintre presiunea spate şi presiunea față pe anvelopă.

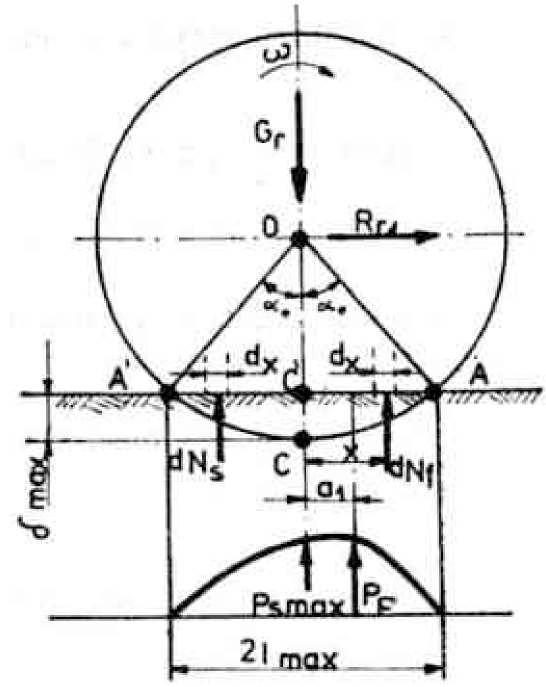

Fig. 11. Deformarea radială a pneului la interacțiunea cu calea de rulare nedeformabilă [10]

Valoarea unghiului la centru al semi-lungimii petei de contact se poate calcula ținând cont de rigiditatea volumică a pneului q_p (dependentă de presiunea din pneu), de sarcina pe roată G_r, de lățimea pneului şi de raza liberă a pneului [10]:

$$\alpha_0 \cong \sqrt[3]{\frac{3}{2}} \cdot \sqrt[3]{\frac{G_r}{q_p \cdot B \cdot R^2}} \qquad (7)$$

Concluzii

Aşa după cum se poate observa în figurile 8 şi 9, presiunea din pneu are o influență importantă asupra caracteristicilor dimensionale ale roților, respectiv asupra presiunii de contact, de care depind parametrii caracteristici ai deformării pneului, respectiv rezistența la rulare a roții.

Cu cât rezistența la rulare este mai mare, cu atât puterea necesară pentru deplasarea vehiculului terestru este mai mare.

Din calcule, dar mai ales din determinări experimentale şi constatări ale firmelor producătoare de anvelope, rezultă că durabilitatea şi randamentul kilometric al pneului scade cu până la 20 % dacă presiunea din pneu este necorespunzătoare.

În consecinţă, au apărut şi au fost implementate sisteme de monitorizare a presiunii din pneu şi chiar sisteme de reglare automată a presiunii din pneu.

Mulţumiri
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ENERGETIC PLANT MECHANICAL PROPERTIES IN RELATION WITH THE PREPARATION PROCESS (GRINDING AND BRIQUETTING)

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Abstract

Biomass is regarded as a key factor in green energy development due to the fact that it is environmental friendly, so it doesn't cause climate change and also it is renewable. Mechanical and physical properties of plants used in biomass process have a major impact on the preparation equipment and process energy consumption. This paper presents the ways in which properties like plant height, width, humidity, etc., affect grinding and briquetting equipments.

Keywords: energetical plant, physical properties, biomass grinding, climate change, miscanthus

1. Introduction

The necessity to lower climate changes and to satisfy the rising energetic needs lead to extended terrain surface energetic plant harvesting in many states. There is the concern that this type of large crops will alter foods production and will have major impact on the environment. The development of renewable energy sources that help ensure future resources, is regarded by worldwide level governments as a vital part of the future durability agenda, [11].

High material volume, biomass low density resulted from agricultural materials represents a significant impediment during its use as raw material for many processes, including bio-energy production, [32].
Material low volume mass raises the transportation costs, and sometimes hardens the use of biomass processing equipment, more specific the feeding with material operation is altered. The first operation during the biomass processing process is grinding, thus reducing the raw matter volume. The lack of scientific/engineering knowledge regarding the fibers that compose the biomass alters grinding of specific plants that could be used as raw matter for energy obtainment, [1].

Although grinding processes are some of the oldest methods for biomass processing, there is little known about the process optimization methods according to the mechanical characteristics of the used material. Mohsenin (1986) in his study concluded the fact that the majority of the grinding process required energy is wasted as heat, the required energy for material grinding being from 0.06 to 1% out of the total process energy requirement, [14].

The main objective of these papers is to create a synthesis regarding energetic plant mechanical properties in relation with the preparation process, looking for the following aspects:

- Mechanical and physical properties analysis of the energetic plants that have biomass role, as influence factors for the grinding/ cutting/ milling;
- Outlining different equipments used for the preparation process;
- Presentation of some specific equipment used for each operation inside the preparation process.

In the papers conclusions suggestions and conclusions regarding the relation between plant mechanical properties and the preparation process will be presented.

2. Materials and methods

This part of the paper uses as bibliographic sources a variety of articles and studies taken from specific sites, as ASABE or/and ScienceDirect, but also from national and international journals that have the same theme. Data have been taken from articles and used in the purpose of understanding the relation (connection) between the plant preparation process and its mechanical properties.

3. Results and discutions

Mechanical and physical properties of the energetic plants

Inside many scientific papers the general conclusion regarding our theme referred to the fact that between mechanical and physical properties of the energetic plants and the preparation process there is a strong connection without which the process could not be completely studied, and without which no optimizations could be realized.

An incipient problem identified was that due to differences in material physical properties (material particle size, material shape, material surface, material hardness, etc) there is hard to determine material breakage resistance and the process energy requirements. Without knowing these data there is the possibility that grinding process modeling will be created with errors that will lead to faulty functioning of the mills or grinders and even pellet installations, [17,29].

Table 1. Different biomass types mechanical and physical properties

Nr. crt.	Plant type	Moisture content, (%wb)	Bulk density, (kg/m^3)	True density (kg/m^3)	Specific energy, kN/m	Ash content, (%)	Paper no.
1	Wheat straw	8.30	108	1210	15	8.32	[28]
2	Switchgrass	8	151	1090	86.5	5.49	[29,30]
3	Corn stover	11 - 15	148	1280	31.5	7.46	[29,30]
4	Barley straw	6.98	98	1100	53kWh/t	10.72	[28]
5	Miscanthus	8.5	1170	1080	4.4 kW	2.3	[10]

Determining these mechanical and physical plant properties is part of a complex process because, through their nature, they have complex composite structures with strongly tied elements between each other, [29].

Determining and measuring plant mechanical and physical properties, maybe considered as a major operation. The standard test procedures of these properties can be applied to the material structure in lab conditions. These plant tests are in the limits of industry default, for equipment s such as harvesting, milling, grinding, pelleting machinery, [28, 22]. Determined mechanical properties from the lab can be used as input data inside mathematical models able to determine the parameters that affect energy consumption from the technological flow, [8, 16, 27]. As an example we can say that the difference between the obtained product associated energy after grinding and the energy associated to the raw matter, is equal with the consumed energy for the grinding process.

The theory of free grinding can be summarized in the relation:

$$E_p - E_m = \eta \cdot E_c$$

where: E_p – grinding process energy; E_m – raw matter energy; E_c – consumed energy by the grinding machine; – equipment energetic performance.

Another example is linked to cutting energy specific consumption, a point that was achieved experimentally in paper [4].

Just 35 herb probes have been evaluated and analyzed, [12], although 62 types of biomass have been taken into consideration, [3]. The analysis of integrated biomass offer and the logistics model, [23] The Integrated Biomass Supply Analysis and Logistics (IBSAL) Model] can create an important instrument in the energetic crop selection, [23]. Developing such a model needs four stages for experiments such as work method establishment, identifying factors and function relations that can be included into the model, programming and model validation with the help of experimental data, [23].

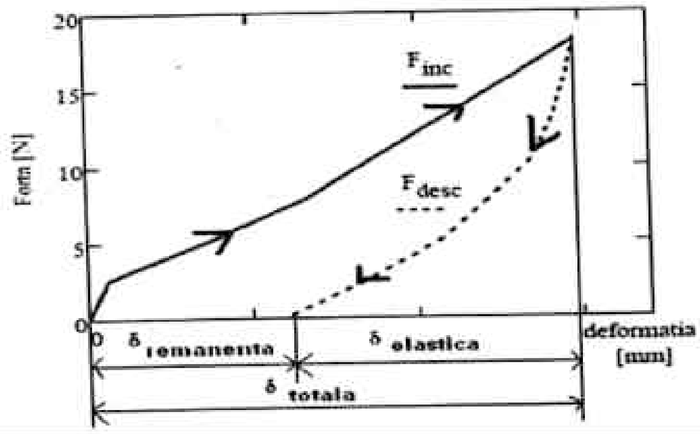


Fig.1. Energetic plant force-deformation curve (adapted after [23])

Following mechanical and physical researches for energetic plants a visco-elastic and elasto-plastic behavior at low temperatures and high pressure values (mechanical tensions) were observed. The energetic plant force-deformation diaphragm was created

Equipments used in the energetic plant grinding process

In order for the energetic plants to be used as bio-energy, bio-fuel, or bio-product, their grinding is necessary. This process mainly depends on the type of plant used, the maneuverability method and its processing. Both plant grinding, as well as biomass compression are important methods for an efficient harvest, transport and material drying, [13].

The grinding process (cutting/milling) refers to the biomass applied mechanical processes that significantly change the size of material particles, the form of the material particles and the volume mass of the material. The energetic plant grinding process can contain more operations such as: cutting, milling, breakage, impact resistance, compression, etc.

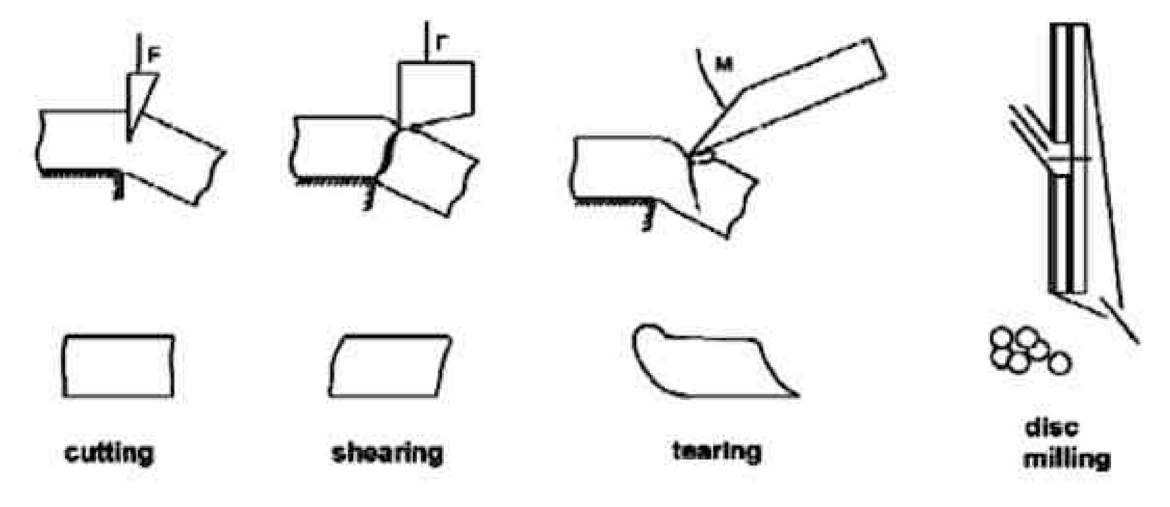


Fig.2. Types of operations and particle corresponding shape [22]

As it can be seen there is a difference between cutting and milling through particle shape of material subjected to the process. Cutting is done, generally, with knives that have a cutting angle of 90°, and grinding is done with 75 to 90° angle knives. Following the cutting process the material is divided through cutting with the knife, not similar to the case of grinding, where the grinded particles are the result of material resistance to shear and stretch [24].The cutting process was investigated in the paper [4], on bush stalk, using two types of knifes, one with a 20° 90° cutting angle. Knife movement, the cutting force as well as the cutting process energy requirement have been collected with the help of a computer.

Conclusions for the study outlined the fact that the bush cutting specific energy was between 8–58 kJ/m^2, and for easy device maintenance the use of a 90° knife is required [4], because the tear is more accentuated in the case of the knife with a below 90^0 sharpening angle.

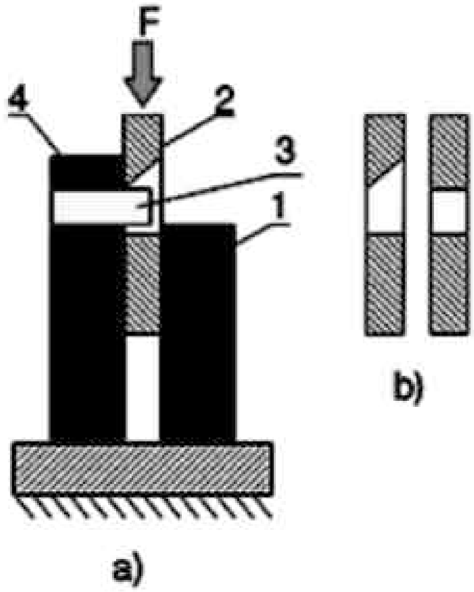
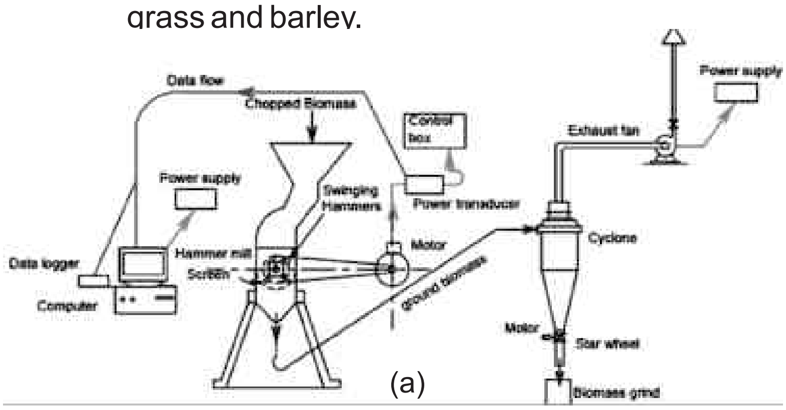


Fig.3. Shearing experimental device, [4]
a. 1.die, 2.device knife; 3.cutting material;
4.material revolving grip device; F – cutting force;
b. knife inclination angle)

The grinding process can be described as a combination of material resistances to torsion, breakage, compression and friction with the equipment active elements, thus resulting in three distinct results for the process: material particle size, form, and the connections inside the material structure. [19,15,17]. Grinding machines used for experimentation have been in resemblance to hammer mills, knife mills and revolving mills. The most popular equipment for biomass grinding is the hammer mill due to its simple construction, easy exploitation and longevity. These hammer mills are most popular due to their capacity (ability) to mill (grind) different types of material [25]. Researches on hammer mills have been done especially on grinding speed, work flow, sieve orifice dimensions, grinded material mass evacuation. Hammer mills are used for grinding average size or fine materials due to the fact that in the grinding process energy is consumed less. Grinded material properties are affected by the mill sieve orifice dimensions and the equipment feeding flow. [7].

The measure in which physical properties have an effect on the grinding process has been studied in the paper [26]. Authors used a hammer mill, and the material was formed out of wheat straws, energetic grass and barley.



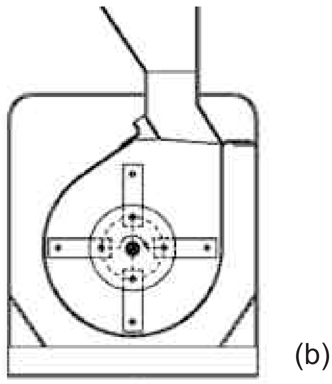


Fig.4. Grinding installation model from the paper [26], (a) and the hammer mill model (b), [20]

Tests have outlined the fact that energetic grass, unlike the other two types of plant had the highest specific energy consumption, at all used sieve dimensions, but also at different levels of humidity content. At a humidity content of 4-7% for wheat straws and sieve dimensions of 0.8, 1.6 and 3.2 mm, the energy specific consumption was of 51.6, 37.0 respectively 11.4 kWh/t. For com stover at a humidity content of 12% and sieve dimension of 3.2mm, the specific energy consumption was of 11kWh/t. [26]. It has been concluded that the smaller sieve orifice dimensions increase specific energy consumption. [26].

Equipment used in the process of biomass compression

The process of pelletization (compression) of biomass is done with the help of a material compression force and transformed in a solid, maneuverable form, easier to deposit and transport, [5]. In the compression process there are currently four methods of densification being used, such as: briquetting, pelletization, cubing and bundling.

Equipments used inside this compression process can be of two types: Type A in which the compression process takes place at high pressures and type B in which the compression process takes place under low compression pressures [2].

An old discovery is that between the material variables (energetic plant mechanical and physical properties: content and plant humidity distribution, material particle dimensions, material particle shape etc), the densification process variables (compression die geometry, extruder orifice dimensions, material temperature, compression an pressure appliance method, etc) and the equipment design and construction, is a strong connection without which an optimal compression process cannot be created [21].

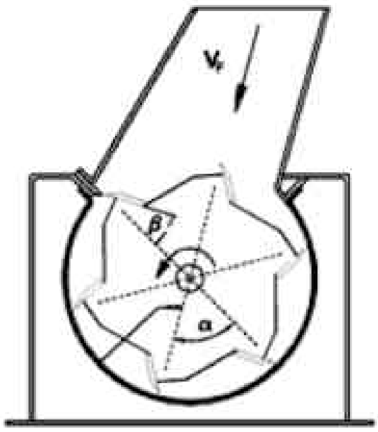


Fig.6. Knife mill with a cylinder-type cutterhead, [19]

Experiments for mechanical and energetic plant physical property influence determination on the process of compression have outlined the fact that a great influence on the final product [cubes, briquettes, pellets, etc] is due to the moisture, temperature and pressure and particle size of the material in use. It has been concluded that for vegetal plants used the moisture content must be of approximately 14.87%, temperature of 115°C, pressure of 32.99Mpa in order for an optimum process, [6]

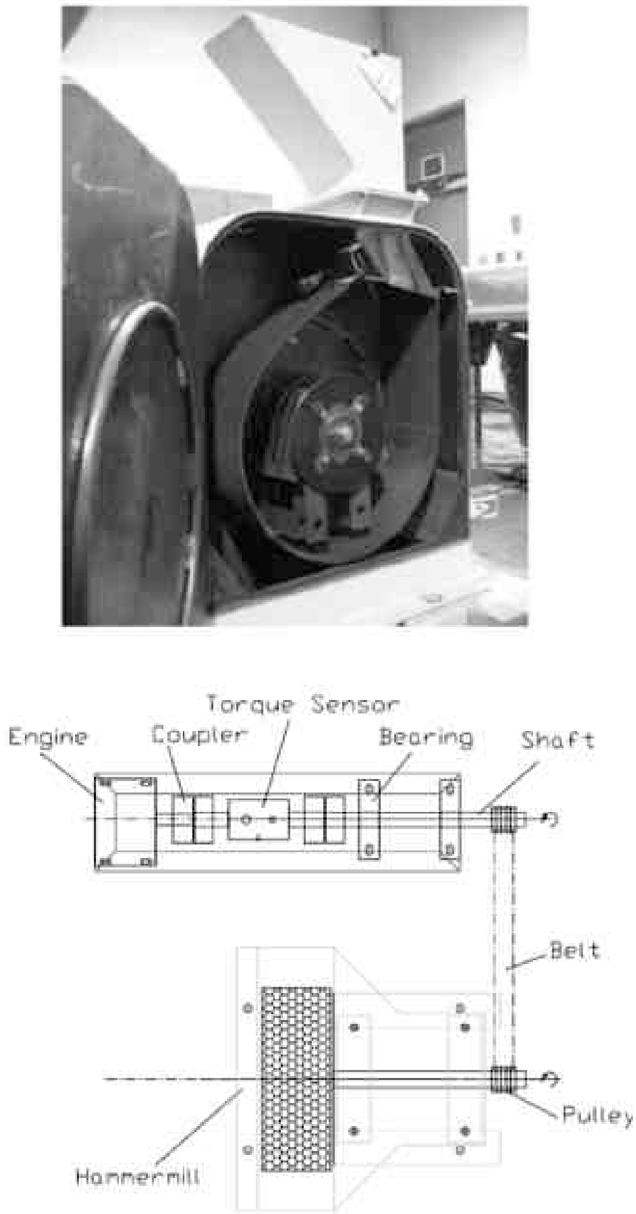


Fig. 7 Photograph of open hammer mill, hammer mill and instrumentation setup [31]

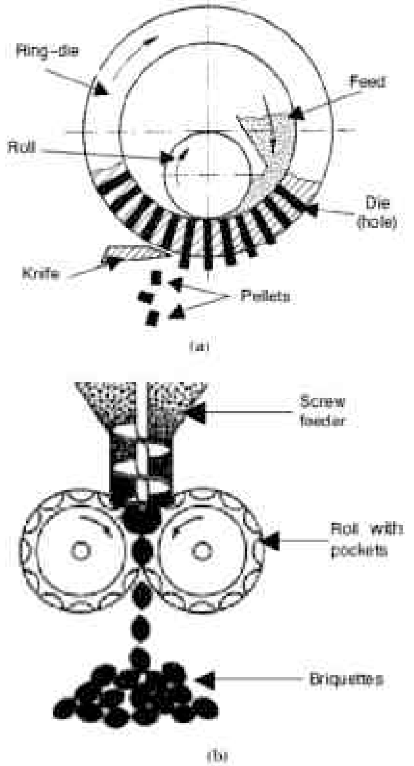


Fig. 8. Schematics of (a) conventional ring-die pelleting and (b) roll press briquetting machines, [9]

4. Conclusions

Energetic plant mechanical-physical properties (especially agricultural biomass) are of great importance in relation with preparation operations, in the bio-fuel converting process.

Thus, it is well to know that initial dimensions of the plants in order to correctly dimension the first equipments from the preparation flow sheet (cutting apparatus, grinding and milling machinery). Plant height influences the cutting platform configuration (header) and its hight, as well as the equipment forward speed. The width of the plant influences the grinding apparatus construction, and as a work appreciation indicator it has great importance over the grinding degree through grinded material particle size (both length, and width).

A great importance in the preparation machinery designing is given by the plant mechanical characteristics and the way in which they respond to mechanical stresses that can appear (flexure, torsion, shear, crushing, compressing, etc).

That is why, it is important to know shear, torsion, crushing and then compression tension vales, at different humidity content values, so appreciations can be drawn on the equipment functional and technological parameters: work speed (revolutions per minute), lost motion, action angles, feeding flows, forces to apply, etc. Again, the influence of density (true density) and plant volume mass (bulk density) need to be mentioned, raw and also adapted, for equipment construction and work regimes.

Important is also the energetic consumption during the preparation processes, given by the reaction to mechanical tensions at which the plants are subjected inside the preparation apparatus, in order to correctly dimension action systems from an energetic point of view.

There are also energetic plant biomass physical properties that influence the bio-fuel converting technological process, but the paper refers only for mechanical preparation operations.

As it can be seen, plant physical characteristics knowledge is of great importance both for biomass preparation equipment designers and fabricants, in order to establish their constructive parameters, and also for this type of equipment exploitation, for establishing functional parameters and optimal work regimes..

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EFFECTS OF THE THERMAL ISLE ON THE URBAN RIVERFLOW OF DAMBOVITA

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Abstract
The article presents the following issues:
- Specific climatic aspects for the year 2007 (temperatures and pluviometry) in Romania and Bucharest city
- Considerations regarding the urban heat isle
- Potential of evatranspiration
- The dynamic of the air and water temperature in the Izvor bridge zone

Interval of study : 2007, April - Sept.2010

Key words: climatic aspects, climatic urban isle, evotranspiration, air and water temperature

1. Introduction

The climatic urban isle represents a zone where are frequently recorded air temperatures which are higher than those of the neighbouring areas. The thermal isles appear as a result of being released a big amount of heat generated by houseware, commercial or industrial appliances. They may reach with 4 or 5° more than the neighbouring areas.

The buildings are made of materials which absorb and reflect more heat than vegetation and ground, radiating it back in the atmosphere. This heat influences the air circulation.

In certain zones the heat isles may be more hazy cause of the photochemical reactions of the polluter agents from the air. The year which is critical in what relates to the air temperature and pluviometry is 2007.

Dambovita crosses Bucharest city on Ciurel Vitan sector on a distance of about 10 km crossing the city from North west to south east. In time population has increased and water has become more and more polluted. The first hydraulic works under the form of aueducts were built in the time of Alexandru Ipsilanti in the XVIII th century

A first work which amplified the floods was the building of the wind mills from the river banks. Another project of sewerage of the Dambovita river was materialized in 1880, after the plans of the eng.Grigore Cerchez.

At the exit from Bucharest city, near Glina are annualy discharged in the river thousands of tons of polluted water, resulted from industrial and sewerage activities, waters which contain organic compounds (phosphates, azote, carbon, paper wastes, detergents) and metals like lead, iron and copper.

The levelş of the oxygen from the water after turning out from Bucharest is 0. The level of phosphorus and organic polluter agents is 25 times higher than at a course of Vth degree which represents the maximum threshold admitted.

2. Material and method

Climatic aspects specific for the year 2007 in Romania

<u>In what regards the air temperature we distinguish the following characteristics</u>:

- January was 6° warmer than the climatologic normal value 1961-1990.

In the winter 2006-2007 were exceeded the absolute records of maximum daily temperatures at 24 stations from Romania.

-

The summer of 2007 is comparable with that from 1946 but with more hot days.

- It was exceeded the maximum temperature value on July allover the country it was recorded 44,3° C on July 24th at Calafat.
- It was exceeded the absolute maximum temperature value on an important zone and and for a significant number of stations as follows: June 53 stations July 94 stations August 17 stations.
- The record value of max.daily temperature 40°C recorded in 148 cases.
- In July was recorded a record number of hot days with max.daily temperatures olf 35°C about 10 days Calarasi, Bucuresti Filaret, Drobeta Turnu Severin.
- In what regards pluviometry:
- The year is slightly exceedingly with big differences on months.

The interval April July has known prolonged severe drought comparable in what regards intensity with that from 1946. The highest hydric deficit pedological drought was recorded in April -71% as average allover the country reaching -100% at Bechet, Caracal, Craiova without any rainfalls

The interval August November has known an exceeding amount of rainfalls on large surfaces, the highest value being recorded in October 123% and 362% at Caracal.

Climatic aspects from 2007 in Bucharest city

Previous studies mention that in Bucharest there are very highly polluted zones, which most oftenly are very much inhabited. It resulted that the highest degree of pollution was recorded in the center but then it was noticed that pollution extends outside this area. The main polluter agent is the car traffic.

It is known that mainly in its central zone it is active the so called thermal isle as a result of increasing the built space which causes a decrease of the green space.

In Bucharest the number of sunny hours is of over 5100 per year and the thermal and hydric deviations of the heat isle reach 3,1-3,3 °C and at 21-22% for the relative humidity of the air.

The extreme temperatures from July 2007 exceeded the maximum daily values the urban heat isle being more powerful during nights.

It appears a pronounced intensity of the extreme phenomena.

The recent evolution of the urban environment imposes a more careful climatologic monitoring and study.

The cities generate a specific climate which is characterized by significant deviations from all the meteorological parameters specific for the extra urban space.

The satellite images contribute to the precise identification of the urban heat isle. The results in this field were obtained within the EUFAR project and published by Cheval and other specialists 2009.

According to the National Office of meteorology the difference between the temperature from the meteo head office and the city may reach 10°C The roofs and asphalt may get hot up to 60° releasing slowly in the air the accumulated heat.

A heat isle is a zone which is hotter than it is normal, says dr.Lisa Gartland from Barkeley University of California. The heat isle may cover an entire urban area but may also limit to a car parking or a building. The phenomenon is causes mainly by the materials of construction of dark color which absorb heat and then release it.

Results and discussions

Cities generate their own climatic naspects At this conclusion came the NASA specialists after they analyzed the meteo data acquired from satellites.

The roofs cover about 20% of the cities surface the paved surfaces cover 40%. Vegetation cover less than 20% in the urban zones but has a lower or equal temperature to that of the air.

Plants are real sources of air conditioning, less expensive and much more efficient than the similar devices. They receive solar radiation and cool the air through a process called evotranspiration. The roots take water from soil and release it through leaves in form of vapors.

A single tree with a top of 9 metres in dyameter may generate a daily transpiration of 150 l of water. A group of trees create an oasis climate, cooling the air and creating more thermal comfort.

The lack of vertical or horizontal currents the decrese of the green surfaces and the lack of morning haze represent additional factors which deteriorate the state of the thermal isle. The more heat is stored in the urban ecosystem during day, the more difficult is the night cooling, the phenomenon becoming even more powerful if there are no rainfalls.

The difference of temperature between a rural zone and a heat isle located in the center of a city is generally of about 2-4° C reaching even 10° C in the case of big cities in Athens in Greece were reached differences of 15° but on short intervals.

There are a series of preocuppations oriented towards combating the negative effects of city heat.

These preocuppation refer to:

- Finding new materials which to permit an increase of the solar radiation reflexetion and of the degree of heat storage in city buildings.
- Finding new types and hybrids of plants which are resistant at high temperatures and drought which to cover soil for a long period of time and reduce the soil evotranspiration.
- Enlarging the green zones by incorporating buildings in life ecosystems.
- Introducing automatized systems of irrigation of the green surfaces depending on the water needs of soil for obtaining a positive potential of evotranspiration see US 6850819.
- Captating solar energy and convert it, reducing energy consumption and toxic gases released in the air which generate glasshouse effects.
- For an urban planning it is necessary beside using new materials to catch solar energy and reduce consumption and emissions, granting special care to the circuit of water in the urban ecosystem Within this circuit a key role is that of the evotranspiration process.

This represents the sum of the flux of water vapors resulting from the plants transpiration and the evaporation of water from soil.

- The studies have shown that about 10% from the humidity from the atmosphere is released by plants through evotranspiration. During its development a leaf transpires more water than its weight. At the scale of an ecosystem evotranspiration regulates the growth of plants the assimilation of carbon and of the level of phreatic water and atmospheric circulation.
- The various species of plants and cultures have different needs of water and therefore different potentials of evotranspiration.
- This value is defined as the evotranspiration of a grass culture with the height of 9 cm from a good quality soil, well irrigated. The factors which determine the amounts of water released in the form of vapors are:
- The temperature which is directly proportional with the amount of water released.
- The air current around the plant directly proportional with the amount of water released.
- The evotranspiration of a species of tree or a certain culture is obtained by multiplying nthe coefficient of the plant with the reference value of evotranspiration
- Relation 1

$$ETc = Kc \times ET_o \qquad (1)$$

For a single tree the volumetric rate of evotranspiration V_{ET} is obtained by multiplying the surface of the top Ac with the rate of evotranspiration ETc relation 2:

$$V_{ET} = ETc \times Ac = Kc \times ET_0 \times Ac \qquad (2)$$

Where the reference value for given climatic conditions is available according with the recommendations of FAO.

There are studies referring at the PET of a tree according to which the tree may use about 380 l of water per day resulting a cooling potential of 230.000 kcal-day.

This cooling potential may lead to temperature differences of 5°C between a wooden area and an uncovered soil and of 3° C between an irrigated millet crop comparing it with uncovered soil.

The wooden plants and the herbaceous catch during summer 50% of the air dust and in winter about 37% and in what regard noise which in the cities may reach a max intensity of 80- 97 dB comparing with 50 -65 dB recorded in the rural zones the tree tops absorb about 26% from the noise creating and facilitating health and comfort in the urban areas.

The main hindrances impeding the improvement of the climate in the highly inhabited urban areas are:

- The permanent pressure for adding more constructions which increase the potential of storing heat generated by solar radiation.
- The increase of the thermal inertia at cooling the habitat.
- The decrease of green surfaces and of the evotranspiration potential.
- The increase of the energy consumption during summer and of the needs for air conditioning.
- The increase of the vokume of emissions generated by transport and traffic which cause toxic gas emissions.

In this context it is absolutely necessary a complex approach of the issue regarding the climatic change by a simultaneous study of the impediments related to constructions and the traffic which are the results of an urban expansion and those connected with the circuit of water in the urban ecosystem.

It was performed a case study on the urban river flow of Dambovita near the Izvor bridge the hydrotechnical ring Opereta during the interval April 19th - August 4th 2010.

It was used a digital thermometer created bz INOE 2000 IHP in cooperation with the company QM Electronic Bucharest and an infrared thermometer with laser made by Fluke

IN the first variant it was measured the temperature of the air above the river flow the water temperature at a depth of 50 and 100 cm the temperature of the concrete breaking waves and the temperature of the road asphalt.

The results of these measurements are shown in table 1. The max value of 49°C was recorded on June 8th 2010 on asphalt at noon time. The water temperature at 50 cm depth was of 22,4°C.

In the second variant it was measured the water temperature at surface the temperature of the concrete pavement and that of the asphalt. The data acquired are shown in table 2 the max value being recorded on the asphalt 51,3°C on July the 1st 2010 at 1 pm. The water temperature at surface was of 26°C and the air temperature of 28,8°C.

The graphic representation of the temperature values is shown in fig.1,2.

Conclusions

For Bucharest and the urban river flow of Dambovita the specific climatic data are the following:

- The average annual temperature increased in the interval 1901 2000 with 0,8°C and is expected an increase with 0,5 1,5 in the interval 2020- 2029 in the same time with a decrease of the level of rainfalls.

-The difference between the temperature recorded between the meteo stations from Filaret and Baneasa is of 2-3 degrees.

-Impeding solar radiation during day to reach the concrete pavement.

-Modify the microclimate by the variation of the air temperature and of the average humidity using the potential of evotranspiration in conditions of irrigated soil.

-The measured air temperature was of 28,8 °C of water of 22,4°C and of the asphalt of 51,3°C.

-It is necessary a complex approach of the issue of the climatic change by study simultaneously the impedements relating to constructions and traffic connected with the need for urban expansion and those of the circuit of water in the urban ecosystem.

It is recommended to continue measurements.

Measurements performed with the OM Electronic device

The temperature dynamics in the Izvor bridge zone Dambovita April 1st 2010-Aug 4-2010

Table 1

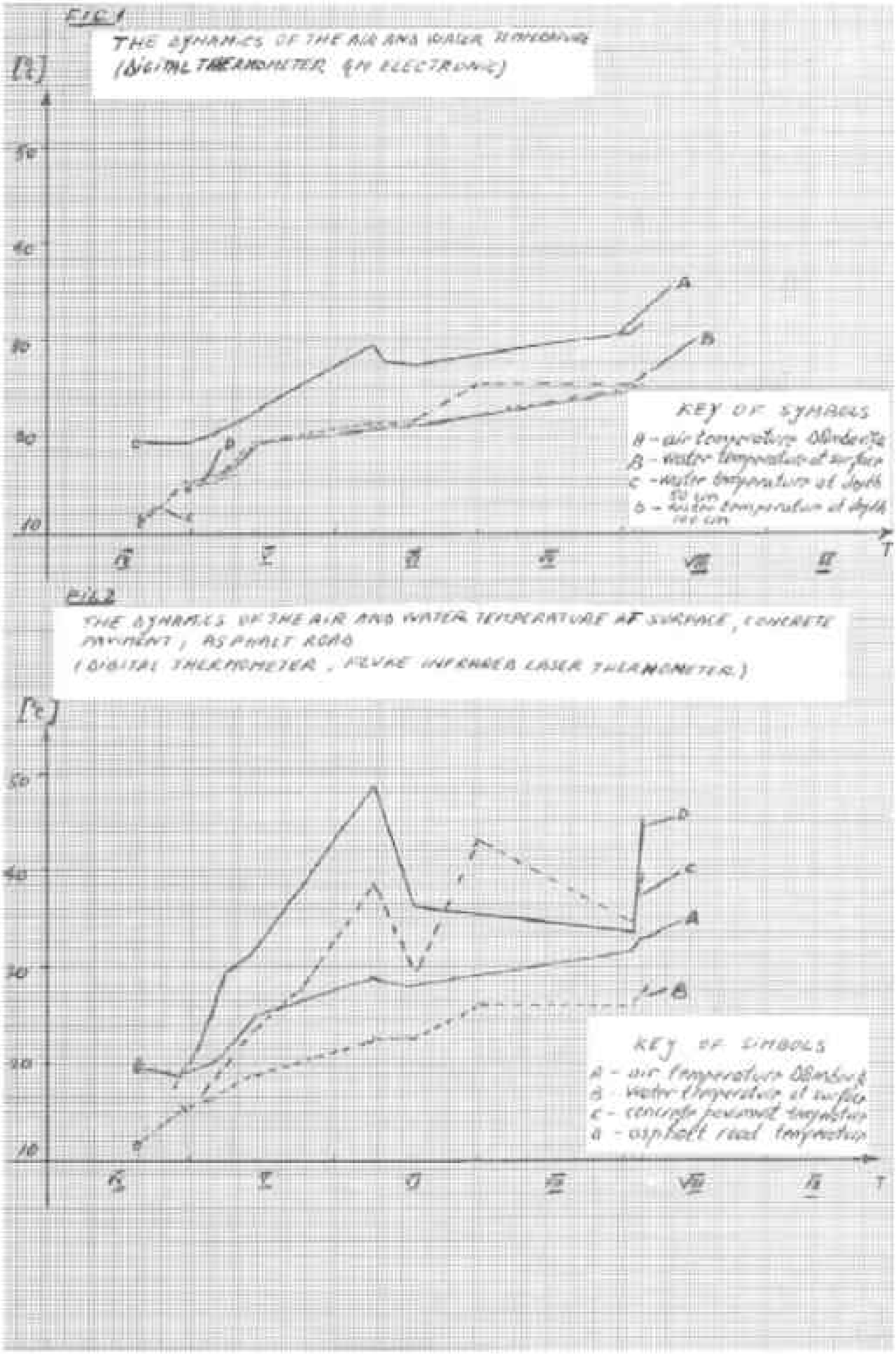
No	Date (day month)	Hour min	Air temperature Dambovița[°C]	Water temperature[°C] At a depth of 50 cm	Water temperature [°C] At a depth of 100 cm	Concrete pavement temperature [°C]	Asphalt road temperature [°C]	Mentions
1	19 April 2010	10^{40}	+18,7	+12,6	-	+19,4	+20	Sunny sky
2	29 April 2010	9^{20}	+18,8	+15,3	+15,1	+18,4	+18,1	Cloudy sky
3	6 may 2010	10^{31}	+20,9	+16,7	+16,6	+23	+29	Changeable sky
4	13 may 2010	10^{40}	+25	+18,5	+18,4	+24	+31,5	Sunny sky
5	8 June 2010	11^{24}	+28,8	+22,4	+22	+38,2	+49	Sunny sky
6	16 June 2010	10^{12}	+27,3	+22,7	+22,5	+29,2	+36,3	Cloudy sky
7	1 July 2010	13^{12}	-	-	-	-	-	Faulty device
8	2 aug 2010	10^{22}	+31,5	+25,2	+24,9	+34,3	+43,1	Sunny sky
9	4 aug 2010	13^{31}	+32,9	+25,3	+24,9	+39	+45,3	Cloudy sky

Measurement with the Fluke device

Temperature dynamics in the zone of Izvor bridge (Dâmbovița 1st April 2010 – 4 Aug 2010)

Table 2

No	Date (day month)	Hour min	Water temperature [°C] At surface	Concrete pavement temperature [°C]	Asphalt road temperature [°C]	mentions
1	19 April 2010	10^{48}	+11,8	+19,7	+24	Sunny sky
2	29 April 2010	9^{32}	+15,4	+17,5	+19	Cloudy sky
3	6 may 2010	10^{31}	+16,9	+23,3	+29,3	Changeable sky
4	13 may 2010	10^{42}	+18,6	+27,1	+32,8	Sunny sky
5	8 June 2010	11^{20}	+22,5	+38,4	+49,5	Sunny sky
6	16 June 2010	10^{12}	+22,6	+29,7	+36,1	Cloudy sky
7	1 July 2010	13^{12}	+ 26,1	+ 42,5	+ 51,3	Sunny sky
8	2 aug 2010	10^{22}	+ 25,9	+34,4	+43,3	Sunny sky
9	4 aug 2010	13^{30}	+27,7	+39,6	+45,7	Cloudy sky



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THE QUALITY OF WATER FROM DAMBOVITA RIVER AND ITS SUITABILITY FOR IRRIGATIONS

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Abstract

The article presents information referring at the water monitoring program (general physico chemical indicators, ecological status, vulnerability at nutrients, water classification taking into account the general indicators from 2010, considerations regarding the application of STAS 9450-88, referring at water suitability for irrigations. The water source is Dambovita river. The section of reference is Popesti Leordeni hydrotechnical junction, located at 36 km from water shedding.

Key words: surface water, quality, Dambovita, monitoring

Introduction

A distinctive feature of the actual and future stage of economic and social development of the society is the requirement for using more efficiently and economically the natural resources, generated by the more and more widening gap between their limited character, their variation and the continously increasing demand for them in all fields of activity.

In this context an adequate water management is mandatory, in the conditions of severe water scarcity in Romania, the resources being of only about 1700 m^3 per inhabitant per year, while in other European countries these resources are 2,5 times higher.

As a result of the predicted climatic changes, agriculture and irrigations in agriculture will become some of the main water consumers. The most important issue is to increase the efficiency of the irrigation water, because it represents 70% from the whole amount of water used on global scale.

Two irrigation methods are prevailing: subirrigation and sprinkling. The performance reached at watering is of 0,95 at subirrigation and 0,90 at sprinkling. The water transport output is of 0,85 for underground watering and of 0,80 for sprinkling.

Material and method

The research station is located at Popesti Leordeni hydrotechnical junction, the monitoring program including The Ecological Status and The vulnerability at nutrients. The acquirement of data was performed on March 10th 2010, May 20th 2010, June 8th 2010, July 14th 2010-11-02This is the only control section on the Dambovita river. Are taken into account the stipulations of the Order issued by the Ministry of the environment and Water management MMGA no.16-2006 for approving the Normative regarding the classification of the surface water for finding the ecological condition of the water body.

For discharging water with suspensions in the Dambovita riverbed is taken into account the related quality indicator, the max value of 350 mg-dm^3 determined through the analysis method which is in accordance with STAS 6953+81. These stipulations are mentioned in the normative NTPA 002-2002

The considerations regarding the application of STAS 9450-88 (Water for agricultural irrigation) are stated in table 3 and the chemical indicators for water suitability for irrigations are listed in table 4.

The water for irrigations is classified taking into account the following indicators table 3

- Concentration of hydrogene ions pH
- Saline indicators : salt residue, dissolved mineral salts, chlorures, sulphites and sodium Sodium absorbtion
- Chemical indicators

Irrigation water is classified in four classes of salinity:

Class C1 low salt residue suitable for most of the soils and plants

Class C2 moderate salt residue suitable for permeable soils and plants which have moderate tolerance at salinity

Class C3 high salt residue suitable for special engineering arrangements on permeable soils and at plants with tolerance at salinity

Class C4 very high salt residue used in special engineering arrangements on permeable soils and at plants with high tolerance at salinity

Depending on SAR the content in calcium sodium and magnesium each salinity class is classified in 3 subclasses of alkalinization

Subclass S1 low alkalinity used at most of the soils

Subclass S2 moderate alkalinity used on permeable soils without any special engineering works

Subclass S3 high alkalinity used for permeable soils with special engineering arrangements

Obtained results

Are attached 2 tables comprising the following results:

The values of the indicators of quality found during 2010 table 1

Classification of water quality in relation with the general indicators in 2010 table 2 have the following values for the global quality class: Oxygen action II, nutrients I overall salinity I natural toxic pollutants I other relevant chemical indicators

According to the values referring at the relation of the sodium absorbtion and the sodium content SAR 0,58-0,695 and Na of 17,6-19,9 mg-l in the studied period March 10th July 14th 2010 the water from Dambovita is suitable for irrigation and is in the S1 alkalinization subclass

Irrigation water is classified in two categories, depending on the toxic indicators, irrigation norm, climatic conditions and soil texture

Type I for high norms used in arid zones and rough soils

Type II for low irrigation norms used in wet zones with fine soils

The toxic indicators found in the water from Dambovita are those shown in table 4 Arsenium cadmium Cobalt chrome Copper Iron Manganese lead zinc

For the conditions studied between March 10th July 14th 2010 water from Dambovita is suitable for irrigations and is in the C2 salinity class

THE GENERAL WATER QUALITY INDICATOR VALUES FOUND IN 2010

Table 1

Acquirement data	10/03	20/05	08/06	14/07
B. physico chemical indicators				
B.1. Physical indicators – thermal and acidification condition				
River flow mc/s	1.12	2.93	3.50	3.12
Water temperature °C	1,0	16,0	22,0	26,0
pH	8,0	7,7	7,8	8,2
suspensions mg/l	34,0	9,6	12,4	14,8
B.2. oxygene mode				
Dissolved oxygene mgO/l	14,30	9,30	9,10	11,10
CB05 mgO/l	5,20	4,00	4,40	5,80
CCO-Mn mgO/l	5,89	5,31	5,16	6,54
CCO-Cr mgO/l	23,14	14,09	13,49	18,20
B.3. Nutrients				
Ammonium (N-NH4) mgN/l	0,259	0,329	0,509	0,211
Azotic coumpounds N-NO2) mgN/l	0,019	0,021	0,024	0,049
Azotic compounds (N-NO3) mgN/l	1,330	0,665	0,338	0,280
Azot Koeldahl (N) mgN/l	0,641	0,764	0,628	1,001
Organic azot (N) mgN/l	0,382	0,435	0,119	0,790
Total azot (N) mgN/l	1,990	1,440	0,990	1,330
Ortophosphates (P-PO4) mgP/l	0,0390	0,0150	0,0110	0,0150
Total phosphorus(P) mgP/l	0,0150	0,0110	0,0450	0,040

Chlorophyll “a” μg/l	1,18	10,66	14,36	3,54
B.4. Salinity				
Conductivity μS/cm	439,00	432,50	399,00	366,00
Filtering residue mg/l	272,2	268,1	274,4	226,9
Chlorures(Cl) mg/l	28,4	28,8	25,2	21,6
Sulphates(SO_4) mg/l	51,5	51,0	52,0	39,9
Calcium(Ca) mg/l	54,1	59,1	53,1	47,6
Magnesium (Mg) mg/l	9,5	8,2	9,4	8,9
Sodium(Na) mg/l	17,6	19,0	17,3	19,9
Alkalinity mval/l	2,40	2,40	2,50	2,15
Bicarbonates (HCO_3) mg/l	146,4	146,4	152,5	131,2
B.5. Natural toxic pollutants				
Arsen (con.tot.) μg/l	-	-	-	-
Cadmium (con.tot.) μg/l	0,10	-	-	-
Chromium hexaval. (con.tot.) μg/l	-	-	-	-
Chrom total (con.tot.) μg/l	1,03	-	-	-
Copper. (con.tot.) μg/l	6,81	-	-	-
Iron total (con.tot.) mg/l	0,28	0,17	0,07	0,20
Mangan total (con.tot.) mg/l	0,070	0,050	0,018	0,104
Nichel (con.tot.) μg/l	0,85	-	-	-
Plumb (con.tot.) μg/l	0,64	-	-	-
Zinc (con.tot.) μg/l	42,00	-	-	-
B.6. other relevant chemical indicators				
Fenols (indice fenolic) μg/l	4,50	4,50	4,50	9,40
Active anionic detergents μg/l	99,0	99,0	99,0	99,0
AOX μg/l	-	-	-	-

CLASSIFICATION OF WATER QUALITY IN RELATION WITH THE GENERAL INDICATORS IN 2010

Considerations regarding the application of STAS 9450-88

(Water for irrigations)

Table 2

Parameter	U/M	Nr. det	Typical statistical data			Arithmetic		Percentages			
			Min	Max	Dev.stand	Value	Class	V(50%)	Class	V(90%)	Class
B. Physico chemical indicators											
B.1. Physical indicators – thermal and acidification condition											
River flow	mc/s	4	1,12	3,50	1,059	2,67	-	-	-	-	-
Water temp.	°C	4	1,0	26,0	10,97	16,3	-	-	-	-	-
pH		4	7,7	8,2	0,22	7,99	-	-	-	-	-
suspensions	mg/l	4	9,6	34,0	11,07	17	-	-	-	-	-
B.2. oxygene mode global quality class II											
Dissolved O	mgO/l	4	9,10	14,30	2,408	10,95	I	-	-	-	-
CB05	mgO/l	4	4,00	5,80	0,806	4,85	II	-	-	-	-
CCO-Mn	mgO/l	4	5,16	6,54	0,628	5,72	II	-	-	-	-
CCO-Cr	mgO/l	4	13,49	23,14	4,462	17,23	II	-	-	-	-
B.3. Nutrients global quality class: I											
Ammonium - NH4)	mgN/l	4	0,211	0,509	0,1306	0,327	I	-	-	-	-
Azotites (N-NO_2)	mgN/l	4	0,019	0,049	0,0140	0,028	II	-	-	-	-
Azotites (N-NO_3)	mgN/l	4	0,280	1,330	0,4819	0,651	I	-	-	-	-
Azot Kjeldahl (N)	mgN/l	4	0,628	1,001	0,1729	0,758	-	-	-	-	-
Organic azot (N)	mgN/l	4	0,119	0,790	0,2761	0,431	-	-	-	-	-
Azot total (N)	mgN/l	4	0,990	1,990	0,4152	1,438	I	-	-	-	-
Ortophosphates (P-PO_4)	mgP/l	4	0,0110	0,0390	0,01281	0,0200	I	-	-	-	-
phosphorus total(P)	mgP/l	4	0,0110	0,0450	0,01826	0,0288	I	-	-	-	-
Chlorophyll "a"	µg/l	4	1,18	14,36	6,128	7,43	I	-	-	-	-
B.4. salinity Cglobal quality class: I											
Conductivity	S/cm	4	366,0	439,0	33,671	409,1	II	-	-	-	-
Filtering residue	mg/l	4	226,9	272,2	20,88	253,6	II	-	-	-	-
ChloruresCl)	mg/l	4	21,6	28,8	3,35	26,0	I	-	-	-	-
Sulphates(SO_4)	mg/l	4	39,9	52,0	5,81	48,6	I	-	-	-	-
Calcium(Ca)	mg/l	4	47,6	59,1	4,71	53,5	II	-	-	-	-
Magnesium (Mg)	mg/l	4	8,2	9,5	0,59	9,0	I	-	-	-	-
Sodium (Na)	mg/l	4	17,3	19,9	1,22	18,5	I	-	-	-	-

Alkalinity	mval/l	4	2,15	2,50	0,149	2,36	-	-	-	-	-
Bicarbonates (HCO3)	mg/l	4	131,2	152,5	9,11	144,1	-	-	-	-	-
B.5. natural toxic pollutants global quality class: I											
Arsen (con.tot.)	µg/l	-	-	-	-	-	-	-	-	-	-
Cadmium (con.tot.)	µg/l	1	0,10	0,10	0,0	0,1	I	-	-	-	-
Cobalt (con. tot.)	µg/l	-	-	-	-	-	-	-	-	-	-
Chrom hexaval. (con.tot.)	µg/l	-	-	-	-	-	-	-	-	-	-
Chrom total (con.tot.)	µg/l	1	1,03	1,03	0,0	1,03	I	-	-	-	-
Copper. (con.tot.)	µg/l	1	6,81	6,81	0,0	6,81	I	-	-	-	-
Iron total (con.tot.)	mg/l	4	0,07	0,28	0,087	0,18	I	-	-	-	-
Manganese total (con.tot.)	mg/l	4	0,018	0,104	0,0361	0,061	II	-	-	-	-
Nichel (con.tot.)	µg/l	1	0,85	0,85	0,0	0,85	I	-	-	-	-
Lead (con.tot.)	µg/l	1	0,64	0,64	0,0	0,64	I	-	-	-	-
Zinc (con.tot.)	µg/l	1	42,00	42,00	0,0	42,00	I	-	-	-	-
B.6. other relevant chemical indicators											
Fenols (indice fenolic)	µg/l	4	4,50	9,40	2,450	5,72	III	-	-	-	-
Anionic detergents	µg/l	4	99,0	99,0	0,00	99,0	I	-	-	-	-
AOX	µg/l	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Considerations regarding the application of STAS 9450-88

(Water for irrigations)

Table 3

B)phisico chemical indicators	10 martie	20 mai	08 iunie	14 iulie
Concentration hydrogen iones [pH]	8,0 Low alkaline	7,7 Low alkaline	7,8 Low alkaline	8,2 Low alkaline
5,5<pH≤8,6				
B.4. Salinity				
Conductivity at 25 °C [µS/cm]	439	432,50	399	366,00
Salinity class S/cm	max≤ 0,25 → salinity class C1			

Salt residue [mg/l]	272	268	247	227
Salinity class max 500 [mg/l]	C2	C2	C2	C2
Chlorures (Cl^-), max , [mg/l]	28,4	28,8	25,2	21,6
Salinity class max 40 [mg/l]	C1	C1	C1	C1
Sulphates (SO_4^{-2}), mg/l	51,5	51,0	52,0	39,9
Max salinity class 100 [mg/l]	C1	C1	C1	C1
Indicele SAR max	S1	S1	S1	S1
Ca^{+2} [mg/l]	54,1	59,1	53,1	47,6
Mg^{+2} [mg/l]	9,5	8,2	9,4	8,9
Indice SAR = max				
Na^{+2} [mg/l]	17,6	19,0	17,3	19,9
Indicele SAR	0,58	0,614	0,575	0,695

Chemical indicators Table 4

Indicator	U/M	quantity				I	II
		10.03	20.05	08.06	14.07	Maximum admitted concentration [mg/dm^3]	
Arsen	µg/l	-	-	-	-	0,1	2,0
Cadmium	µg/l	0,1	-	-	-	0,01	0,05
Cobalt	µg/l	-	-	-	-	0,05	5,0
Chrom (Cr^{+6})	µg/l	-	-	-	-	0,1	1,0
Chrom total	µg/l	1,03	-	-	-	-	-
Copper	µg/l	6,81	-	-	-	0,2	5,0
iron total	µg/l	0,28	0,17	0,07	0,20	1,0	5,0
Manganese	mg/l	0,7	0,050	0,018	0,104	10,2	3,0
Nichel	µg/l	0,85	-	-	-	0,2	2,0
Lead	µg/l	0,64	-	-	-	2,0	5,0
Zinc	µg/l	42,0	-	-	-	2,0	10,0

Conclusions

The values of the quality indicators listed in the tables from above representing data from 2010 show that the water from Dambovita river is suitable for irrigations, being in accordance with all valid standards and norms in the field, not exceeding the admitted toxicity threshold, having physical and chemical properties which satisfy all standards and facilitate its safe use in agricultural purposes.

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TRADUCTOR DE DEBIT MASIC PENTRU MATERIALE GRANULARE

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Rezumat

Se prezintă un nou tip de traductor de debit masic pentru materiale granulare utilizabil în activitățile de cercetare, precum şi în conducerea automată a proceselor de dozare a materialelor granulare. Principiul de măsurare se bazează pe stabilizarea suprafeței superioare a unui strat de material granular sub forma de taluz natural. Pentru măsurarea variației masei se utilizează un traductor de forță tensometric sau pneumatic cu gabarit şi greutate foarte mică. Traductorul realizat poate măsura debite masice în domeniul 1...5 kg/h şi a fost testat la încercările unui dozator de porumb boabe.

Cuvinte cheie: debit masic, traductor, dozare, taluz natural

1. Introducere

În cursul încercărilor efectuate cu un dozator de porumb boabe, realizat în cadrul activităților de cercetare, s-a constatat că utilizarea traductorului de forță montat sub întregul dispozitiv de dozare este o soluție constructivă complicată şi scumpă, cu o sensibilitate de măsurare foarte redusă, deoarece debitul masic măsurat – maxim 1 g/s - este mult mai mic decât masa totală a dispozitivului de circa 11 kg. Această constatare a condus la concluzia că pentru a se obține o precizie mai mare de măsurare a debitului masic acesta trebuie măsurat imediat înainte sau după dozator cu o masă inertă implicată cât mai mică.

Din practica industrială se cunoaşte că debitul masic al materialelor granulare se măsoară cu traductoare de impact montate imediat sub sistemele de dozare continuă. În cazul analizat dozatorul este de tip volumic cu alveole, ceea ce produce un debit discontinuu, care măsurat cu traductoare de impact produce un zgomot aleator puternic, ceea ce necesită o filtrare agresivă care reduce sensibilitatea măsurătorii şi necesită o procedură de integrare cu medie alunecătoare. Fizic este foarte dificil de montat în instalație un traductor cu impact care necesită un spațiu relativ mare.

Pentru obținerea de date relevante în cadrul activităților de încercare a dozatorului colectivul de cercetători de la UPB, Catedra de Sisteme Biotehnice, au conceput un traductor de debit masic pentru porumb boabe care s-a montat pe buncărul dozatorului şi poate măsura precis debitul de material granular, în cazul prezentat porumb boabe, în domeniul 1...5 kg/h sau 0,25...1,5 g/s.

2. Prezentare generală

Schema de principiu a traductorului este prezentată în figura 1.

În buncărul de măsurare 1, la un moment dat (t) există un volum de porumb boabe 2 cu masa $M_{pb}(t)$ din care iese în buncărul dozatorului un debit masic $D_{mt}(t)$:

$$D_{mt}(t) = \frac{dM_{pb}(t)}{dt} \quad \langle kg/s \rangle \tag{1}$$

Acest debit se adaugă în stratul 3 de porumb boabe din buncărul de alimentare al dozatorului. Acest strat este limitat superior de un taluzul natural format de curgerea fluxului de porumb boabe din buncărul de măsurare 1 în buncărul dozatorului din care, continuu, se extrage un debit masic $D_{md}(t)$:

$$D_{md}(t) = k_{doz} i_{doz} n_{doz} \quad \langle kg/s \rangle \tag{2}$$

unde:
$k_{doz} = \rho_{pb} \cdot V_{alv}$ – factorul de transfer al caracteristicii de dozare (kg/alveolă);
i_{doz} – numărul de alveole pe rotorul dozatorului;

n_{doz} – turația rotorului dozatorului (rot/s).

Aplicând principiul continuității rezultă că: $D_{mt}(t) = D_{md}(t)$ datorată tendinței, naturale, a stratului de material granular (porumb boabe) de a se limita în partea superioară cu un taluz cu unghiul φ_{taluz} .

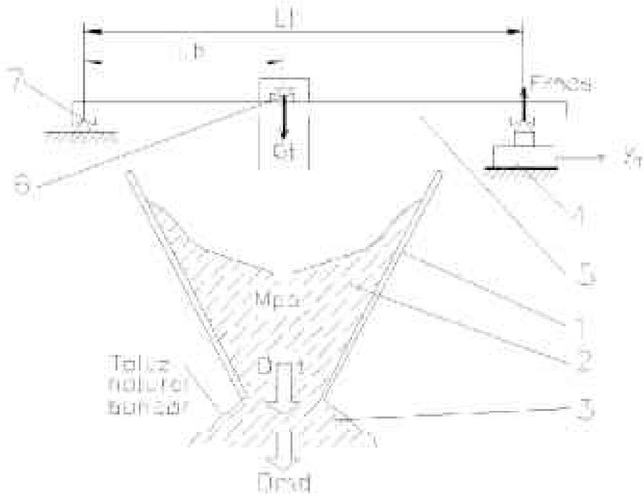

Fig. 1 Schema funcțională a traductorului de debit masic de porumb boabe

Pentru măsurarea masei de boabe $M_{pb}(t)$ din buncărul de măsurare se utilizează un traductor de forță 4, pneumatic sau tensometric, montat la un capăt al pârgiei de reazem 5 pe care este suspendat buncărul de măsurare 1 prin articulația 6. Celălalt capăt al pârgiei 5 este rezemat pe articulația 7.

3. Principiul de mă**surare**

La distanța L_b de articulația 7 este aplicată pe pârghia 5 o forță $G_T(t)$:

$$G_T(t) = G_{bunc} + g \cdot M_{pb}(t) \ (N) \tag{3}$$

Traductorul de forță 4 plasat la distanța L_t de articulația 7 este apăsat cu o forță $F_{mas}(t)$:

$$F_{mas}(t) = \frac{L_b}{L_t} G_T(t) = k_p \cdot G_T(t) \ (N) \tag{4}$$

SI

$$F_{mas}(t) = k_p \cdot \left(G_{bunc} + g \cdot M_{pb}(t)\right) \ (N) \tag{5}$$

Derivând relația (5) în funcție de timp se obține:

$$\frac{d}{dt} F_{mas}(t) = k_p \cdot g \cdot \left(\frac{d}{dt} M_{pb}(t)\right) = = k_p \cdot g \cdot D_{mt}(t) \ (N/s) \tag{6}$$

Discretizând ecuația diferențială din relația (6) cu Δt se obține forma:

$$\frac{F_{mas}[j-1] - F_{mas}[j]}{\Delta t} = k_p \cdot g \cdot \frac{M_{pb}[j-1] - M_{pb}[j]}{\Delta t} = = k_p \cdot g \cdot D_{mt}[j] \ (N/s) \tag{7}$$

rezultă că debitul masic la momentul [j] este:

$$D_{mt}[j] = \frac{1}{k_p \cdot g} \frac{F_{mas}[j-1] - F_{mas}[j]}{\Delta t} \ (kg/s) \tag{8}$$

Traductorul de forță are o caracteristică de forma:

$$y_G(t) = k_F \cdot F_{mas}(t) \ (V) \tag{9}$$

şi discretizând:

$$F_{mas}[j] = \frac{1}{k_F} y_G[j] \ (N) \tag{10}$$

Înlocuind (10) în (8) se obține:

$$D_{mt}[j] = \frac{1}{k_p \cdot g \cdot k_F \cdot \Delta t}(y_G[j-1] - y_G[j]) \ (kg/s) \tag{11}$$

Se notează factorul de transfer al traductorului:

$$k_T = \frac{1}{\Delta t \cdot k_p \cdot g \cdot k_F} \ (kg/V) \tag{12}$$

şi se poate scrie că:

$$D_{mt}[j] = k_T \left(y_G[j-1] - y_G[j]\right) \ (kg/s) \tag{13}$$

Traductorul de forță are o caracteristică dinamică $H_T(s)$ de forma:

$$H_T(s) = \frac{k_T e^{-\tau s}}{T_T s + 1} \tag{14}$$

La traductoarele de forță timpul mort τ şi constanta de timp T_T sunt în general foarte mici, în domeniul 0,05...0,2s; ceea ce conduce la decizia de a se utiliza o perioada de discretizare de minim 1s şi maxim 5s, în funcție de tipul de traductor de forță şi de debitul minim măsurat.

4. Realizări

S-a realizat un traductor de debit masic pentru porumb boabe care a fost montat pe un arzător experimental de porumb boabe.

În figurile 2, 3 şi 4 este prezentat traductorul de debit masic realizat la încercările arzătorului experimental.

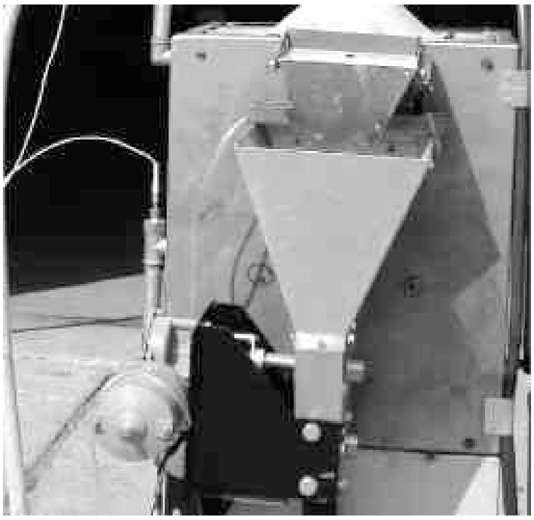

Fig. 2 Traductorul de debit masic montat pe buncărul arzătorului experimental

Fig. 3 Traductorul de debit masic încărcat cu porumb boabe pentru experimente cu arzătorului experimental

Fig. 4 Arzătorul experimental în timpul încercărilor

Încercările au confirmat principiul de funcționare şi precizia dorită, urmând să se realizeze unele modificări constructive care să asigure o mai sigură funcționare a traductorului realizat.

5. Concluzii

S-a conceput şi s-a realizat un traductor de debit masic pentru materiale granulare, în cazul analizat, porumb boabe, pentru debite de 1...5 kg/h.

Traductorul se bazează pe principiul limitării suprafeței superioare a unui volum de material granular de un taluz natural.

Măsurarea variației masei se face cu un traductor de forță tensometric sau pneumatic cu volum şi greutate redusă.

Traductorul a fost realizat pentru măsurarea debitului de porumb boabe al unui arzător de biomasă, dar poate fi utilizat pentru oricare alt tip de material granular.

Traductorul se poate utiliza atât în activitățile de cercetare, cât şi în sistemele de conducere automată a proceselor de dozare a materialelor granulare.

Mulțumiri

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ENERGIE DIN CORZI DE VITA PENTRU IRIGARE IN VITICULTURA

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Rezumat

Irigarea este o lucrare care consumă multă energie. În viticultură pentru irigare se consumă motorină, în medie 130 litri/an.ha, ceea ce corespunde la o emisie anuală de circa 370 kg CO_2/ an.ha. S-a analizat influenţa irigării asupra eficienţei culturii viticole, ca criteriu de apreciere a oportunităţii tehnologice, economice cât şi ecologice, punându-se accentul pe utilizarea biomasei produse local (corzi de viţă de vie) pentru producerea de energie mecanică cu bilanţ de CO_2 aproape nul.

Pentru utilizarea energetică s-a determinat formula $CH_{1.48}O_{0.68}$ pentru compoziţia medie a corzilor de viţă, precum şi valorile medii de 77,4 % pentru volatile, 20,0 % pentru carbon fixat şi 2,6 % pentru cenuşă. Potenţialului energetic al biomasei din corzi de viţă de vie este, în medie, 6,8 MWh/ha.an iar la nivel naţional de circa 2400 TJ/an. O estimare economică conduce la un cost de producţie a tocăturii de corzi de viţă, comparabile energetic cu peletele, de circa 0,023 €/kWh, comparativ cu 0,09 €/kWh la utilizarea motorinei.

Cuvinte cheie: corzi de viţă, biomasă, energie regenerabilă, gazeificare, irigare

1. Introducere

Schimbările climatice manifestate prin încălzirea treptată şi reducerea nivelului de precipitaţii conduc la reducerea lentă, dar continuă a producţie viticole, atât cantitativ cât şi calitativ. O modalitate de a compensa această stare de fapt constă în asigurarea irigării culturilor viticole în perioadele critice, iunie, iulie şi august. Dar dacă anul precedent a fost secetos este necesară o udare şi la pornirea vegetaţiei în aprilie şi mai [1], [4] şi [14].

S-a analizat influenţa irigării asupra producţiei culturilor viticole, ca un criteriu de apreciere a oportunităţii tehnologice şi economice a unei irigări eficiente şi din punct de vedere ecologic. Utilizarea motorinei pentru motopompe produce un plus de emisie de CO_2, ceea ce nu este de dorit, punându-se aşadar accentul pe utilizarea biomasei produsă local (corzi de viţă de vie) pentru producerea de energie mecanică pentru irigare.

2. Condiţiile reale de mediu şi irigarea culturii viticole

În figura 1 este prezentată evoluţia mediilor multianuale ale nivelului de precipitaţii [Pp] precum şi cel al evapotranspiraţiei [ETP] pentru o cultură viticolă monitorizată în perioada 2002-2004. Consumul de apă al viţei de vie s-a calculat cu formula elaborată de Thornthwaite, care este cea mai indicată, întrucât consumul calculat cu ajutorul acesteia se corelează cel mai bine cu cel rezultat din experimentele efectuate pe loturile de cercetare.

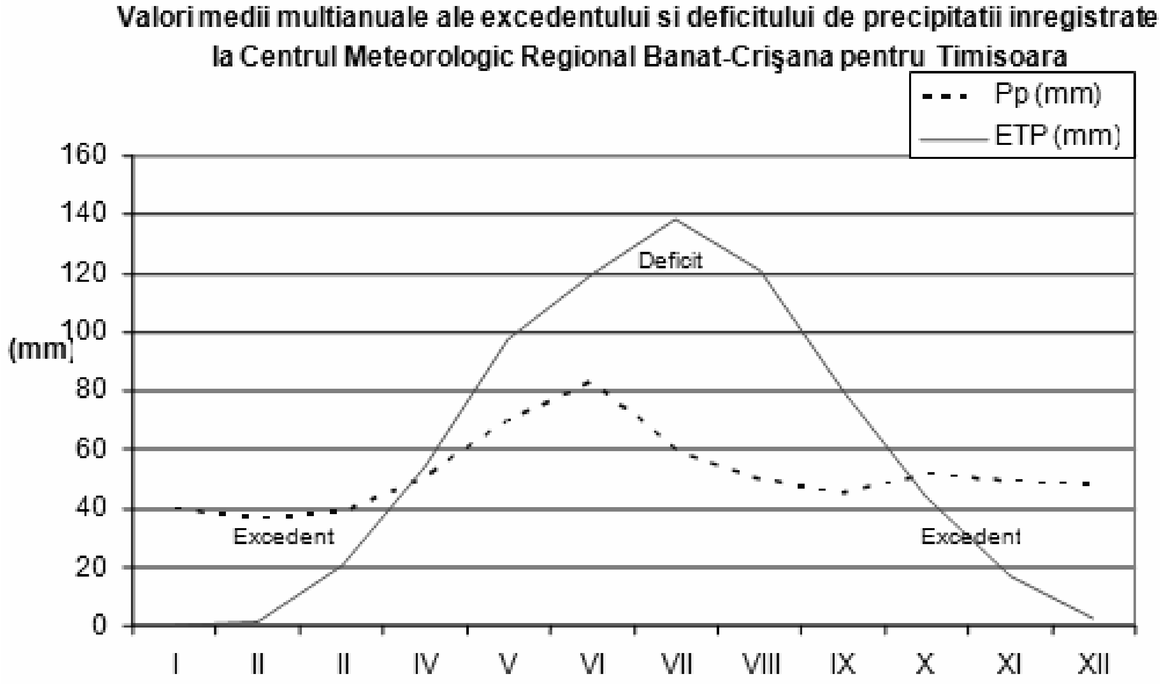

Fig 1 - Valorile medii multianuale ale excesului şi deficitului de precipitații

S-au utilizat date obținute în experimentele efectuate pentru a determina influența irigării asupra evoluției culturilor viticole. Aceste date au fost prelucrare şi sunt prezentate sintetic în tabelele 1a şi 1b pentru intervalul calendaristic mai – septembrie.

Tabelul 1a

Anul	mai [50%]				iunie [70%]			
	Deficit [mm]	Irigare [mm]	timp [h]	motorină [l]	Deficit [mm]	Irigare [mm]	timp [h]	motorină [l]
2002	640	320	1.28	19.2	630	441	1.764	26.5
2003	710	355	1.42	21.3	640	448	1.792	26.9
2004	200	100	0.4	6	880	616	2.464	37

Tabelul 1b

Anul	Iulie [100%]				august [50%]				sept. [0%]	
	Deficit [mm]	Irigare [mm]	timp [h]	motorină [l]	Deficit [mm]	Irigare [mm]	timp [h]	motorină [l]	Deficit [mm]	Irigare [mm]
2002	920	920	3.68	55.2	250	125	0.5	7.5	27	0
2003	1050	1050	4.2	63	1410	705	2.82	42.3	0	0
2004	1000	1000	4.0	60	480	240	0.96	14.4	18	0

Conform recomandărilor specialiştilor, s-au utilizat următoarele niveluri de irigare pentru compensarea deficitului hidric:

a. pentru luna mai se realizează o compensare a circa 50% din deficitul hidric;
b. pentru luna iunie se realizează o compensare de 70% din deficitul hidric;
c. pentru luna iulie se realizează o compensare de 100% din deficitul hidric;
d. pentru luna august, înainte de recoltare, se realizează o compensare de 50% din deficitul hidric [1], [3], [4] şi [14].

Din datele experimentale s-au calculat care sunt producțiile realizabile pentru cultura neirigată şi pentru cea irigată.

Aceste date, precum şi sinteza anuală a necesarului de irigare este prezentată în tabelul 2. Iese în evidență faptul că irigarea culturii viticole produce o creştere a producției de circa 30%, dar cu un consum relativ mare de motorină, în medie 130 litri/an□ha.

Această cantitate de combustibil fosil produce o emisie anuală de circa 370 kg CO_2/ an□ha. [15]

Utilizarea de motopompe cu motor m.a.c. cu randament ridicat, comparativ cu celelalte variante, prezintă cel mai redus nivel de emisie de CO_2, motiv pentru care estimarea eficienței energetice s-a făcut pentru acest tip de agregat de pompare.

Necesarul de irigare este de circa 2000 m^3 la o presiune de 3 bar; ceea ce necesită o energie hidraulică de 600MJ. Randamentul mediu al unei pompe centrifugale pentru irigație este de 60%. Randamentul motorului termic de acționare a pompei, alimentat cu gaz de gazogen, este de maxim 25%, Randamentul de conversie a biomasei în energie termică este de circa 75%. Rezultă că pentru a iriga un hectar de vie anual este nevoie de circa 5,4 GJ din biomasă, adică de circa 300 kg corzi de viță uscate [2], [6] şi [10].

Tabelul 2

Anul	Deficit [mc/ha]	Irigare [mc/ha]	Acoperire deficit %	timp [h]	motorină [l]	Producție [kg/ha]		
						Neirigat	Irigat	Creştere [%]
2002	2467	1800	72.96	8	110	7000	9000	28.57
2003	3810	2600	68.24	11	155	6500	7800	20.00
2004	2578	2000	77.58	9	120	7000	9000	28.57

3. Utilizarea biomasei pentru producerea de energie

Se pune în prezent problema înlocuirii combustibililor fosili în producerea de energie, atât din punct de vedere al reducerii emisiei de CO_2 cât şi ca alternativă la scăderea inerentă a rezervelor de combustibili fosili.

Un deziderat al dezvoltării durabile a agriculturii constă în creşterea independenței energetice a fermelor agricole bazată pe utilizarea resurselor de biomasă şi a energiei solare disponibile local. Producția agricolă are caracter sezonier care implică utilizarea în perioade relativ scurte a energiei necesare realizării lucrărilor necesare procesului de producție. Acest aspect conduce la concluzia că biomasa este sursa de energie regenerabilă cea mai adaptată la necesitățile producției agricole, deoarece se poate depozita după recoltare şi se poate utiliza eficient atunci când este necesar [2], [3], [7] şi [10].

Din biomasă se pot obține prin prelucrări fizico-chimice: gas de generator, denumit în continuare gazgen, etanol pentru transport, păcură vegetală etc., care se pot utiliza pentru producerea de energie. Sunt două modalități diferite de abordat în ceea ce priveşte producerea de energie din biomasa agricolă:

a. Recoltare şi un minim de prelucrare locală, transport, depozitare şi utilizare într-o instalație mare de prelucrare sau de producere de energie;
b. Recoltare, prelucrare, depozitare şi utilizare locală, cu reintroducerea în terenul agricol a cenuşii minerale şi a unei părți din carbonul aflat în compoziția biomasei şi care nu a fost consumat.

Varianta *b* contribuie la: creşterea nivelului de independență energetică a fermelor, creşterea gradului de valorificare a produselor secundare, creşterea nivelului tehnic general. Ca urmare în continuare se va analiza cu prioritate utilizarea potențialului enegetic al corzilor de viță, provenite din tăieturile anuale, pentru producerea energiei necesare în fermele viticole.

Lucrările necesare în viticultură consumă energie pentru tractor, pentru irigare, pentru transport, pentru procesele de vinificație. Se cunoaşte că în timpul celui de al II-lea război mondial s-au utilizat vehicule cu gazogene alimentate cu cărbune sau cu biomasă, funcționând peste 1,5 miloane de vehicule cu gazogen [7], [9] şi [11].

Utilizarea gazogen-ului, relativ slab filtrat, implică realimentări dese, uzura ridicată a motoarelor şi puteri mai mici, aspecte pe care alimentarea cu combustibili fosili lichizi nu le are, motiv pentru care în prezent încă nu este competitivă economic utilizarea biomasei în gazogene montate direct pe vehicule. Pentru lucrările în care se utilizează tractorul, etanolul şi biodieselul sunt alternativele care pot contribui la reducerea emisiei de CO_2 [2], [7], [11] şi [12].

Pentru lucrările la staționar se poate utiliza cu eficiență economică şi ecologică gazgen-ul, produs din biomasă printr-un proces de gazeificare termo-chimică, pentru alimentarea motoarelor cu ardere internă utilizate pentru antrenarea motopompelor de irigare, a tocătoarelor şi a generatoarelor electrice de avarie, cu un randament mediu de 25 % în producerea de energie mecanică. Este de dorit să se cupleze generarea de energie mecanică cu un utilizator de energie termică pentru a se obține un sistem energetic de cogenerare cu un randament total mult mai mare, spre 60%. Această variantă se poate utiliza în procesele tehnologice din vinificație [2], [6], [7], [10] şi [13].

Este de remarcat că un sistem energetic de cogenerare se poate utiliza în sezonul rece pentru a asigura energia termică şi electrică necesară într-o cramă. Această posibilitate contribuie la creşterea timpului de utilizare a instalației de cogenerare şi contribuie la scăderea perioadei de recuperare a investiției. [2], [8] şi [12].

4. Potențialul energetic al corzilor de viță

Din punct de vedere al utilizării pentru producerea de energie termică corzile de viță sunt caracterizate chimic prin două tipuri de analize: analiza termografică în care sunt puse în evidență proporțiile masice de: volatile, carbon fixat şi cenuşă; precum şi analiza chimică detaliată în care sunt puse în evidență proporțiile masice de: carbon, oxigen, hidrogen, azot, sulf, clor şi minerale.

Se cunoaşte că în funcție de soiul de viță şi de condițiile pedoclimatice compoziția chimică a corzilor poate varia în anumite limite.

Pentru evaluarea potențialului energetic al corzilor de viță s-a efectuat un studiu pentru determinarea unor valori medii şi a abaterilor standard pentru cele două tipuri de analize chimice. S-au utilizat datele experimentale prezentate în literatura de specialitate [5], [6] şi [10].

În tabelul 3, pentru 10 soiuri de viță de vie, sunt prezentate datele obținute din încercările termografice: volatile, carbon fixat şi cenuşă, precum şi pentru puterea calorifică superioară (PCS) determinată cu bomba calorimetrică. Analiza statistică pune în evidență că abaterea standard este mică pentru:

- Volatile: 0, 814 %;
- carbon fixat: 2,275 %;
- cenuşă:13,4 %; valoare relativ mare care arată că această mărime este puternic influențată de condițiile pedoclimatice şi de soiul de viță, dar care are o influență foarte mică asupra puterii calorifice superioare;
- PCS: 0,77 % ceea ce arată că potențialul energetic al corzilor de viță este relativ puțin influențat de soiul de viță şi condițiile pedoclimatice.

Aceste valori indică o mare uniformitate în compoziția corzilor de viță şi deci valorile medii obținute pot fi utilizate cu un înalt nivel de încredere în calculele efectuate pentru evaluarea potențialului energetic, în proiectarea proceselor de ardere şi de gazeificare

Tabelul 3

Nr.	Soiul de vin	Volatile	Carbon fixat	Cenuşă	PCS
		[%]	[%]	[%]	MJ/kg
1	Cabernet Sovignon	78.63	19.20	2.17	19.03
2	Cardinal	78.17	19.81	2.22	19.21
3	Chenin Blanc	77.26	20.21	2.51	19.13
4	Gewurzttraminer	77.27	20.26	2.47	19.16
5	Merlot	77.47	19.49	3.04	18.84
6	Pinot noir	76.83	20.46	2.71	19.05
7	Ribier	76.97	20.00	3.03	19.12
8	Thompson Seediess	77.39	20.36	2.25	19.35
9	Tokay	76.53	21.02	2.45	19.31
10	Zinfandai	76.98	19.49	3.04	19.05
	Media	***77.3500***	***20.0300***	***2.5890***	***19.1250***
	Abatere medie pătratică	***0.6294***	***0.5458***	***0.3468***	***0.1471***
	Abatere medie pătratică [%]	***0.8137***	***2.7247***	***13.3943***	***0.7694***

O altă analiză chimică pune în evidență ponderea principalelor elemente chimice (C, H, O, N, S, Cl) şi minerale. În tabelul 4 sunt prezentate date experimentale pentru 5 soiuri de viță, precum şi puterea calorifică inferioară (PCI) calculată în funcție de conținutul în hidrogen.

Analiza statistică a acestor date arată că abaterile standard sunt relativ mici, sub 2%, pentru C, H şi O, şi mai mari pentru N. Pentru S şi Cl abaterile sunt foarte mari ceea ce arată că sunt puternic influențate de condițiile pedoclimatice, dar acestea afectează foarte puțin PCI care este utilizată pentru evaluarea potențialului energetic al corzilor de viță de vie, pentru care abaterea standard este doar de 0,86 %.

Uzual, pentru studiile de gazeificare termo-chimică, se utilizează pentru biomasă o formulă simplificată de forma CH_xO_y neglijându-se celelalte componente cu ponderi nesemnificative.

Pentru corzile de viță se estimează valorile medii: **x = 1,48** şi **y = 0,68**; valori foarte apropiate de media compoziției biomasei lemnoase [15]. Ca urmare se va lua în calcul pentru un kmol de corzi de viță valoarea de 24,38 kg/kmol.

Pentru estimarea potențialului energetic s-au utilizat diferite relații empirice pentru calcularea puterilor calorifice superioare PCS şi inferioare PCI. S-au utilizat relațiile propuse de Demirbaş [5], Parikh [13] şi Sheng cu care s-a calculat PCS.

Demirbaş:

$$PCS=0,01\cdot(34.1\cdot C+132.2\cdot H+6.8\cdot S-1.53\cdot Ash-12\cdot(O+N) \quad (1)$$

Parich:

$$PCS=0.3536\ FC+0.1559\cdot VM-0.0078\cdot Ash \quad (2)$$

Sheng (a):

$$PCS = 19.914 - 0.2324\cdot Ash \quad (3)$$

Sheng (b):

$$PCS=-1.3675+0.3137\cdot C+0.7009\cdot H+0.0318\cdot O \quad (4)$$

Tabelul 4

Nr.	Soi de vin	C	H	O	N	S	Cl	Mine-rale	PCI
		[%]	[%]	[%]	[%]	[%]	[%]	[%]	MJ/kg
1	Cabernet Sovignon	46.59	5.85	43.90	0.83	0.04	0.08	2.71	17.84
3	Chenin Blanc	48.02	5.89	41.93	0.86	0.07	0.10	3.13	17.94
6	Pinot noir	47.14	5.82	43.03	0.86	0.01	0.13	3.01	17.86
8	Thompson Seediess	47.35	5.77	43.32	0.77	0.01	0.07	2.71	18.18
9	Tokay	47.77	5.82	42.63	0.75	0.08	0.07	2.90	18.12
	Media	**47.3740**	**5.8300**	**42.9620**	**0.8140**	**0.0420**	**0.0900**	**2.8920**	**17.9880**
	Abatere medie patratica	**0.5577**	**0.0442**	**0.7396**	**0.0513**	**0.0327**	**0.0255**	**0.1850**	**0.1540**
	Abatere medie patratica [%]	**1.1772**	**0.7574**	**1.7215**	**6.3002**	**77.8830**	**28.3279**	**6.3965**	**0.8562**
	Pondere atomică	3.9478	5.8300	2.6851	0.0581	0.0013	0.0026		
	Coef. Formula generală	1.0000	1.4768	0.6802	0.0147	0.0003	0.0007		
	Coef. Formula redusă	***1.00***	***1.48***	***0.68***					

Din tabelul 5 reiese că valoarea cea mai apropiată de media datelor experimentale se obține cu relația Parich, cu o eroare relativă de 195 ppm.

Tabelul 5

Mărime	U.M.	Valoare	Diferența [%]
Putere calorifică superioară - *experimental*	MJ/kg	19,1250	0,0000

Putere calorifică superioară – Demirbaş	MJ/kg	18,5673	- 2,9162
Putere calorifică superioară – Parikh	MJ/kg	19,1213	-0,0195
Putere calorifică superioară – Sheng (a)	MJ/kg	19,3123	0,9794
Putere calorifică superioară – Sheng (b)	MJ/kg	18,9487	-0,9220
Putere calorifică inferioară – *experimental*	MJ/kg	17,9900	0,0000
Putere calorifică inferioară – funcție de H	MJ/kg	17,7668	1,2298

La un hectar normal de cultură de viță de vie sunt 4000-5000 butuci care la tăiere produc 0,5-1 kg biomasă/butuc cu umiditatea realtivă în domeniul 30...40%, cu o media de 35%, deci între 2000-4000 kg.cv/an. Aceste valori pot varia relativ mult în funcție de condițiile de sol şi climaterice ale anului viticol [2], [3], [4] şi [14].

Masa uscată ($_{us}$) a corzilor are o puterea calorifică inferioară PCI_{mu} (medie) de:

$$PCI_{mu} \approx 18\ MJ/kg._{us} \tag{5}$$

La tăiere corzile au o umiditate relativă medie de 35%, iar puterea calorifică inferioară PCI_{cv} utilizabilă este :

$$PCI_{cv} \approx 12\ MJ/kg._{um} \tag{6}$$

După uscare naturală sau forțată, corzile de viță ajung la o umiditate medie de 10%, valoare optimă pentru depozitare, ardere sau gazeificare termochimică.

Luând în considerare, ca estimare inițială, o masă minimă de corzi de viță tăiate de $M_{cvs} \approx$ 2000 kg/ha, rezultă că potențialul energetic anual minim al unui hectar de vie este:

$$EP_{cvs} \approx 24.000\ MJ/ha.an = 24,0\ GJ/ha.an \approx 67000\ kWh/ha.an \tag{7}$$

Considerând că randamentul de efectiv de utilizare a energiei potențiale a corzilor de viță este de minim η_{ef} = 70% rezultă că de pe un hectar de viță de vie se poate obține o energie termică specifică utilă minimă de:

$$EU_{cvs} \approx 16.800\ MJ/ha.an = 4700\ kWh/ha.an \tag{8}$$

ceea ce corespunde unui consum echivalent de 540 litri motorină.

Înlocuirea combustibililor clasici, de tip motorina, duce la reducerea emisiei de CO_2 cu 74,1 t_{CO2}/TJ (OM. nr. 1175 din 31.10.2006 - Ghid privind monitorizarea şi raportarea emisiilor de gaze cu efect de seră), adică cu 0,64 $t_{CO2}/t._{cv}$. Rezultă că utilizarea energiei din biomasa de corzi de viță recoltată de pe un hectar de vie duce la reducerea emisiei de CO_2 cu 1,28 t_{CO2}/ha.an [15].

La nivel național, luând în calcul o suprafață de minim 100.000 ha de viță de vie în producție, rezultă un potențial energetic în biomasa formată din corzile de viță tăiate de:

$$EP_{cv} \approx 2400\ TJ/an = 670\ TWh/an \tag{9}$$

care corespunde unui consum anual de motorină de 43.000 t/an. Rezultă reducerea emisiei de CO_2 cu 128.000 t_{CO2}/an, valorile anterioare fiind impresionante chiar şi la nivel național.

Tehnologia actuală în viticultură prevede tăierea corzilor şi scoaterea lor la capătul de rând. Mecanizarea disponibilă în acest moment poate asigura strângerea sub formă de baloți cilindrici care sunt transportați la sediul fermei, depozitați, uscați şi tocați pentru utilizare energetică. Studii efectuate în Italia au condus la concluzia că totalitatea operațiunilor necesare pentru pregătirea corzilor de viță pentru uz energetic duc la un cost de producție de circa 100 €/t.us [12].

Această valoare conduce la un cost de producție specific al energiei termice potențiale de:

$$c_{sp} = 100\ €/18{,}0\ GJ/t_{us} \approx 5{,}56\ €/GJ \qquad (10)$$

sau

$$c_{sp} = 100\ €/(0{,}7 \times 5000\ kWh/t_{us}) \approx \approx 0{,}0286\ €/kWh \qquad (11)$$

În cazul utilizării motorinei costul specific al energiei este de 0,09 €/kWh, deci de circa trei ori mai mare.

Prețul de producție este comparativ cu cel al peletelor din reziduurile lemnoase, ca urmare tocătura de corzi de viță putând fi un produs cu succes pe piața energiilor regenerabile.

În prezent se studiază o altă tehnologie de prelucrare a corzilor de viță de vie pentru utilizare energetică, cu costuri de producție mai reduse, în care corzile sunt tocate imediat după tăiere, apoi se depozitează în containere cu care sunt transportate la sediul fermei pentru uscare şi utilizare ulterioară.

5. Concluzii

1. S-a analizat o modalitate de utilizare a biomasei, un produs secundar din viticultură, cozile de viță taiate anual, cu care să se producă energie necesară irigăriilor suplimentare pentru a se atenua influența perturbațiilor climatice asupra calității si a producției de struguri cu un bilant aproape nul al emisiei de CO_2. Acest mod de abordare corespunde cerințelor dezvoltării durabile a agriculturii şi a creşterii independenței energetice.

2. S-a constatat că asigurarea unei irigari a viței de vie la momentele optime, lunile mai-august, asigură o creştere în medie a producției cu 30%.

3. Corzile de viță tăiate reprezintă un potențial energetic care poate fi valorificat eficient atât economic şi ecologic.

4. S-a constatat că compoziția chimică la diferite soiuri de viță este asemănatoare, abaterea standard a componentelor principale fiind mai mică de 2%; iar formula chimică redusă pentru corzile de viță este de forma: $\mathbf{CH_{1,48}O_{0,68}}$. S-a constatat că soiul şi condițiile pedoclimatice influențează în mod deosebit doar conținutul de minerale regăsit în cenuşă.

5. Puterea calorifică superioară PCS este în medie de 19 MJ/kg.$_{ms}$. S-au selectat modele empirice adecvate pentru estimarea valorii acesteia în funcție de compoziția chimică a corzilor de viță.

6. S-a calculat că, în medie, potențialul energetic anual al unui hectar de vie este de 24 GJ/ha; ceea ce pentru o suprafață de cultură de 100.000 ha reprezintă 2400 TJ/an, echivalentul a circa 43.000 tone motorină.

Mulțumiri

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NECESAR ENERGETIC LA DIFERITE TIPURI DE FERME AGRICOLE DIN ROMÂNIA

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Rezumat.
Lucrarea face o evaluare a necesarului energetic pentru patru cazuri particulare: fermă de vaci cu lapte din comuna Viişoara, judeţul Cluj, capacitate 170 vaci cu lapte; fermă de 150 vaci cu lapte, din comuna Viişoara, judeţul Cluj; fermă de 3000 de porci din comuna Ţaga, judeţul Cluj şi ferma de porci din Apahida, cu 250 scroafe şi 2000 porci la îngrăşat judeţul Cluj.

1. Introducere

Asocierea şi cooperarea în agricultură reprezintă strategii de apărare a intereselor producătorilor agricoli şi de rezolvare a unor aspiraţii sociale tot mai acute, precum concediile de odihnă, weekend liber etc., putând îmbrăca forma integrării pe orizontală sau pe verticală. Pentru modernizarea relaţiilor de producţie şi de schimb, pentru creşterea competitivităţii, un rol hotărâtor îl vor avea cooperativele pluri-funcţionale. În acest sens, cooperativele de consum şi aprovizionare, de comercializare, de servicii, de producţie, de prelucrare, de stocare, de derulare a creditelor şi de apărare împotriva riscului sunt premize esenţiale pentru modernizarea agriculturii.

Având în vedere diversitatea condiţiilor pedoclimatice, economice şi sociale existente în ţara noastră, exploataţiile agricole sunt, la rândul lor, de o mare diversitate, fiecare dintre ele având caracteristici distincte.

Din punct de vedere al producţiei finale, principalele tipuri de exploataţii agricole sunt: ferme vegetale; ferme legumicole; ferme pomicole; ferme viticole; ferme zootehnice pentru vaci cu lapte; ferme zootehnice pentru viţei la îngrăşat; ferme zootehnice pentru porci la îngrăşat; ferme avicole; ferme mixte, care îmbină producţia vegetală şi cea zootehnică (uzual cultura mare şi creşterea vacilor de lapte / viţeilor la îngrăşat sau porcilor la îngrăşat.

Din punct de vedere al zonei de relief exploataţiile agricole se clasifică: ferme situate în zonele de câmpie; ferme situate în zonele colinare; ferme situate în zonele premontane şi montane.

Având în vedere destinaţia producţiei agricole, fermele din ţara noastră sunt: exploataţii agricole destinate realizării de produse pentru comercializare; ferme de subzistenţă.

Zootehnia reprezintă un important sector în agricultura ţării noastre, fiind extinsă la toate speciile principale (vaci cu lapte, viţei, găini, pui, porci, oi, capre, etc), cu o menţiune specială pentru vacile cu lapte (1134.10^3 – ferme zootehnice pentru vaci cu lapte) (fig. 1). Intensitatea activităţii zootehnice este de 0,46 UZ/ha comparativ cu 0,8 UZ/ha media europeană [1].

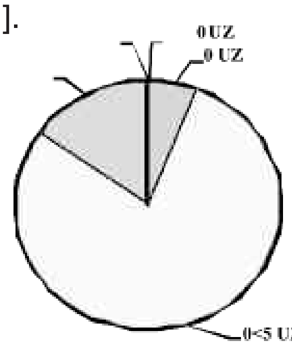

Fig. 1Distribuţia exploataţiilor agricole după numărul de capete
(unităţi zootehnice/cap bovină mare – UZ*)*

Analizând datele prezentate se remarcă că marea majoritate a exploatațiilor agricole din România sunt de tip mixt, având pe lângă sectorul producției vegetale şi producția zootehnică (977.10^3 ferme cu 0≤5 ZZ, 183.10^3 ferme cu 5≤50 UZ şi $3,2.10^3$ cu peste 50 UZ) [10, 11].

Este de subliniat că în cazul unui procent mare din fermele din țara noastră (32,3 % - față de media europeană de 13,3 %) se desfăşoară şi alte activități în afara celor agricole, 23,2 % din totalul fermelor realizând şi procesarea producției primare. În tabelul 1 este prezentată situați privind exploatațiile agricole cu efective de animale în 2009 [8, 9, 12]

Exploatații agricole cu efective de animale în 2009
Tabelul 1

Specia	Nr. ferme	Specia	Nr. ferme
Bovine	1067726	Păsări	3228920
Ovine	390562	Cabaline	547864
Caprine	198729	Măgari şi catâri	35750
Porcine	1697575	Iepuri de casă	45488
Familii de albine	39740		

2. Consumuri energetice la ferme

O paradigmă a dezvoltării este aceea că fără asigurarea unui sistem energetic corespunzător nu poate avea loc o dezvoltare economică în adevăratul sens al cuvântului. Energia a fost şi este piatra fundamentală a dezvoltării economice a lumii moderne şi de aceea disponibilitatea resurselor energetice alături de capacitatea de folosire rațională a acestora sunt elementele cheie în atingerea unui înalt grad de civilizație şi nivel de trai a populației.

Conform Convenției privind mediul semnate de peste 150 de țări la Conferința UNCED de la Rio de Janeiro şi a Protocolului de la Kyoto statele lumii s-au angajat a lua măsuri pentru reducerea poluării prin managementul rațional al energiei [2, 31.

În acest context, problemele hranei şi energiei sunt strâns legate între ele deoarece agricultura de mare performanță se bazează tot mai mult pe folosirea produselor şi serviciilor cu mare consum de energie, cca. 12 % din energia consumată fiind absorbită de fluxul total al hranei, de la nivelul fermei agricole şi până la distribuția şi consumul hranei. Dacă până în prezent managementul energiei în exploatațiile agricole era o activitate secundară, în prezent aceasta a devenit din ce în ce mai importantă ca rezultat a noilor condiții globale [5].

O soluție extrem de eficace este utilizarea cu randament maxim a resurselor energetice alternative [7]. Astfel, se preconizează ca până în anul 2020 energia produsă din surse alternative să ajungă la 12 % din consumul total în țările Comunității Europene. În acelaşi timp, producția de energie din surse alternative reprezintă o sursă de venit suplimentară a fermierilor.

Aderarea României la Comunitatea Europeană impune, printre altele redimensionarea strategiei sale în domeniul producerii şi consumului energiei. În acest context, spațiul rural în general şi agricultura în special va utiliza într-o măsură, din ce în ce mai mare, energie furnizată de surse alternative, nepoluante [4-6].

Creşterea continuă a prețului energiei, precum şi lipsa energiei electrice în unele localități, alături de creşterea indicelui general de poluare a mediului a impus şi în România necesitatea gospodăririi raționale a resurselor energetice existente. În acest context, un loc important este ocupat de utilizarea resurselor energetice reînoibile şi nepoluante.

Convenția mondială a inginerilor (Hanovra, 19-21, iunie, 2000) a confirmat legătura esențială existentă între dezvoltarea economică (deci bunăstarrea oamenilor) şi consumul energetic. La unison, preşedintele Băncii mondiale, James D. Wolfenson şi cel al Clubului de la Roma, Ricardo Diez-Hochleitner au scos în evidență importanța etică a energiei în viața umanității.

Conform previziunilor Agenției Internaționale pentru Energie (IEA) consumul mondial energetic va creşte cu cca. 65 % până în anul 2020, în timp ce consumul specific rămâne constant (cca. 70 GJ/locuitor).

În acest context, energia (dobândirea şi gospodărirea sa rațională) este un element indispensabil pentru majoritatea activităților umane, cantitatea de bunuri şi servicii disponibile pentru oameni, fiind, în principal, funcție de gradul de disponibilitate şi de utilizare a acesteia. În acelaşi timp, natura şi calitatea energiei sunt tot atât de importante ca şi cantitatea ei.

Problemele hranei şi energiei sunt strâns legate între ele deoarece agricultura de mare performanță se bazează tot mai mult pe folosirea produselor şi serviciilor cu mare consum de energie cel puțin 12 % din energia consumată în țările cu o economie dezvoltată este absorbită de fluxul total al hranei, de la nivelul fermei agricole şi până la distribuția şi consumul hranei. Astfel, țările EU (între care se remarcă Germania) au adoptat o serie de reglementări menite să stimuleze producția de energie nepoluantă şi să creeze pentru fermieri o sursă de venit suplimentară.

Creşterea continuă a prețului energiei, precum şi lipsa încă a energiei electrice în unele localități sau zone izolate din unele localități, alături de creşterea indicelui general de poluare a mediului a impus şi în exploatațiile agricole din România necesitatea gospodăririi raționale a resurselor energetice. În acest context şi având în vedere resursele naturale ale țării, un loc important este ocupat de utilizarea resurselor energetice regenerabile şi nepoluante.

Consumurile intermediare în agricultura României reprezintă alt punct sensibil, deviat fată de normalitate şi față de situația întâlnită în statele dezvoltate. Consumurile de carburanți, îngrăşăminte chimice şi naturale, dar şi celelalte consumuri necesare agriculturii sunt mult sub nivelul necesar realizării de performanțe în acest domeniu. In fig. 2. este data structura consumului energetic în fermele din zonele premontane

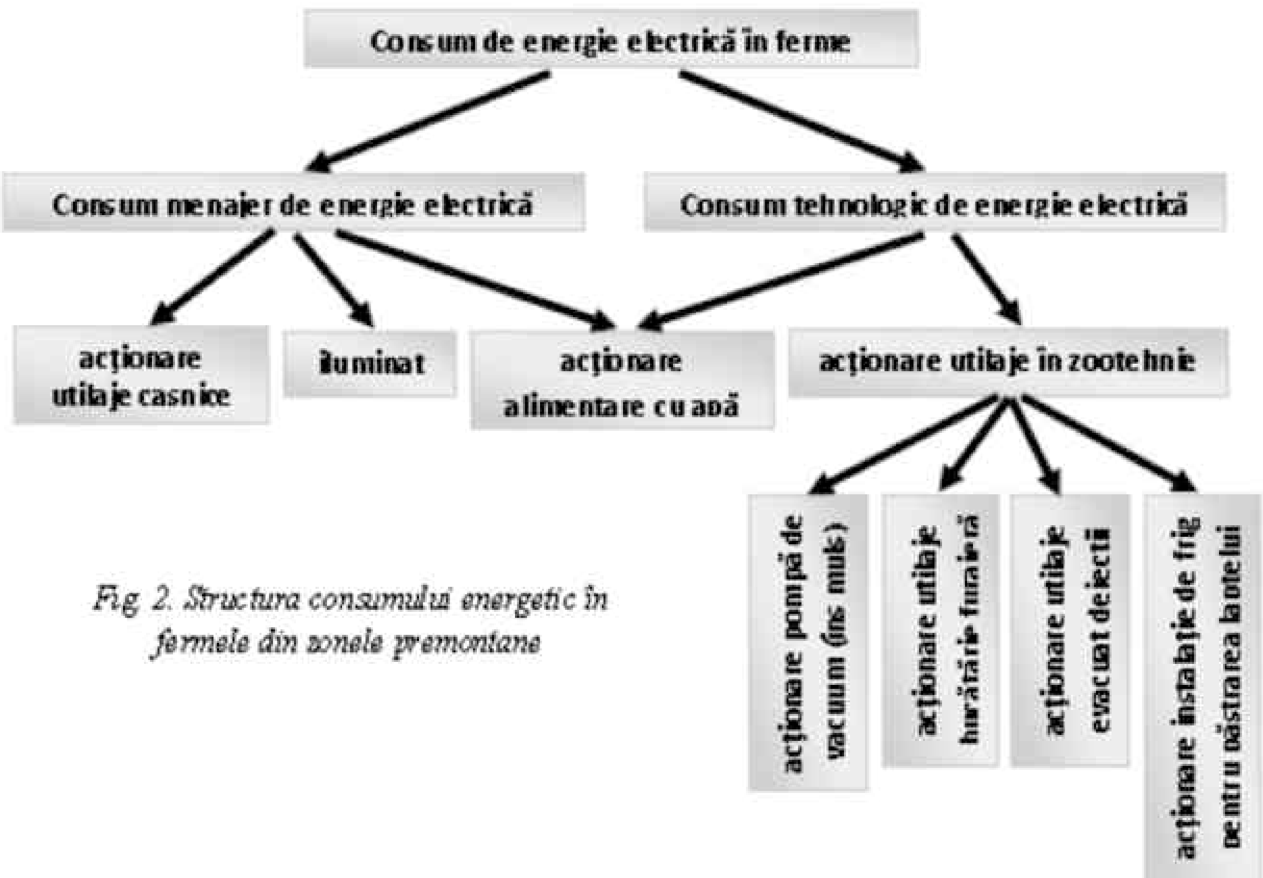

Fig 2. Structura consumului energetic în fermele din zonele premontane

În acest context şi având în vedere predominanța fermelor de creştere a vacilor de lapte cea mai mare parte a energiei consumate în fermă sau gospodărie (fig. 2) este legată de producerea rețetelor furajere şi distribuție, precum şi de lapte (muls şi răcit).

La un nivel de dotare tehnică de ultimă generație, consumul energetic specific anual calculat ajunge la 936,7 kW/cap animal cu structura prezentată în figura 3.

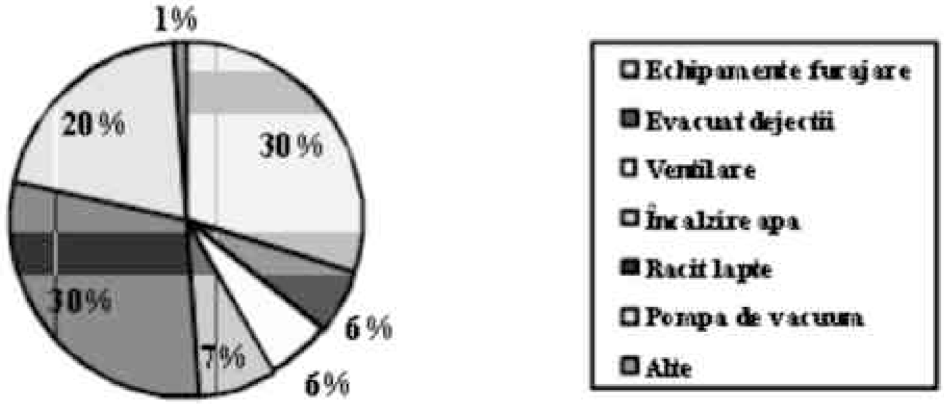

Fig. 3 Ponderea diferitelor elemente în consumul energetic dintr-o fermă zootehnică situată în zona premontană

În practică, consumurile energetice nu se ridică întotdeauna la aceste valori teoretice.

In cadrul prezentei lucrări se va efectua o analiza tehnico-economică pentru patru cazuri particulare:

- Fermă de vaci cu lapte din comuna Viişoara, județul Cluj, capacitate 170 vaci cu lapte,
- Fermă de 150 vaci cu lapte, din comuna Viişoara, județul Cluj,
- Fermă de 3000 de porci din comuna Țaga, județul Cluj
- Ferma de porci din Apahida, cu 250 scroafe şi 2000 porci la îngrăşat județul Cluj

3. Consumuri de energie electrica la ferme zootehnice

3.1 Ferma SC Ada Prod Com SRL, Viişoara, jud. Cluj

SC. Ada Prod Com. SRL este o fermă de 170 de capete de vaci cu lapte din comuna Viişoara, județul Cluj. Consumul energetic este prezentat în tabelul 2. Analizând datele prezentate se observă că se înregistrează un consum anual de 616,5 kW pe cap de vacă, respectiv 1,68 kW/zi şi cap de vacă.

Consumul cel mai ridicat se înregistrează în luna decembrie când consumul mediu de energie electrică se ridică la 2,4 kW/zi cap de vacă şi valoarea cea mai mică în luna aprilie, cu 0,99 kW/zi cap de vacă.

În consecință, consumul zilnic de energie electrică variază între 167,7 kW/zi şi 409 kW/zi.

Consumul mai mare la grajdul 1 este determinat în proporție de 80% de consumul din sala de muls. De asemenea, trebuie menționat că moara include uscătorul de cereale şi minifabrica de nutrețuri concentrate (moară, amestecător, transportor cu melc).

La acest consum de energie electrică se adaugă consumul de gaz metan, consum prezentat în tabelul 3.

Nota:

- S-a uscat cantitatea de: 1016 to porumb boabe.
- S-au consumat 11389 mc gaz.

Tabelul 3
Consumul de energie electrică la Sc Ada Prod Com Srl, Noiembrie 2008- Octombrie 2009

An	Luna	Grajd 1 kW	Atelier reparatii kW	Pompa apa kW	Birouri kW	Grajd 2 kW	Moară kW	Total kW
2008	Noiembrie	2810	95	0	121	3259	480	6765
2008	Decembrie	4524	27	0	207	6968	560	**12286**
2009	Ianuarie	2950	83	0	124	3372	3800	10329
2009	Februarie	3060	86	0	128	3497	600	7371
2009	Martie	2857	128	0	247	5551	520	9303
2009	Aprilie	2220	70	0	95	2566	80	**5031**
2009	Mai	2440	204	0	129	3193	0	5966
2009	Iunie	4134	137	0	246	5025	1040	10582
2009	Iulie	2160	183	3953	101	3616	560	10573
2009	August	2700	229	0	127	4520	480	8056
2009	Septembrie	3813	145	0	148	7403	480	11989
2009	Octombrie	1850	155	1483	123	2419	520	6550

În figura 4 şi 5 sunt prezentate detaliat consumurile pe lunile 2009 aprilie şi decembrie 2008, luni cu cel mai mic, respectiv cel mai mare consum.

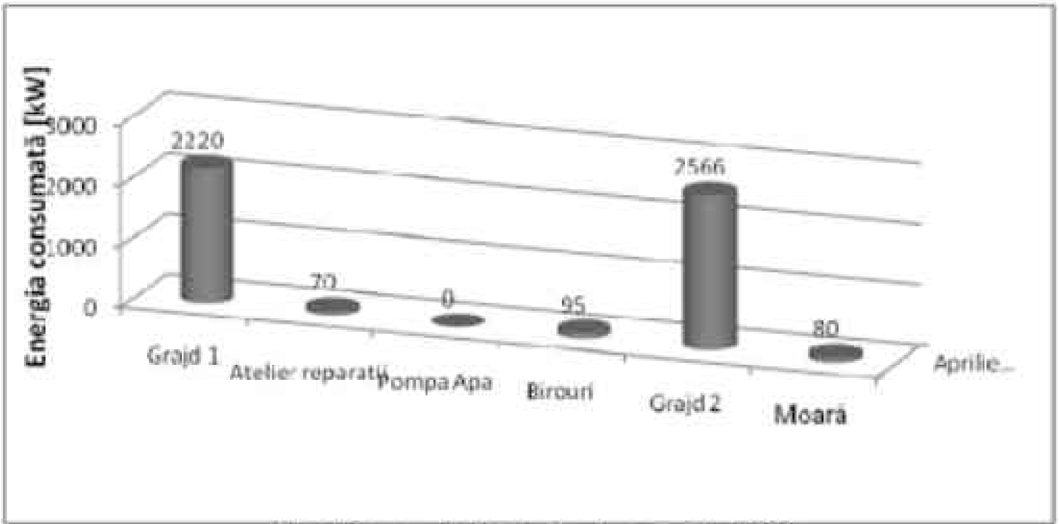

Fig. 4 Consumul detaliat pe luna aprilie 2008

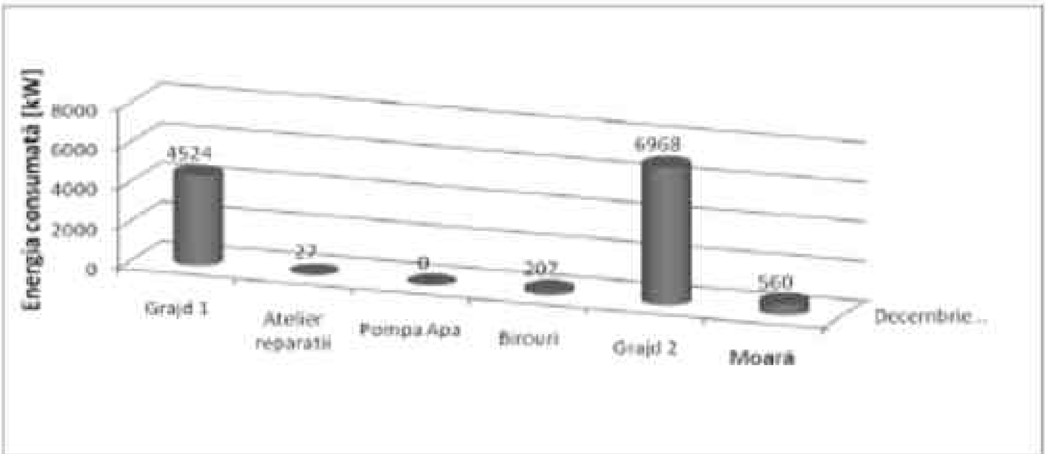

Fig. 5 Consumul detaliat pe luna decembrie 2009

Se observă că în ambele cazuri, cel mai mare consumator este grajdul 2 urmat de grajdul 1, celelalte ateliere având un consum foarte mic comparativ cu cele două.

3.2 Ferma Nora Ly, Viişoara, județul Cluj

SC Nora LY este o ferma de 150 vaci cu lapte, din localitatea Viişoara, județul Cluj. Consumul de energie electrica, pe principalii consumatori este conform celor de mai jos:

- aparat muls – 2 pompe cu motor de 2,2 kW, funcționare 6 ore/zi
- pompa evacuare dejecții lichide- 1 bucata cu motor de 17 kW, funcționare 0,5 ore/zi
- alimentare cu apa – 1 pompa submersibila cu motor de 1,1kW funcționare 6 ore/zi(18000 litri apa/zi)
- iluminat – consum 1,8 kw/ora, funcționare 10 - 14 ore/zi
- boiler încălzire apa tehnologica de 4,5 kw, funcționare 8 ore/zi, pentru cantitatea de 500 litri apa la 70 grade C
- radiatoare încălzire birouri si vestiare, Pu 10kW 8 ore/zi, cinci luni/an
- răcitor lapte capacitate de 4000 litri, Pu-1,1 kW, funcționare 12-18 ore/zi
- atelier întreținere, consum 6kw/zi, 300 zile/an
- moara cu ciocane, consum 60 kw/săptămână

In tabelul 4 este prezentat sintetic consumul de energie electrica

Tabelul 4
Consumul de energie electrică la ferma de vaci Nora Ly

Loc consum	**Iarna 5 luni kw**	**Vara 7 luni kw**	**Total**
Aparat muls	3960	5676	9636 kW/an
Pompa evacuat dejectii	1275	1826	3101 kW/an
Iluminat	3780	3888	7668 kW/an
Boiler apa calda	5400	7740	13140 kW/an
Racitor lapte	1650	4224	5874 kW/an
Radiatoare incalzire	9000	-	9000 kW/an
Atelier intretinere	900	1300	2200 kW/an
Moara cu ciocane	1200	1680	2880 kW/an
Alimentare cu apa	990	1419	2409 kW/an
Total	**28155**	**27753**	**55908 kW/an**
Consum mediu pe lună	5631 kW/luna	3965 kW/luna	4659 kw/luna
Consum mediu pe zi	187,7 kW/zi	132,2 kW/zi	159,9 kW/zi

În figura 6 sunt prezentate consumurile pe cele 5 luni de vară respectiv 7 luni de iarnă.

La această fermă, consumul zilnic de energie electrică variază între 132,2 kW/zi pe perioada de vară şi 187,7 kW/zi pe perioada de iarnă, revenind un consum energetic per zi per cap de vacă între 0,88 kW/zi şi cap de vacă (vara) şi 1,25 kW/zi şi cap de vacă (iarna).

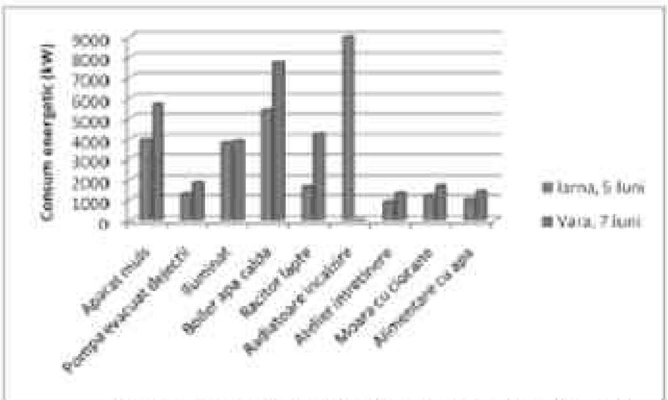

Fig. 6 Consumurile pe cele 5 luni de vară, 7 luni de iarnă

3.3 Ferma Bala, Năsal – comuna Țaga, județul Cluj

S-a mai analizat consumul energetic la o fermă de 3000 de porci respectiv, ferma Bala din Năsal – comuna Țaga, județul Cluj

În general la fermele de porcine consumurile energetice sunt mai mari la purceii sugari la care trebuie să se asigure o temperatură locală de circa 32°C şi în hală de minim 25°C.
Toate datele sunt centralizate în tabelul 5.

Tabelul 5
Consumurile lunare la ferma porcină Bala din Năsal – comuna Țaga, județul Cluj

Anul	Luna	Consum lunar [kW]	Consum lunar /cap porc [kW/cap porc]	Consum zilnic [kW/zi]	Consum zilnic / cap porc [kW/zi/cap porc]
2008	Octombrie	**8088**	**2.70**	**269.60**	**0.09**
2008	Noiembrie	**9114**	**3.04**	**303.80**	**0.10**
2008	Decembrie	**9676**	**3.23**	**322.53**	**0.11**
2009	Ianuarie	**10800**	**3.60**	**360.00**	**0.12**
2009	Februarie	**10238**	**3.41**	**341.27**	**0.11**
2009	Martie	**8552**	**2.85**	**285.07**	**0.10**
2009	Aprilie	**7990**	**2.66**	**266.33**	**0.09**
2009	Mai	**7526**	**2.51**	**250.87**	**0.08**
2009	Iunie	**6402**	**2.13**	**213.40**	**0.07**
2009	Iulie	**5840**	**1.95**	**194.67**	**0.06**
2009	August	**6976**	**2.33**	**232.53**	**0.08**
2009	Septembrie	**8650**	**2.88**	**288.33**	**0.10**

În figura 7 este prezentat grafic, consumul zilnic de energie, pentru ferma Bala din Năsal.

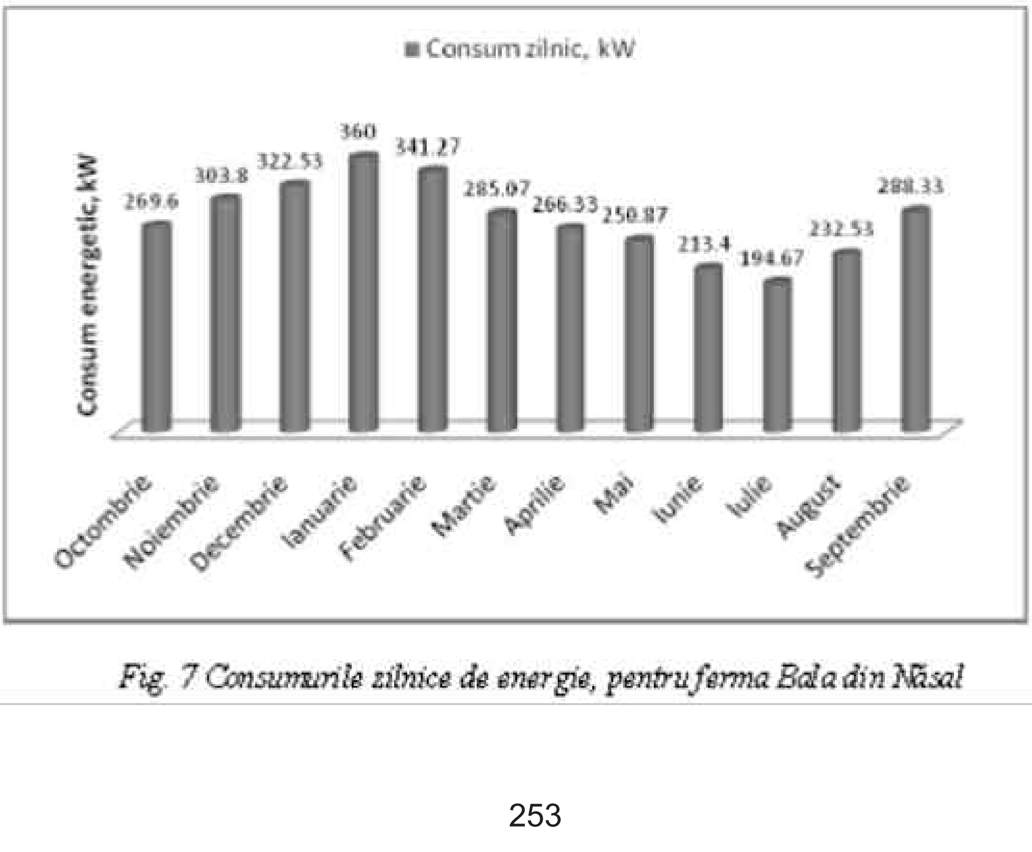

Fig. 7 Consumurile zilnice de energie, pentru ferma Bala din Năsal

3.4 Ferma de porci, Apahida, judetul Cluj

Ultima fermă la care s-a studiat consumul energetic este o fermă din Apahida, județul Cluj, care are 250 scroafe şi 2000 porci la îngrăşat.

Consumurile lunare sunt prezentate în tabelul 6 şi grafic, în fig. 8 şi 9.

Tabelul 6.
Consumurile lunare la o fermă porcină din Apahida

Luna	Consum lunar [kW]	Consum lunar /cap porc [kW/cap porc]	Consum zilnic [kW/zi]	Consum zilnic/cap porc [kW/zi/cap porc]
Octombrie 2008	11311	5.03	377.03	0.17
Noiembrie 2008	8105	3.60	270.17	0.12
Decembrie 2009	10301	4.58	343.37	0.15
Ianuarie 2009	12321	5.48	410.70	0.18
Februarie 2009	11816	5.25	393.87	0.18
Martie 2009	10806	4.80	360.20	0.16
Aprilie 2009	9796	4.35	326.53	0.15
Mai 2009	8610	3.83	287.00	0.13
Iunie 2009	7602	3.38	253.40	0.11
Iulie 2009	6590	2.93	219.67	0.10
Aug-09	7095	3.15	236.50	0.11
Septembrie 2009	9115	4.05	303.83	0.14

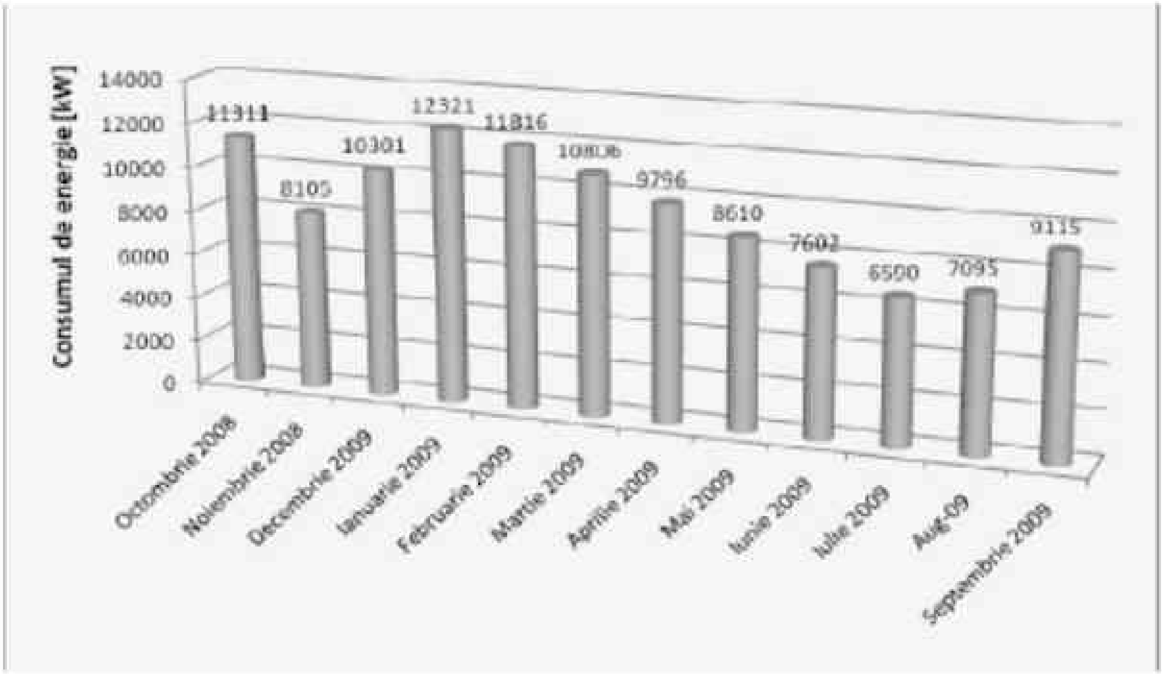

Fig. 8 Consumurile energetice lunare la ferma din Apahida

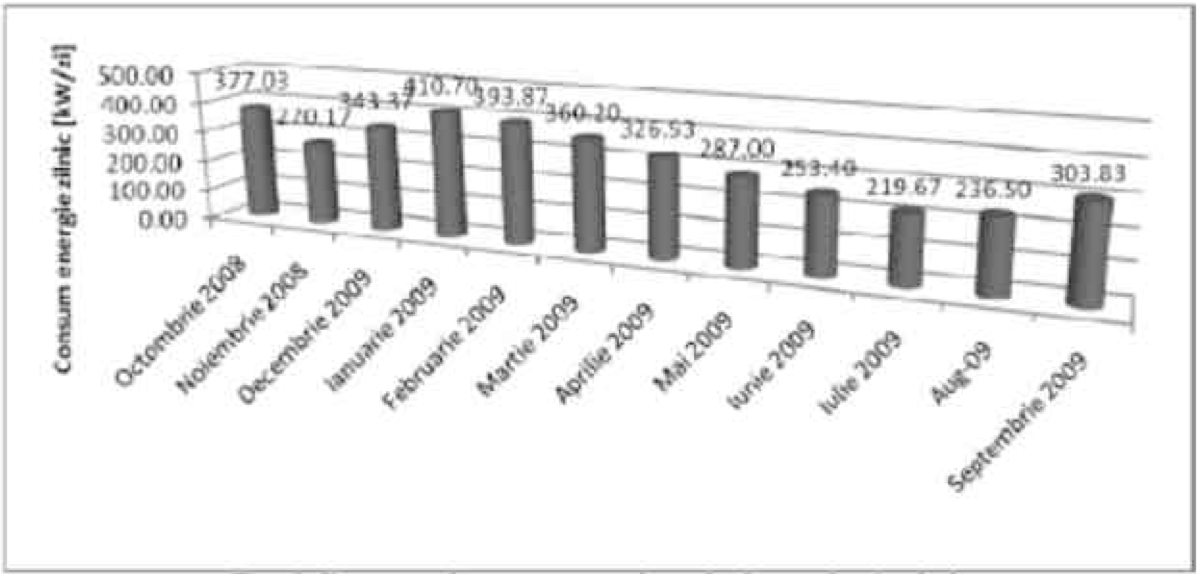

Fig. 9 Consumurile energetice zilnice la ferma din Apahida

4. Necesar energetic

Studiile efectuate la cele 4 ferme din judetul Cluj au reliefat urmatoarele:

· Putem afirma că necesarul de energie electrică pe cap de vacă şi zi la cele două ferme analizate (Ada si Nora Ly) este între 0,88 kW şi 0,99 kW vara, iar pe perioada de iarnă între 1,25 kW şi 2,4 kW, putându-se recomanda în calculul necesarului pe fermă o majorare cu 10%, necesarul rezultând apoi din înmulțirea necesarului maxim per vacă şi zi (iarna) cu numărul de vaci din fermă.

· La o fermă cu 3000 capete purcei înțărcați pe serie, (ferma Bala) consumurile energetice sunt asigurate de 2 tone motorină pentru încălzire cu aeroterme la care se adaugă 5840 kW pe o lună de vară, iulie 2009 şi respectiv 10800kW pe o lună de iarnă, ianuarie 2009.

§ Rezultă un consum de 1,94 kW/luna/cap porc vara şi 3,6 kW/luna/cap porc iarna şi respectiv un consum zilnic pe cap de porc, de 0,064 kW vara şi 0,12 kW iarna.

§ Pentru o serie (6 luni) rezultă un consum de 2 tone motorină (aeroterme) şi 35040 kW la 6 luni de vară, respectiv 64800 kW pentru 6 luni de iarnă.

§ Consumul zilnic se va situa între 194,67 kW şi 360 kW, la care se adaugă cele 2 tone de motorină pe an.

§ Costurile consumului de energie electrică în luna iulie 2008 a fost de 3300 RON iar în luna ianuarie 2009 de 6100 RON.

·În calculul necesarului de energie electrică pentru creşterea porcilor (Apahida) se recomanda să se pornească de la necesarul zilnic pe cap de porc în perioada de iarnă, când este consumul cel mai ridicat (0,12 kW), care se va înmulți cu numărul de porci.

§ Pentru purceii sugari (0 – 35 zile) se recomanda pe perioada de iarnă un consum în plus de 0,2 kW/cap şi zi.

§ La o fermă cu 2250 capete purcei, 250 scroafe şi 2000 porci la îngrăşat consumurile energetice sunt asigurate de 2 tone motorină pentru încălzire cu aeroterme la care se adaugă 6590 kW pe o lună de vară, iulie 2009 şi respectiv 12321 kW pe o lună de iarnă, ianuarie 2009.

§ Rezultă un consum de 2,93 kW/luna/cap porc vara şi 5,48 kW/luna/cap porc iarna şi respectiv un consum zilnic pe cap de porc, de 0,10 kW vara şi 0,18 kW iarna.

§ Consumul zilnic se va situa între 219,7 kW vara şi 410,7 kW iarna

5. Concluzii

Între exploatațiile agricole, ca entități structurale, şi mărimea proprietății există o relație direct proporțională. Prin urmare, proprietatea agricolă mică duce la o exploatație mică, aşa cum se prezintă gospodăria individuală de mici dimensiuni, care se află sub limita viabilității economice.

Fărâmițarea proprietății agricole prin vânzări sau între moştenitori este în continuare în plină desfăşurare. Acest fenomen negativ pentru agricultura românească impune măsuri urgente de susținere a formării unor exploatații viabile, performante. Organizarea exploatațiilor agricole performante se poate face, în principal, prin vânzare-cumpărare de terenuri, arendare, concesionare şi asociere a proprietăților funciare, pe care să se poată aplica tehnologii agricole moderne.

Tipurile de exploatații agricole pot fi diverse, în funcție de forma de proprietate: gospodării familiale, asociații familiale şi societăți agricole, societăți comerciale agricole, cooperative agricole etc. Politica agricolă viitoare trebuie să se bazeze pe proprietate şi pe exploatația agricolă de tip comercial. Exploatațiile agricole din sectorul vegetal (cereale, plante tehnice, legume, pomi, vii), dar şi exploatațiile agricole zootehnice (carne de pasăre, carne de porc, carne de vită, ouă, lapte, etc.) trebuie să fie modernizate şi mărită dimensiunea acestora până la un nivel optim economic.

In România, în prezent există o mare fărâmițare a efectivelor pe ferme astfel:

- Ferme zootehnice mixte de mici dimensiuni în care predomină vacile de lapte (până la 15 capete vaci matcă) şi alături de acestea ovine (până la 20 capete), porcine (până la 5 capete) şi păsări (în special găini şi rațe).
- Ferme zootehnice în care predomină creşterea ovinelor (între 350 şi 1500 capete), alături de care se cresc porci (până la 10 capete) şi păsări.
- Ferme în care se cresc 4-5 scroafe sau pînă la 15-20 porci la îngrăşat şi câteva zeci de păsări

Nivelul tehnologic din ferme este scăzut, în majoritatea exploatațiilor agricole predominând utilizarea forței de muncă manuale care reprezintă cca. 75 % din consumul energetic total, restul fiind reprezentat de către energia electrică (iluminat + acționare pompe apă şi mori furaje) şi carburanți (motorină).

Implementarea tehnologiilor moderne, acum mai ales prin programe europene, care presupun implicit mulsul mecanic, păstrarea laptelui în cisterne cu instalație de refrigerare, bucătării furajere, alimentare cu apă, gard electric pentru păşunat, etc, duce la creşterea necesarului de energie electrică.

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OBSERVATIONS ON THE IMPROVEMENT OF THE BLADES FOR SMALL HORIZONTAL WIND TURBINES

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Abstract:
- The paper presents three variants of small horizontal wind turbines, compared by their performances and geometries. The paper intends to set some criteria to compare the blades of a wind turbine, working in the same area.

Key-Words:
- wind, turbines, characteristic, geometrical, parameters

1. Introduction

Horizontal axis wind turbines (HAWT) of small powers are especially used by individual small energy consumers. The paper discusses the case of such case of machines of power form 3.5 to 5 kW.

The design of the blades for these turbines is made under the following hypothesis:

- the pressure coefficient is adopted in vicinity of the Betz's value,
- the peripherial section of the blade is loaded to a level of 25 % compared to the shroud section,
- the load of the blade is optimized and controlled on the whole length of the blade,
- the aerodynamic profiles which define the sections of the blade are of NACA 4 digits type.

2. Turbine variant A

The first analyzed variant has the following characteristics:

- the nominal power at the shaft of the turbine: 3.5 kW,
- the nominal wind speed at the shaft of the turbine: 6.5 m/s,
- the nominal rotational speed of the shaft of the turbine: 150 rev/min,
- the characteristic diameters of the rotor are 4.5 respectively 1.2 m.

Figure 1 presents the variation with radius of the load on the blade, represented by the pressure difference on the sides of the blade.

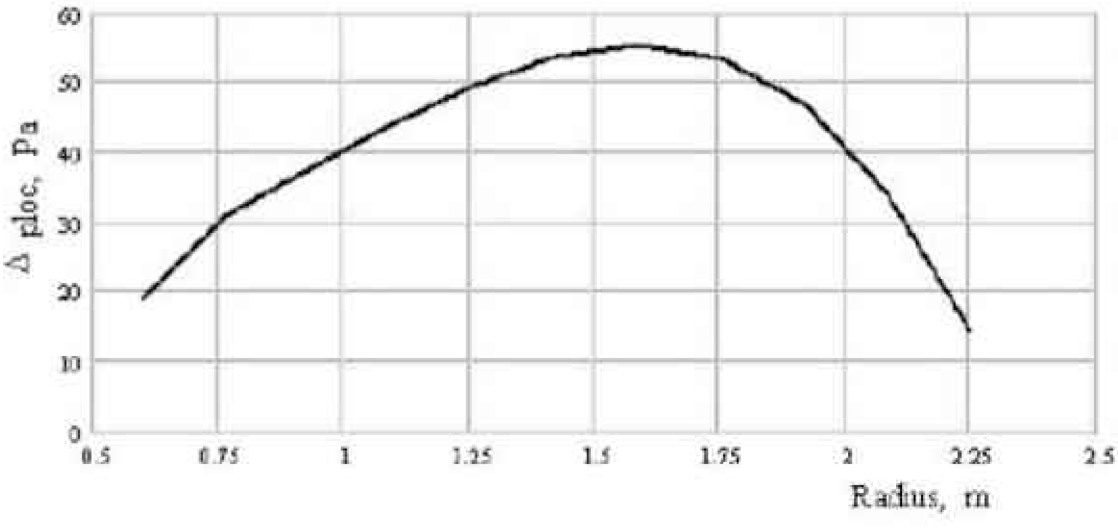

Fig. 1. The variation of the local load along the blade, for variant A

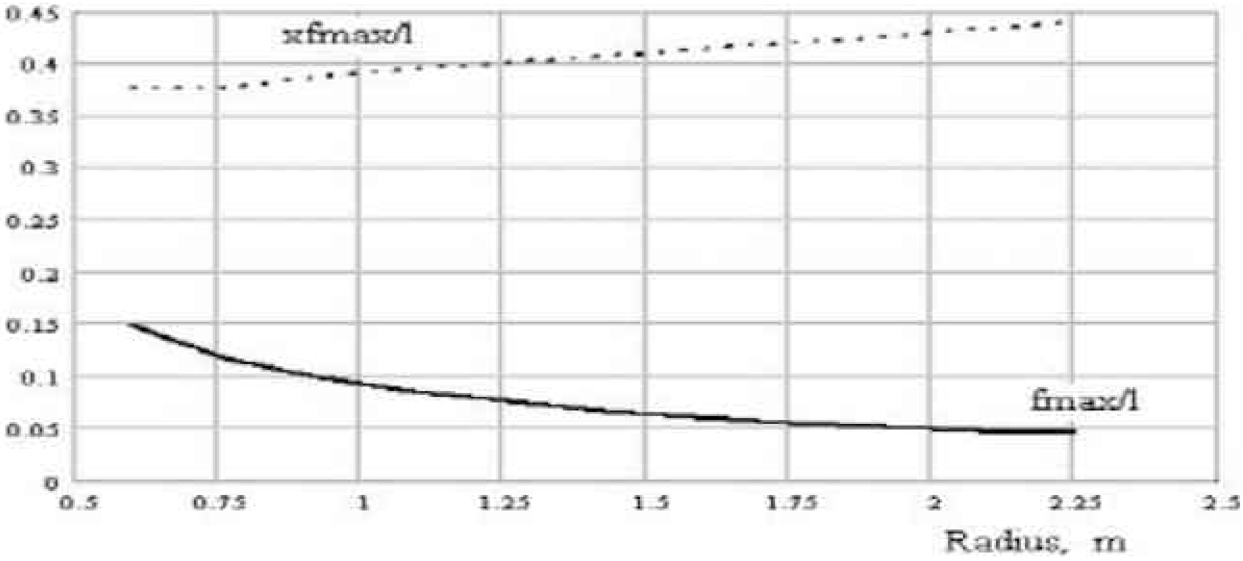

Fig. 2. The variation of the main geometric parameters of the blade with the radius, for variant A

In figure 2 are represented the variation with the radius of the main geometric parameters of the blade – the maximum relative camber (fmax/l) and its relative position (xfmax/l), referring to the leading edge of the blade for the variant A.

3. Turbine variant B

The second variant has the following characteristics:

- the nominal power at the shaft of the turbine: 5 kW,
- the nominal wind speed at the shaft of the turbine: 7.5 m/s,
- the nominal rotational speed of the shaft of the turbine: 120 rev/min,
- the characteristic diameters of the rotor are 7 respectively 1.6 m.

The figure 3 presents the variation with radius of the load on the blade, represented by the pressure difference on the sides of the blade.

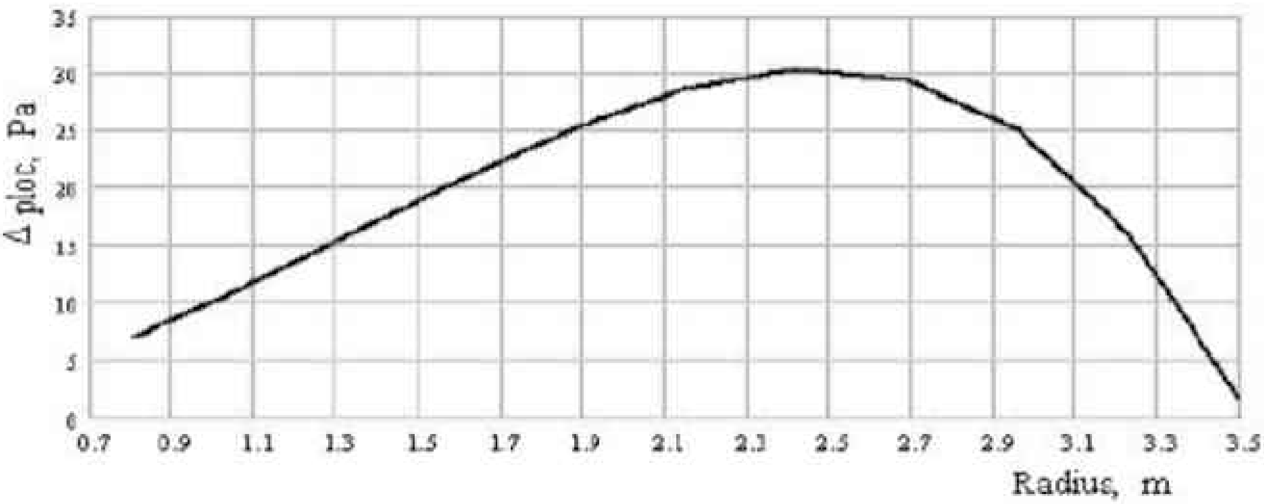

Fig. 3. The variation of the local load along the blade, for variant B

In figure 4 are represented the variation with the radius of the main geometric parameters of the blade – the maximum relative camber (fmax/l) and its relative position (xfmax/l), referring to the leading edge of the blade for the variant B.

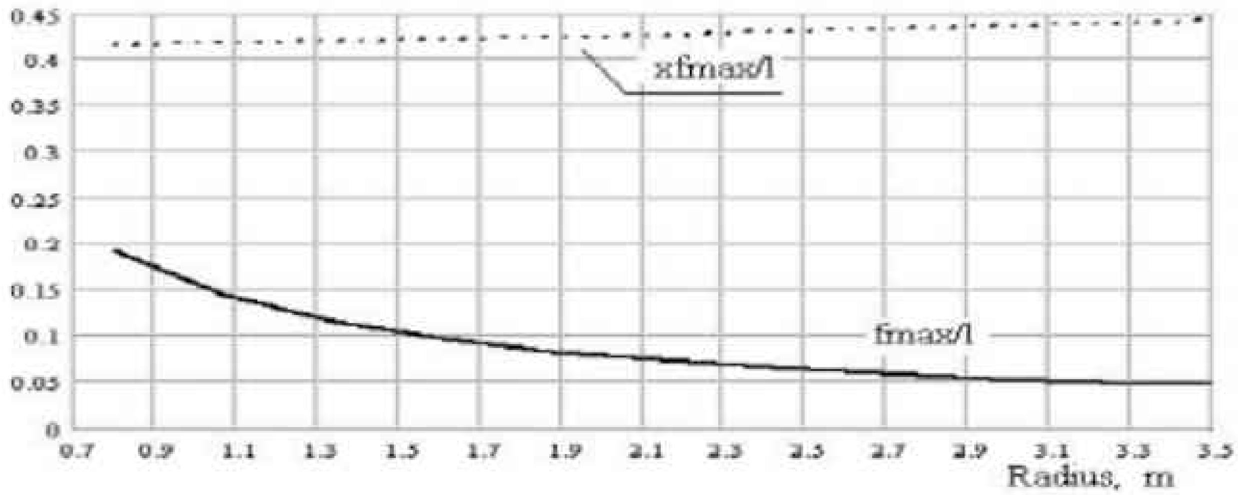

Fig. 4. The variation of the main geometric parameters of the blade with the radius, for variant B

4. Turbine variant C

The third variant has the following characteristics:

- the nominal power at the shaft of the turbine: 5 kW,
- the nominal wind speed at the shaft of the turbine: 7.5 m/s,
- the nominal rotational speed of the shaft of the turbine: 150 rev/min,
- the characteristic diameters of the rotor are 7.75 respectively 1.2 m.

Figure 5 presents the variation with radius of the load on the blade, represented by the pressure difference on the sides of the blade.

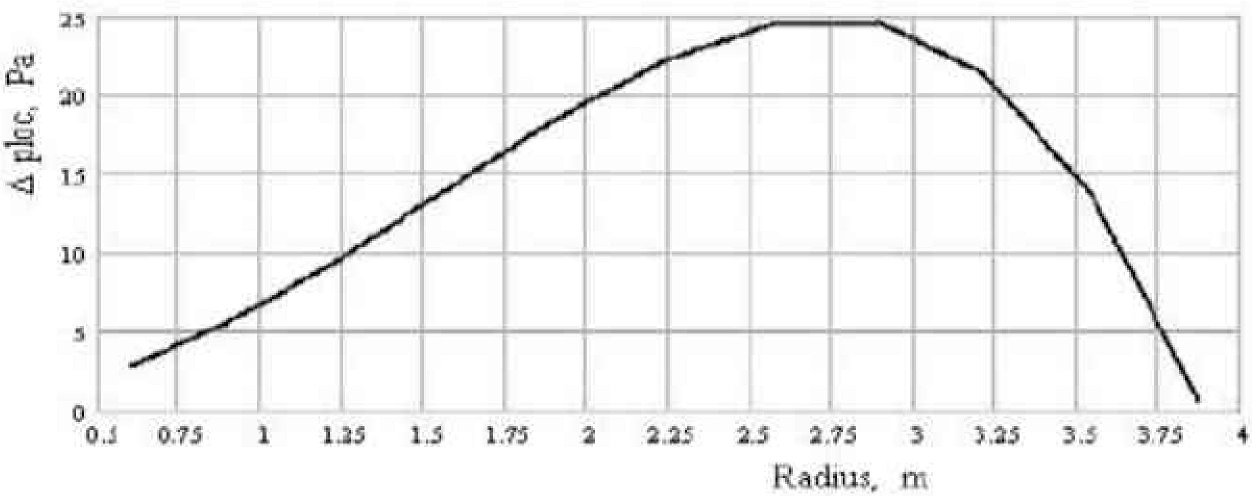

Fig. 5. The variation of the local load along the blade, for variant C

In figure 6 are represented the variation with the radius of the main geometric parameters of the blade – the maximum relative camber (fmax/l) and its relative position (xfmax/l), referring to the leading edge of the blade for the variant C.

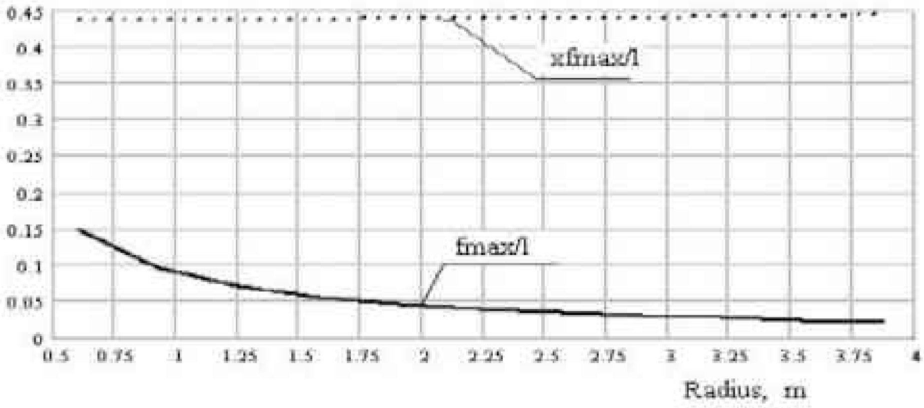

Fig. 6. The variation of the main geometric parameters of the blade with the radius, for variant C

5. Choosing the variation of the thickness

Among the characteristic parameters of the sections of the blade, according to NACA definition is the thickness of the characteristic profiles.

This parameter is close connected to the mechanical resistance of the blade according to the solicitations of the blade: longitudinal stress, due to the centrifugal force, and bending, due to the aerodynamic load.

Considering the blade as an embedded beam to the shroud and free to the periphery and taking into account a linear variation of the relative thickness along the radius between 25 % to 2 %, results the variation of the equivalent stress according to figure 7.

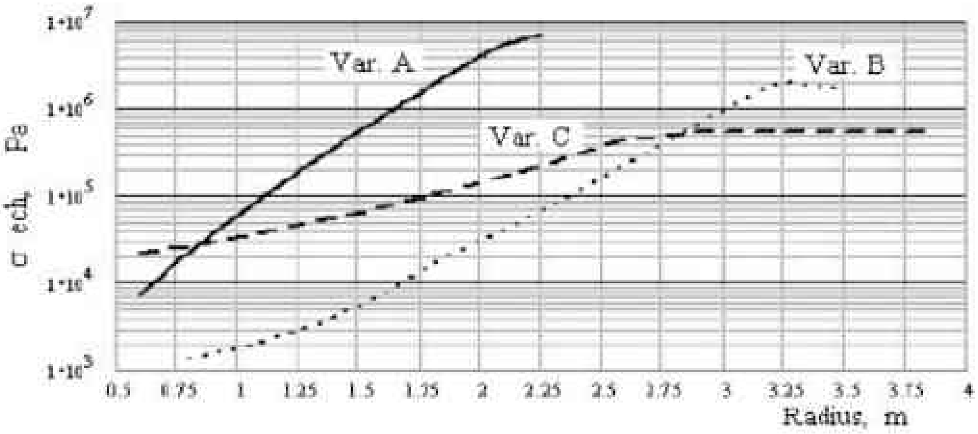

Fig. 7. The variation of the equivalent stress along the radius

6. Conclusions

In present paper are presented three variants for a small wind turbine with horizontal axis. The difference between the variants consists in the main energetic parameters: the nominal power at the shaft of the turbine, the nominal wind speed at the shaft of the turbine, the nominal rotational speed of the shaft of the turbine, and the characteristic diameters of the blade. The main advantage of the variant C consists in a more flat variation of the stress on the blade than the other two turbines. In the future, the designers of the wind turbines must taken into account several characteristics of the turbine and the blade, in order to obtain more efficient machines.

7. Acknowledgements

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HPLC METHOD DEVELOPMENT FOR DETERMINATION OF 15 PRIORITY POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) IN WATERS

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Abstract
Polycyclic aromatic hydrocarbons (PAHs) are a class of anthropogenic chemicals which have been proved to be carcinogenic and mutagenic in living species in aquatic systems and especially for humans. There presence was reported in waters, soils and recently in food. Due to the facts it is necessary to develop a new performant method for their identification. The present study follows this trend to develop an HPLC method for PAHs identification at nanoscale level which should be applicable for water, soil and food samples. Method development consisted in choosing an appropriate column and the optimum temperature, finding the best mobile phase, identifying the retention times and optimizing the excitation and emission wavelengths of each compound. The results were considered to be satisfying.
Keywords: PAHs, HPLC, separation column, mobile phase, wavelenght.

Introduction

PAHs are a group of chemicals that are formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances, such as tobacco and charbroiled meat [1-3]. There are more than 100 different PAHs, they have a relatively low solubility in water, but are highly lipophilic [4, 5]. PAHs generally occur as complex mixtures (for example, as part of combustion products such as soot), not as single compounds. They are found throughout the environment in the air, water, and soil [6- 8].

PAHs enter the environment mostly as releases to air from volcanoes, forest fires, residential wood burning, and exhaust from automobiles and trucks [9]. They can also enter surface water through discharges from industrial plants and waste water treatment plants, and they can be released to soils at hazardous waste sites if they escape from storage containers. The movement of PAHs in the environment depends on properties such as how easily they dissolve in water, and how easily they evaporate into the air. PAHs in general do not easily dissolve in water [1, 7, 10, 11]. They are present in air as vapors or stuck to the surfaces of small solid particles. They can travel long distances before they return to earth in rainfall or particle settling. Some PAHs evaporate into the atmosphere from surface waters, but most stick to solid particles and settle to the bottoms of rivers or lakes [11, 12]. In soils, PAHs are most likely to stick tightly to particles. Some PAHs evaporate from surface soils to air. Certain PAHs in soils also contaminate underground water [13-15]. The PAH content of plants and animals living on the land or in water can be many times higher than the content of PAHs in soil or water due to the bioaccumulation of these compounds. PAHs can break down to longer-lasting products by reacting with sunlight and other chemicals in the air, generally over a period of days to weeks. Breakdown in soil and water generally takes weeks to months and is caused primarily by the actions of microorganisms [1, 15]. Food can be contaminated by environmental PAH that are present in air (by deposition), soil (by transfer) or water (by deposition and transfer), or during processing and cooking [2, 16, 17].

Several PAHs are carcinogenic, teratogenic and mutagenic [18-21], and are included in the United States Environmental Protection Agency (USEPA) and EU priority pollutants list.

Data from animal studies indicate that several PAHs may induce a number of adverse effects, such as immunotoxicity, genotoxicity, carcinogenicity, reproductive toxicity (affecting both male and female offspring), and may possibly also influence development of atherosclerosis. However, the critical endpoint for the health risk evaluation is the well-documented carcinogenicity of several PAHs *[18, 22, 23]*.

Adverse haematological effects have been observed in animals following oral exposure to high doses of PAHs. Aplastic anaemia, pancytopenia, severe reduction in peripheral blood leukocytes, and severe bone marrow depression with almost complete destruction of pluripotent haematopoietic stem cells have been seen in non-responsive mice after oral BaP, while extreme resistance to bone marrow toxicity was observed in responsive mice [24, 25]. Many PAHs are capable of producing tumors in experimental animals. BaP has been used for many years as a model compound in a variety of different carcinogenicity bioassays, although no adequate studies that meet modern requirements for toxicological testing have been identified [24, 26]. When administered by the oral route, BaP and several other PAHs produced tumours in the forestomach, liver, lungs and mammary glands of rodents, while mono- and dinitropyrenes produced pituitary and mammary gland tumours [18, 24, 26].

Due to the number of factors mentioned above, the interes in developing a simple and sensitive method to detect these pollutants in the environment and in food is of great interest.

Reagents and standards

PAH Calibration Mix which contained 10μg/ml of each compound (Naphthalene, Acenaphthene, Fluorene, Phenanthrene, Anthracene, Fluoranthene, Pyrene, Benz[a]anthracene, Chrysene, Benzo[*b*]fluoranthene, Benzo[*k*]fluoranthene, Benzo[*a*]pyrene, Dibenz[*a*,*h*]anthracene, Benzo[*ghi*]perylene, Indeno[1,2,3-cd]pyrene) in Acetonitrile was acquired from Supelco. Acetonitrile Chromasolv gradient grade for HPLC (purity ≥99.9%) was acquired from Sigma Aldrich. The ultra-pure water was obtained with a Milli-Q water purification system from Millipore.

Liquid Chromatography conditions

A Perkin Elmer 200 Series HPLC, consisting in a manual injection system, degassing system, column oven, binary pump, UV and FLD detectors was used. The manual injection system had a loop which allowed an injection volum of 20μL. The liquid chromatographic column was a ZORBAX Eclipse PAH 5μm, 4.6×150 mm from Agilent Technologies which was kept at 25°C. The mobile phase consisted in two solvents: water (A) and an organic solvent Acetonitrile (B) in different proportions. The UV detector was set at 254 nm and the FLD detector was set at different wavelenghts appropriate for each compound.

Preparation of standards and samples

A stock solution of 200 ng/ml was prepared from an ampoule of PAH Mix. The standard solutions for calibration curves were made in dark glass volumetric flasks of 5 ml using 2 pipettes of 1 and 5 ml. The working standards for calibration curves were developed in Acetonitrile at a 5-60 ng/ml concentration range. A spiked sample of 50ng/ml concentration was extracted by liquid liquid extraction method according to SR EN ISO 17993.

Results

In order to obtain the retention times for each compound, a standard solution of 100ng/ml was injected into the system. A mobile phase of A/B 50:50 v/v were A represents water and B Acetonitrile was used. According to the application note of the column the flow was first set at 2 ml/min. The UV detector was set at 254 nm and the elution order and the retention time of the compounds were established. Due to the fact that the compound eluted very closely one from another the flow rate was set at 1.6 ml/min. This change was made in order to assure adequate resolutions between the compounds to allow an eventually changing in the wavelengths of FLD detector.

Taking in account the solubility of each compound in water, the mobile phase was improved (Table 1). The elution of PAHs takes place in the 1-5 steps. The 6th and 7th steps assure the column conditioning back to the mobile phase gradient used in 1st step.

The FLD detector wavelengths (Table 2) were established. The changes induced by column temperature were evaluated in a 15-40°C range. The most adequate temperature was proved to be 25°C and was used further in the study.

The chromatogram obtained for 60ng/ml standard solution by FLD detector using the gradient program for mobile phase (Table 1) and the wavelengths program described in Table 2 is presented in Figure 1.

Calibration curves for all 15 PAHs were obtained. In Figure 2 is presented the calibration curve of Benzo[*a*]pyrene one of most representative PAH respectively.

Table 1. Gradient program for PAHs separation by HPLC

No.	Time (min.)	Flow (ml/min)	Water A(%)	Acetonitrile B (%)
Step 1	1	1,6	55	45
Step 2	5	1,6	40	60
Step 3	15	1,6	10	90
Step 4	4	1,6	0	100
Step 5	2	1,6	0	100
Step 6	6	1,6	55	45
Step 7	17	1,6	55	45

Table 2. Wavelengths program for PAHs determination by HPLC

Compound		Wavelength (nm)		Time (min)	Gain*
		Excitation	Emission		
1. 2. 3.	Naphthalene Acenaphthene Fluorene	224	330	0	3
4.	Phenanthrene	254	402	9.9	3
5. 6.	Anthracene Fluoranthene	237	440	10.9	4
7. 8. 9. 10. 11. 12.	Pyrene Benz[a]anthracene Chrysene Benzo[*b*]fluoranthene Benzo[*k*]fluoranthene Benzo[*a*]pyrene	270	390	13.4	3
13. 14.	Dibenz[*a,h*]anthracene Benzo[*ghi*]perylene				4
15.	Indeno[1,2,3-cd]pyrene	300	500	27.4	3

*Gain order ranges from 1-5 where 1 is the highest and 5 is the lowest.

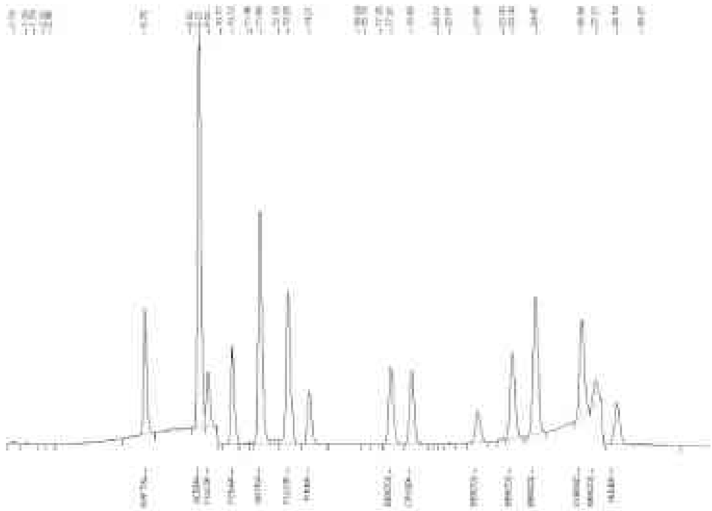

Figure 2. Benzo[*a*]pyrene calibration curve for 5-60ng/ml concentrations range

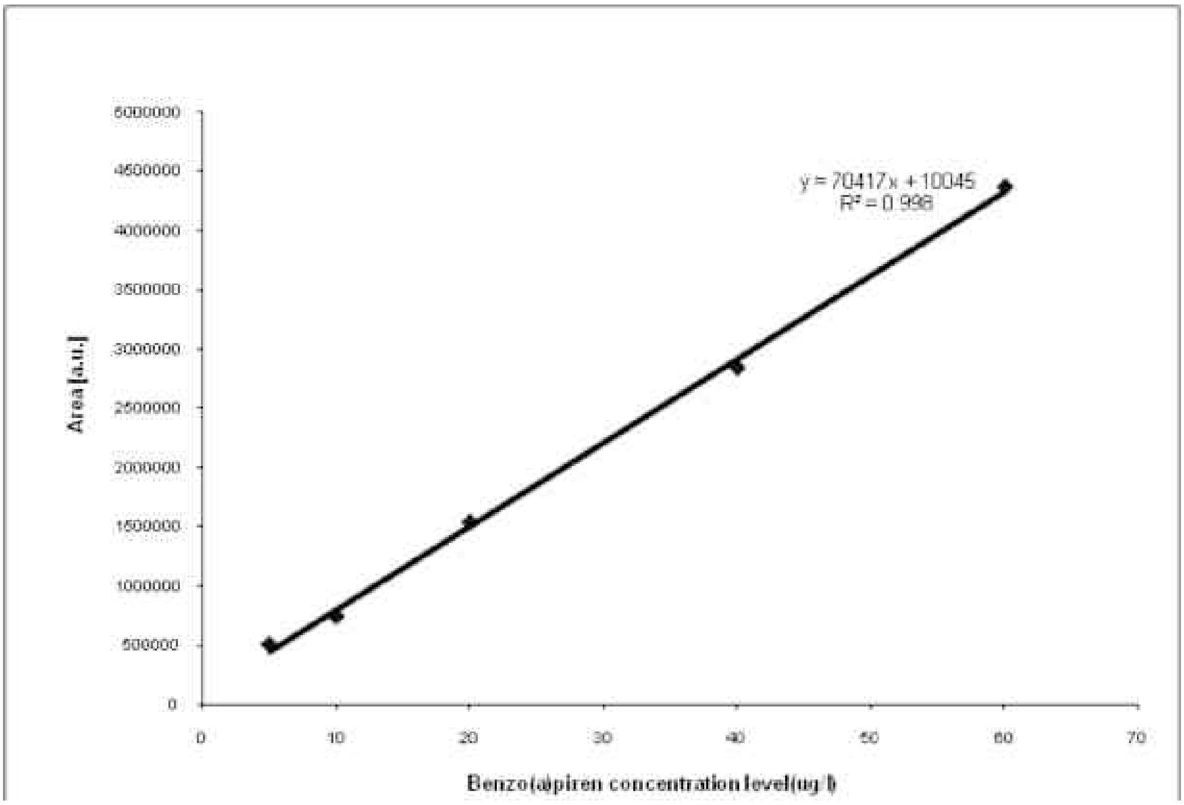

Figure 2. Benzo[*a*]pyrene calibration curve for 5-60ng/ml concentrations range.

Using the method developed earlier and the calibration curves obtained for each compound, a spike sample with a 50ng/ml concentration was extracted and injected into the HPLC system. The recovery ranges for each compound are presented in Table 3.

No.	Compound	Recovery range (%)	Recovery (%)
1	**Naphthalene**	[88.3-95.4]	92.1
2	**Acenaphthene**	[50.9-55.3]	53
3	**Fluorene**	[52.4-58.7]	56.6
4	**Phenanthrene**	[83.3-88.6]	85
5	**Anthracene**	[61.1-66.9]	63
6	**Fluoranthene**	[58.4-63.7]	60
7	**Pyrene**	[69.4-73.3]	71.3
8	**Benz[a]anthracene**	[61.7-65.2]	64.3
9	**Chrysene**	[67.4-71.7]	69.1
10	**Benzo[*b*]fluoranthene**	[102.3-107.5]	105
11	**Benzo[*k*]fluoranthene**	[75.4-80.1]	78.3
12	**Benzo[*a*]pyrene**	[84.9-88]	86.3
13	**Dibenz[*a,h*]anthracene**	[65.2-69.1]	67.6
14	**Benzo[*ghi*]perylene**	[64.4-69.7]	66.9
15	**Indeno[1,2,3-cd]pyrene**	[82.4-86.7]	84.3

Conclusions

All 15 prioritary PAHs were indentified and quantified with the HPLC developed method. The concentration levels for the calibration curves were selected based on bibliographic studies. The correlation factor for Benzo[*a*]pyrene calibration curve R=0.998 which proves that the calibration curve is reliable for further sample analysis. The spiked sample extracted and measured has proved to have recoveries for all compounds between 53 and 105.

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HYDROSTATIC TRANSMISSION WITH MIXED ADJUSTMENT

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Abstract:
This paper deals with the analysis of a hydrostatic transmission with mixed adjustment [2],[4],[10], existent in the laboratory of INOE 2000-IHP Bucharest, which includes in its primary sector a MOOG servo pump, and in its secondary sector a BOSCH servo motor. The original aspects of the paper consist in:
- development of simulation models in AMESim [6], specific to pump and transmission;
- development of a virtual interface for the adjustment model of transmission;
- validation of the adjustment model of hydrostatic transmission through successive iterations of numerical simulations and experimental identifications, developed by alternative coupling of the virtual interface at the numerical simulation network, respectively at the physical laboratory model [1],[3].

Keywords: hydrostatic transmission, AMESim, LabVIEW

1. Introduction

Latest trends in modeling and simulation of dynamic systems regard new concepts, such as co-simulation and real-time simulation.

The concept of real-time simulation of dynamic systems allows simultaneous existence of both a part of a mathematical model, and a part of a physical model, thus obtaining a decrease of the degree of uncertainty, caused by certain phenomena neglected in the mathematical model [5].

Co-simulation involves simultaneous use of resources from multiple modeling /simulation environments, with the opportunity to enjoy maximum performance of each environment [7].
The article presents an actual example of achieving a numerical co-simulation network based on two programs: AMESim and LabVIEW. With AMESim program a hydrostatic transmission model was developed, while analysis of data obtained from simulations in AMESim has been performed with virtual instrumentation, by means of LabVIEW software.
Simultaneous use of the two simulation/ programming environments, AMESim and LabVIEW, can lead to the development of an advanced modeling / simulation network of electro hydraulic systems [8]. The objectives of this paper consist in development of the basic model of a simulation network for a hydrostatic transmission with mixed adjustment [9], development of simulation models for MOOG servo pump and hydrostatic transmission, integration of servo pump's model with the simulation model of hydrostatic transmission with mixed adjustment, development of virtual interface of the adjustment model of hydrostatic transmission, optimization and validation of the adjustment model of transmission through successive couplings of virtual interface to the modeling/simulation network and to the physical laboratory model.

The main characteristics of the two adjustable volumetric machines from the primary and secondary sectors of transmission are the following:
a) for the adjustable radial piston MOOG type pump within the primary sector of hydrostatic transmission: rotational speed n=1500rpm; interior radius of the adjustment ring R=0.155m; radius of the cylinder module r=0.15m; excentricity e=0..5mm; diameter of a radial small piston d_p=20mm; maximum capacity $V_{p\,max}$ = 32 cm^3/rev.

b)for the hydraulic adjustment servomechanism of pump capacity: diameter of small piston d=25mm; diameter of large piston D=31.5mm; inertial mass of the two pistons and adjustment ring M_i=3Kg; minimum supply pressure of servomechanism P_{min}=20bar.
c) for BOSCH hydraulic servo motor within the secondary sector of hydrostatic transmission: minimum capacity $V_{m\,min}$ = 7 cm^3/rev; maximum capacity $V_{m\,max}$ = 28 cm^3/rev.

2. Basic model of a simulation network of hydrostatic transmission

Simulation model includes a numerical simulation network of a hydrostatic unit that operates as a pump (Moog - RKPD / radial piston pump) and a simulation network of a hydrostatic transmission in open circuit made of two units of adjustable capacity.

The analyzed hydrostatic transmission, with secondary adjustment, with single consumer of type rotary volumetric motor, adjustable, according to figure 1, includes:

- **in the primary sector**: a MOOG servo pump, place 1, with radial pistons and integrated electronics, with three loops of adjustment, that is in flow, in pressure, in flow and pressure; an electric motor for servo pump actuation, of constant rotary speed, place 2; a pressure limiting valve, place 3; a flow transducer, place 4; and a pressure transducer, place 5.
- **in the secondary sector:** a BOSCH servo motor, place 7, with axial pistons, tilted block and integrated electronics, a torque transducer place 8; a speed transducer, place 9; an axial piston pump, with tilted block and fixed capacity place 10, to simulate the load of hydraulic servo motor, two pressure transducers, place 11 and place 13; four way-valves, place 12, fitted on load suction / repression side of pump; a pressure adjustment valve, with electric control, place 14 for adjusting load of hydraulic servo motor.
- **a** PXI-NATIONAL INSTRUMENTS **block**, place 6, which provides a virtual interface of the adjustment process of capacity of the adjustable volumetric machines (LabVIEW / PXI).

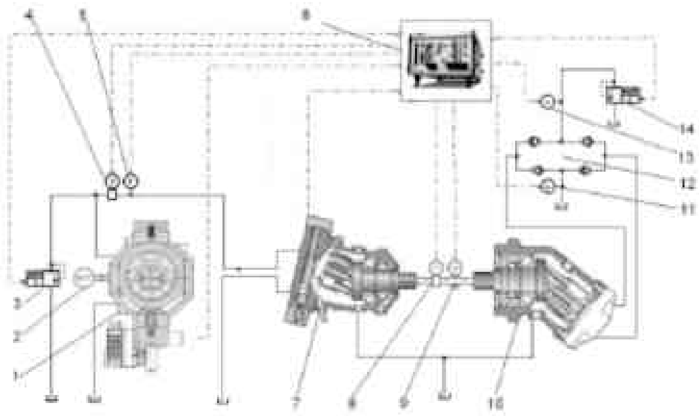


Fig. 1. Simulation network of a hydrostatic transmission – basic model.

3. Numerical simulation of radial piston pump type MOOG-RKP

Simulation model developed for the analysis of volumetric pump is shown in figure 2. It includes: the hydraulic servomechanism for prescribing the position of the adjustment ring; a module for calculating the relative position of small pistons as against to their angular position and the ordered eccentricity; the two small radial pistons of the pump; the distribution unit, controlled by the angular position of small pistons and the geometrical characteristics of the distribution flange.
By means of the modeling network developed, static characteristics were determined, Figure 3, and dynamic ones, Figures 4 and 5, of the servo motor that adjusts capacity of the analyzed radial piston pump. The model was excited with control signals (prescribing of eccentricity of the flow adjustment / control ring), sinusoidal, rectangular and ramp type signals, of various amplitudes and frequencies. The results are compared, simulated and experimentally shown. Simulation model has been "tuned" as a result of the comparative analysis between simulated and experimental response for a better accuracy of results.

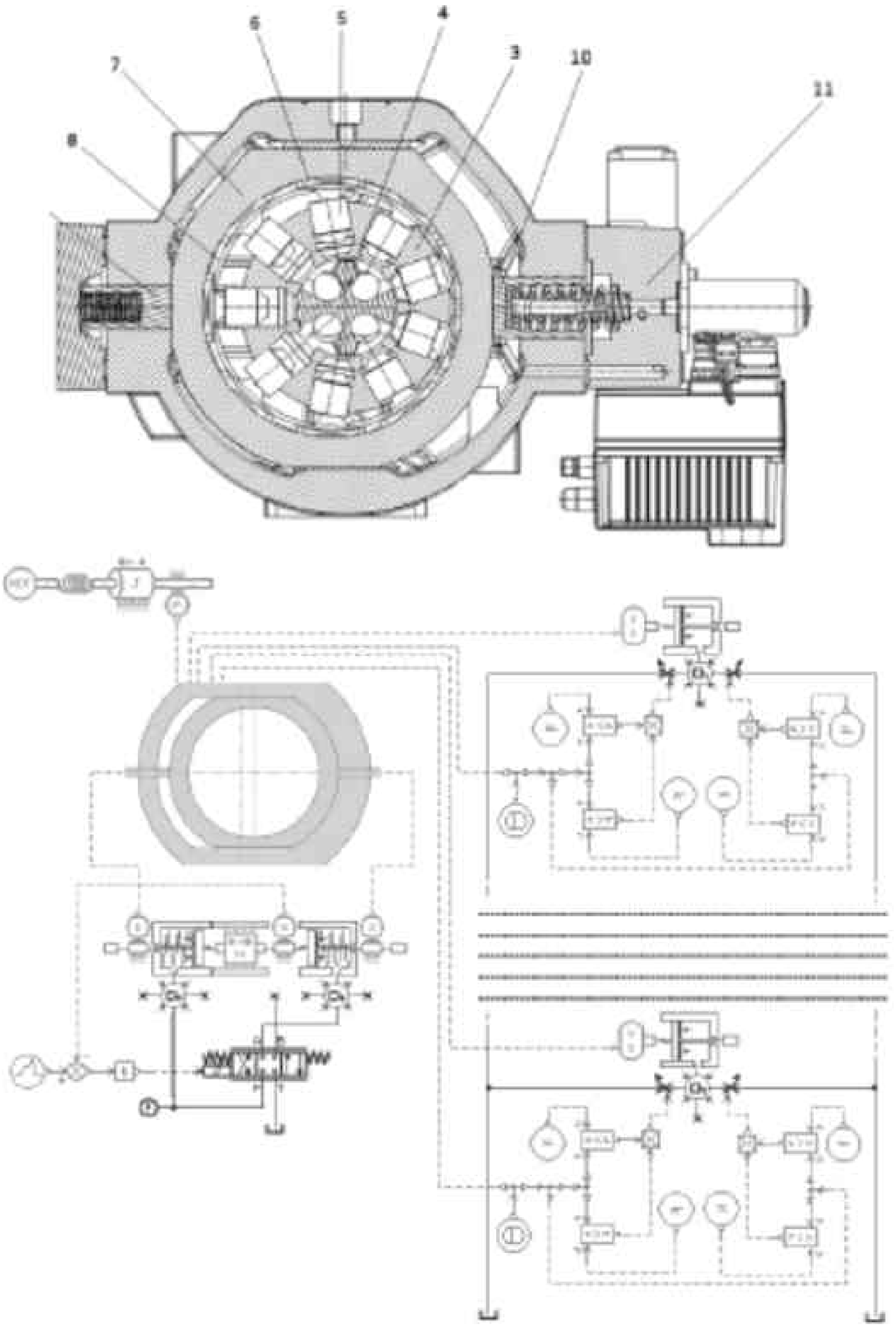


Fig. 2. Servo pump MOOG type RKP: above- cross-section; below- numerical simulation network.

Figure 3 shows, in percentages, dependence between the input and output of the hydraulic servomechanism that adjusts pump capacity, respectively between the eccentricity developed and the one prescribed for the capacity adjustment ring. Curve 1 represents the stationary characteristic of the adjustment servomechanism obtained by numerical simulation, and curve 2 the same characteristic obtained on an experimental basis. Servomechanism was subjected to a control voltage (V), ramp type, with frequency of 0.05 Hz.

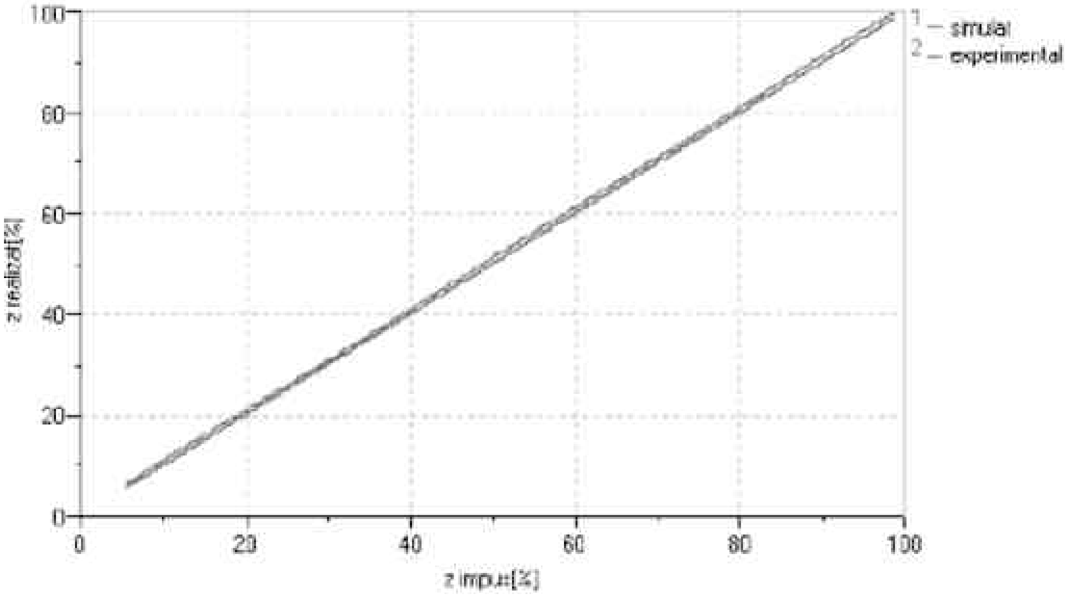


Fig. 3. Stationary characteristic of hydraulic servomechanism that adjusts capacity of pump MOOG-RKP

In Figures 4 and 5 curve 1 represents the control signal, curve 2 response of servomechanism that adjusts capacity, obtained through numerical simulation, and curve 3 response of servomechanism that adjusts capacity, obtained on an experimental basis.

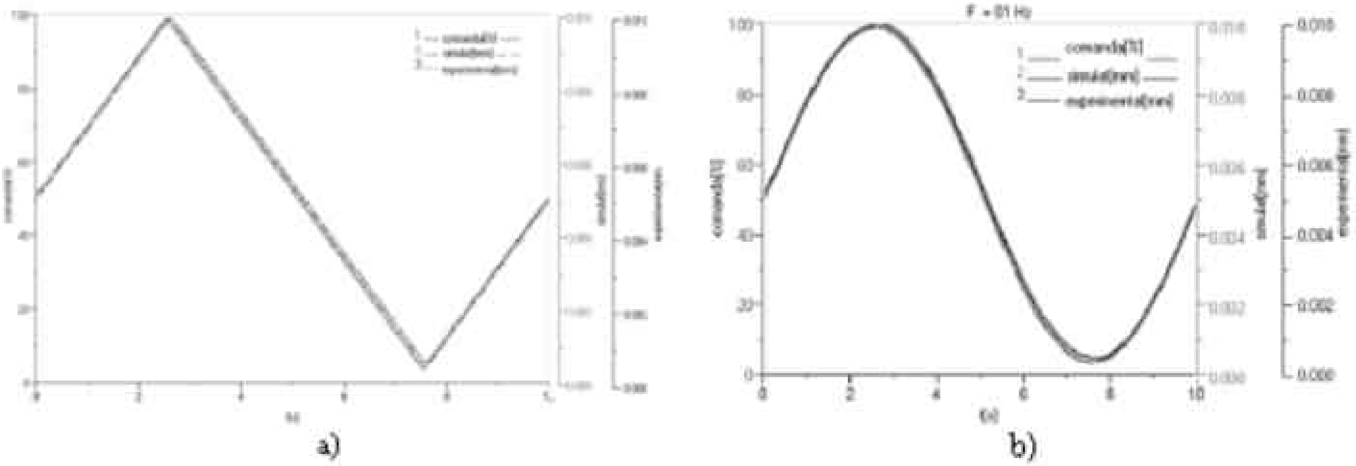


Fig. 4. Response of the adjustment servomechanism to control triangular, a) and sinusoidal, b) signals (f=0.1 Hz).

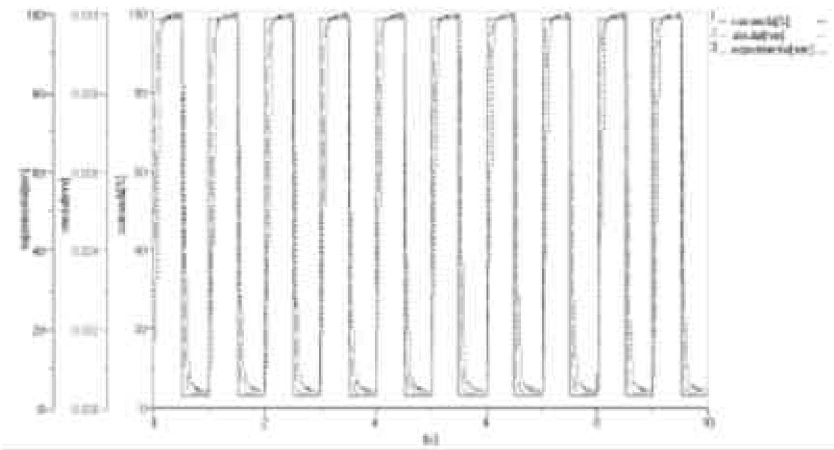


Fig. 5. Response of the adjustment servomechanism to control rectangular signal (f=1 Hz).

4. Detailed model of numerical simulation of a hydrosatic transmission; virtual interface of the adjustment model

Model of volumetric radial piston pump has been integrated to the simulation network of hydrostatic transmission. Transmission includes hydrostatic unit which operates as a pump, volumetric motor of adjustable capacity and module consisting of hydrostatic pump of fixed capacity, pressure limiting valve and block of way-valves, module which is used as hydrostatic load. The hydraulic system is controlled by the process computer NI-PXI. By means of this one various adjustment schemes of transmission parameters can be implemented. For the analyzed case a feed-forward compensator with inclusive correction has been used.

Application implemented on the digital system is a co-simulation model AMESim/ LabVIEW, model developed in AMESim by simulating hydraulic and mechanical components of the process, and the software component – the numerical adjustment part. Co-simulation process allows coupling of the software control component to the simulated model of the process for a preliminary tuning of regulator parameters, these being still used as reference sizes for the stage of fine-tuning performed on the experimental stand.

Figure 6 shows the detailed model of numerical simulation network for mixed adjustment hydrostatic transmission, developed by means of AMESim program, and in Figure 7 virtual interface of the adjustment model of transmission, developed using LabVIEW software and a PXI-NATIONAL INSTRUMENTS module.

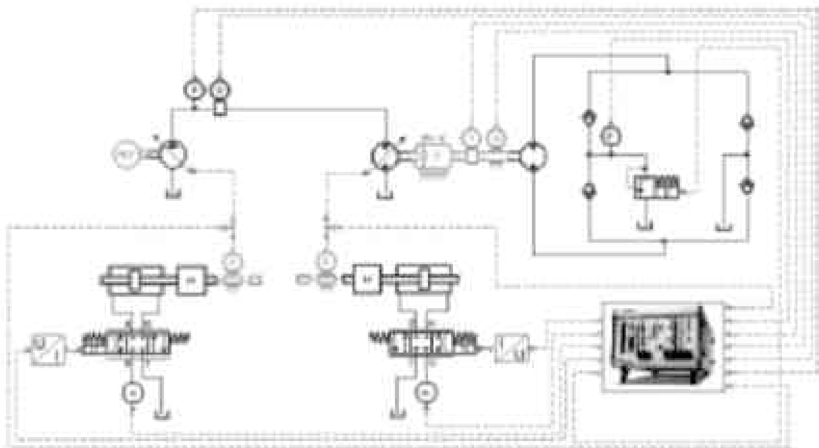


Fig. 6. Numerical simulation network of hydrostatic transmission – detailed model

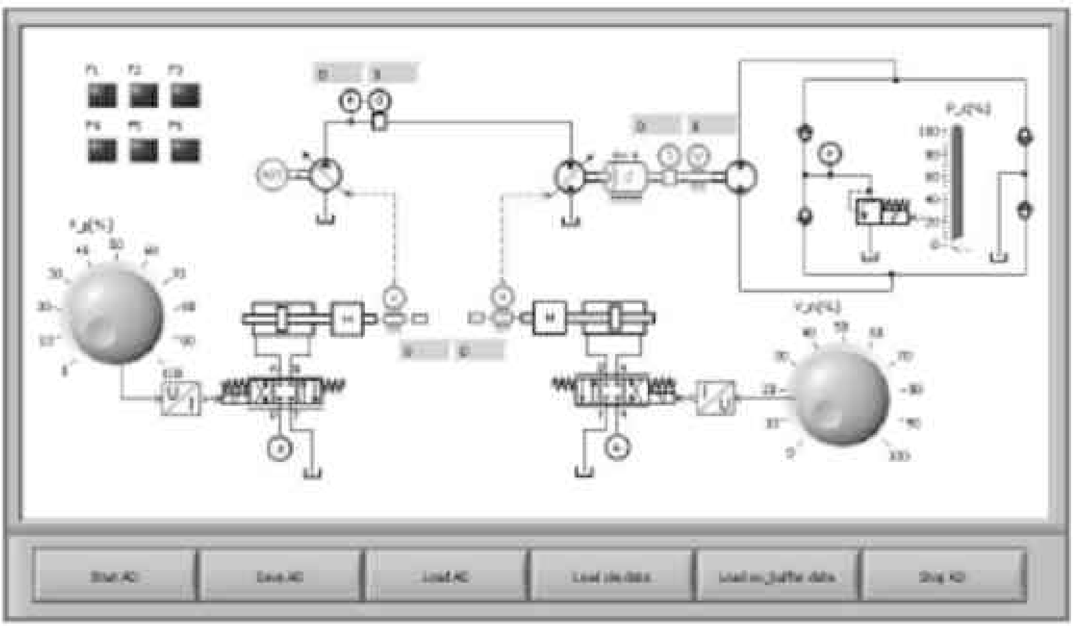


Fig. 7. Virtual interface of the adjustment model (LabVIEW / PXI).

The software application contains a module for conveying experimental results collected on the stand via the Internet using a web page. The online application also allows control of process parameters, capacity of volumetric pump, motor capacity and pressure within the load circuit. Figure 8 shows the web interface for the adjustment model of transmission with mixed adjustment, and in Figures 9, 10 and 11 components of the laboratory model on which experimental measurements have been performed.

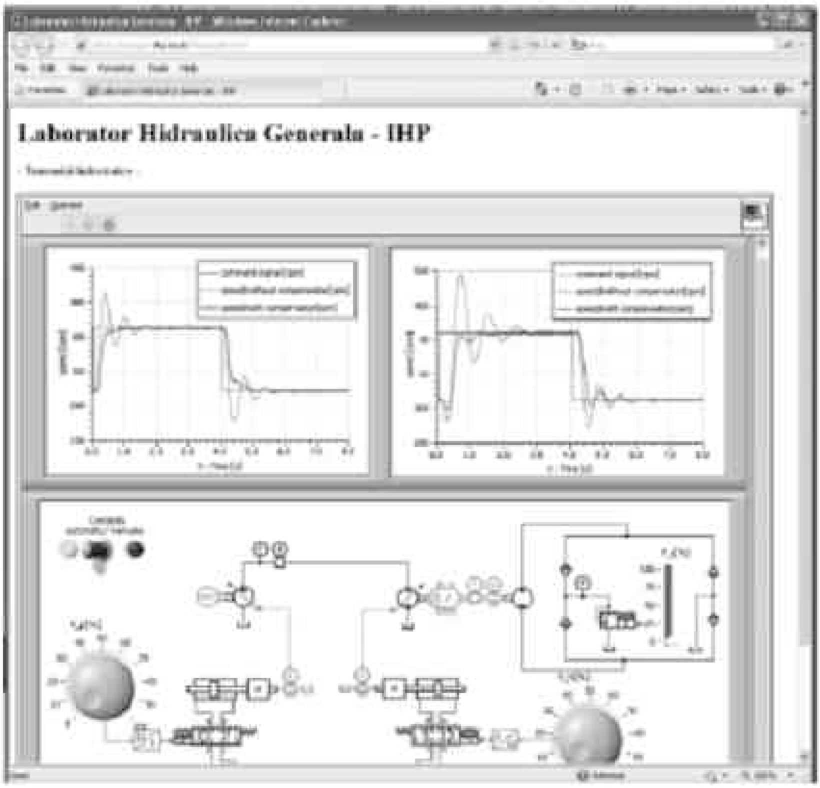


Fig. 8. Web interface of the adjustment model (LabVIEW / PXI).

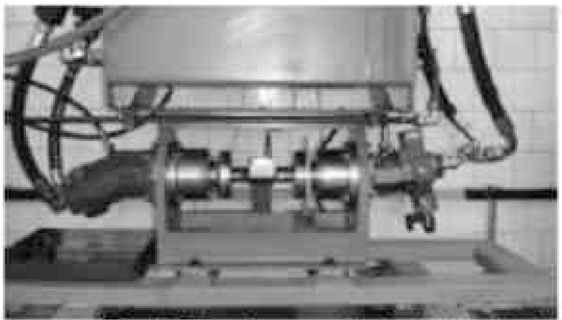


Fig. 9. Fixed pump for load simulation and Bosch adjustable motor within the secondary sector of hydrostatic transmission.

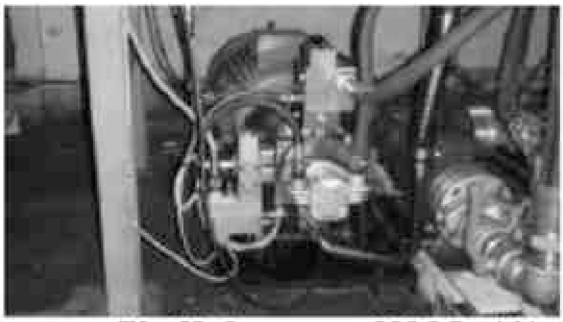
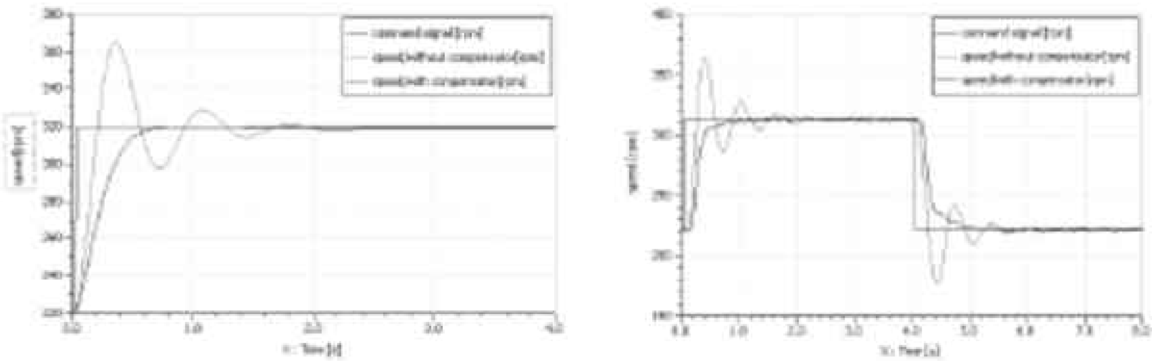


Fig. 10. Servo pump MOOG within the primary sector of hydrostatic transmission.

Fig. 11. Secondary sector of hydrostatic transmission – laboratory model.

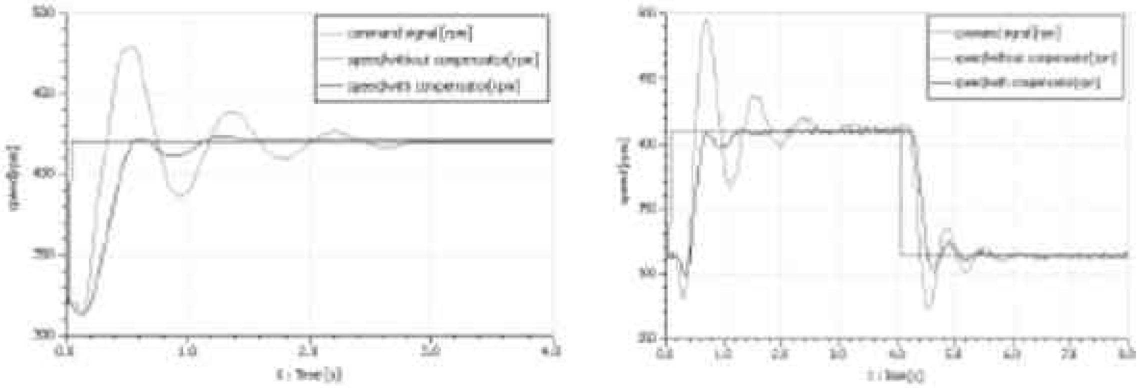
5. Validation of the adjustment model of mixed adjustment hydrostatic transmission

Validation of the adjustment model is confirmed by the shape of characteristic curves experimentally raised, by coupling LabVIEW/ PXI virtual interface to a physical model developed in the laboratory, equivalent to AMESim simulation model. One can notice comparable dynamics, theoretically and experimentally identified, of the adjustment system of hydraulic transmission. Obtaining adjustment models for other configurations of hydraulic transmissions, with primary, secondary or mixed adjustment, can be treated as a customization of this model developed.



a) b)

Fig. 12. Response of the adjustment system of rotational speed of hydraulic motor to step type excitation signal – pump capacity drive: a) simulated; b) experimental.



a) b)

Figure 12 shows comparatively the responses of the adjustment system of rotational speed of hydraulic motor Bosch within the secondary sector of hydrostatic transmission with mixed adjustment to a step-type excitation signal, when the command is applied to the hydraulic servomechanism that adjusts capacity of MOOG pump within the primary sector of transmission, responses obtained by numerical simulation and on an experimental basis, with and without error compensation.

Figure 13 shows comparatively the responses of the adjustment system of rotational speed of hydraulic motor Bosch within the secondary sector of hydrostatic transmission with mixed adjustment to a step-type excitation signal, when the command is applied to the hydraulic servomechanism that adjusts capacity of this motor, responses obtained by numerical simulation and on an experimental basis, with and without error compensation.

6. Conclusions

a) The application was performed by co-simulation, modern concept that uses simultaneously multiple modeling languages within the same simulation network.
b) Use of this method of analysis is particularly useful in the development and design stages of complex automated systems, providing a rapid solution to identify characteristics of analyzed system.
c)By using advanced modeling and experimental identification procedures superior dynamic performance can be obtained for hydrostatic transmissions.
d) Virtual interface of the adjustment model (LabVIEW / PXI) of hydrostatic transmission allows tuning of the system by successive iterations of simulations performed in AMESim, and data processing, performed in LabVIEW. It can alternatively be coupled to the laboratory physical model or to the simulation network in AMESim.
e) Web interface of the adjustment model (LabVIEW / PXI) allows remote control of hydrostatic transmission, i.e. laboratory testing of transmission also by persons outside the testing laboratory.

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ADAPTIVE HYDRAULIC TRANSMISSION DESIGNED FOR LOW POWER HORIZONTAL-AXIS WIND TURBINES

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Abstract

Low power horizontal-axis wind turbines equipped with adaptive hydraulic transmissions can operate at variable speed. The adaptive hydraulic transmission allows adjustment of the outlet to the consumer demands (power or constant speed), without affecting the performance of the turbine. Adaptive hydraulic transmission requires a constant speed of the motor shaft during variations in pump speed at the hydraulic motor shaft. For the cases analyzed, it is found that the adaptive hydraulic transmission behaves like a stable system of damped oscillatory type with good dynamic performance. The proper tuning of the regulator leads to an improved unit step response. The socio-economic impact of implementing low power wind turbines will be amplified by the fact that nearly half of the country's population lives in rural areas. These turbines are designed specifically for these rural areas.

1. Introduction

The difficulty of transmitting and converting the potential of wind power, the energy level of which is relatively low (numerous areas), is limited by technical possibilities and energy performance of the conversion, transmission and practical use by different types of consumers. It is, essentially, about increasing the extraction capacity of primary energy and the use of this energy by the consumers as a source of mechanical energy. Mechanical energy can be used as such, or can be converted into electric, hydraulic or pneumatic energy, according to necessities and the parameters of the primary energy.

Specialized studies and analyses concerning exploitable wind energy sources show that Romania's wind potential is about 14,000 MW, which can provide an energy quantity of about 23,000 GWh / year.

Applications with a lower potential of energy (bellow 50 kW) intended mainly for the electrification of remote rural areas offer real opportunities for the implementation of projects concerning exploitation of wind energy sources. Profitable use of wind energy requires active control of the wind turbine. Ground transmission of power by hydraulic means is used for medium power wind stations in Schiedam and Winsum.

The transmissions have only one customer and do not adapt to loading conditions.

Compared with electrical systems, hydraulic control systems are robust, reliable and have reduced dimensions, being easily able to achieve high power levels. Hydraulic control systems developed so far are mainly designed for large turbines controlled by changing the pitch. In recent years, there has been increased preoccupation with adapting these systems to the specifics of low power wind turbines (LPWT). New control strategies are needed, which have to be compatible both with the specific operating conditions of LPWT, and with the consumers supplied by these turbines.

Low power HAWT (horizontal-axis wind turbines) operate under moderate winds. To become profitable, it is necessary to increase the extraction rate, and the generated energy / installed power (kWh / year / installed kW) respectively.

Low power horizontal-axis wind turbines (HAWT) equipped with adaptive hydraulic transmissions can operate at variable speed. Researches in this direction aim at developing adaptive hydraulic transmissions (AHT) designed for low power HAWT. AHT allows adaptation of the output to consumer demands (power or constant speed), without affecting the performance of the turbine. It can operate at optimum drive until it reaches the power limit. If the outlet of the hydraulic transmission is provided with two power plugs, secondary plug can be connected to a storage system (production of heat, ice or hydrogen).

2. The model for the adaptive hydraulic transmission designed for low power horizontal-axis wind turbines

The block diagram for the adaptive hydraulic transmission designed for low power horizontal-axis wind turbines is shown in Figure 1.

Wind turbine TV transforms aeraulic power in mechanical power with parameters ω_1 (angular velocity) and M_1 (moment). The PDR pump with adjustable unit volume transforms mechanical power into hydraulic power (flow Q and pressure p). The hydraulic motor transforms hydraulic power into mechanical power transmitted to load S.

The feedback loop includes speed transducer TT which gives signal $U\omega$. This is compared with reference value U_r. At the outlet of the regulator R results the command value c. The servomechanism SVM transforms the command value into an execution value m, which acts on the pump flow control elements PDR.

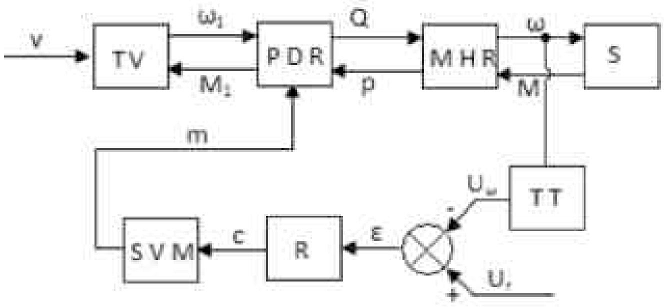

Fig. 1 Block diagram of the adaptive hydraulic transmission system

In the absence of the feedback loop, changes in wind speed *v* will increase pump speed, pump flow and therefore the drive speed of load *S* as well. Similarly, load variation leads to a decrease in motor speed.

The feedback loop, which depends on the value of the engine speed *MHR*, allows maintaining a constant speed imposed by the reference value U_r on the hydraulic motor shaft, under variations of both the wind speed and the load *S*. The adaptive system allows adjustment of two disruptive values: wind speed *v* and load *S* variation on the engine.

3. Demonstrative stand for adaptive hydraulic transmission designed for low power horizontal-axis wind turbines

Figure 2 shows the block diagram for the adaptive hydraulic transmission, designed for low power horizontal-axis wind turbines, highlighting the components.

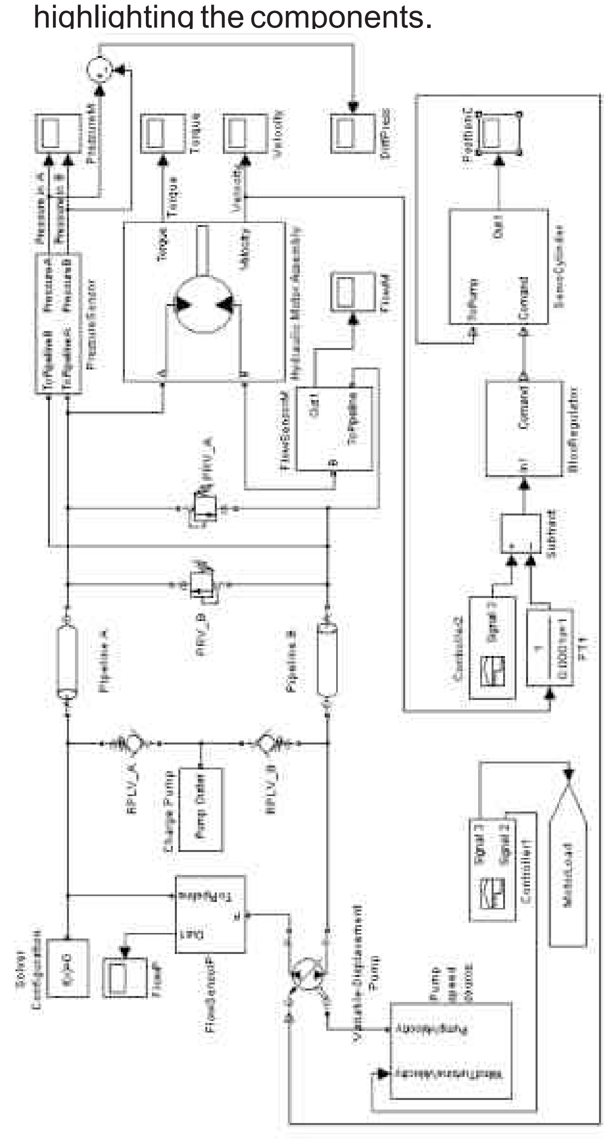

Fig. 2. Block diagram for the adaptive hydraulic transmission, designed for low power horizontal-axis wind turbines

The attempts regard the dynamic regime. Of interest are the unit step response of the regulating system under disruptive step values, and its track capacity respectively. The reference value is the motor shaft speed. The disruptive input values are the pump drive speed and the load at the work body, respectively.

The adaptive hydraulic transmission determines a constant speed at motor shaft ωM = cst. imposed as reference value for step variations of the pump speed and load step variations at the hydraulic motor shaft.

4. Unit step responses of the adaptive hydraulic transmission at load charging of the hydraulic rotary motor

Figures 3, 4, 5, 6 present unit step responses corresponding to angular velocity variations ωM(t) in the hydraulic motor, pump flow rate with unitary variable volume QP(t), the stroke of the pump control element c(t) and pressure drop on the hydraulic motor Δp(t) at step changes in the charging of the hydraulic rotary motor with load M..

Figure 3 shows the unit step response of hydraulic motor shaft speed under a constant pump speed ωP = cst. at the pump shaft and two load variations ΔM1, ΔM2.

It can be observed that at the occurrence of the load step the response type is a periodically damped one, being stabilized on the size of the reference value; the stabilization time is less than one second. At load changes, the variation tendency of the motor speed detected by the speed gauge is transmitted as a reaction signal to the servomechanism. This then modifies the stroke of the command element of the pump with adjustable flow. An increase in load initially leads to a decrease in speed, the stroke of the pump's control element is modified by an increase in the flow. The speed error is corrected. Motor shaft speed remains constant.

There is a tendency of the motor speed to decrease when the load is increased, after which the motor speed returns to the reference value. The system is stable, of a damped oscillatory type.

The dynamic regime analysis shows that override δ,, length of the transitional regime Tv and rise time Tc increase with the size of the load variation.

Figure 4 shows the unit step response of the pump flow QP(t) for constant speed at the pump inlet ωP = cst. There are considered two step variations ΔM1 and ΔM2 of the load at hydraulic rotary motor shaft.

It is observed that an increased load causes the pump flow to increase. Thus, the hydraulic motor feeding flow is increased, which offsets the declining tendency of the speed.

Figure 5 shows the unit step response of stroke c(t) variation of the control element for the pump capacity. The reference value imposed for ωM remains constant. The tests are conducted for two values of the load variation ΔM1 and ΔM2.

Figure 6 presents the unit step response for the pressure drop Δp(t). The reference value ωM remains constant. There are considered two load variations ΔM1 andΔM2. It is observed that Δp on the hydraulic rotary motor rotating increases with the load increase.

Proper tuning of the regulator can lead to an improved response from the system.

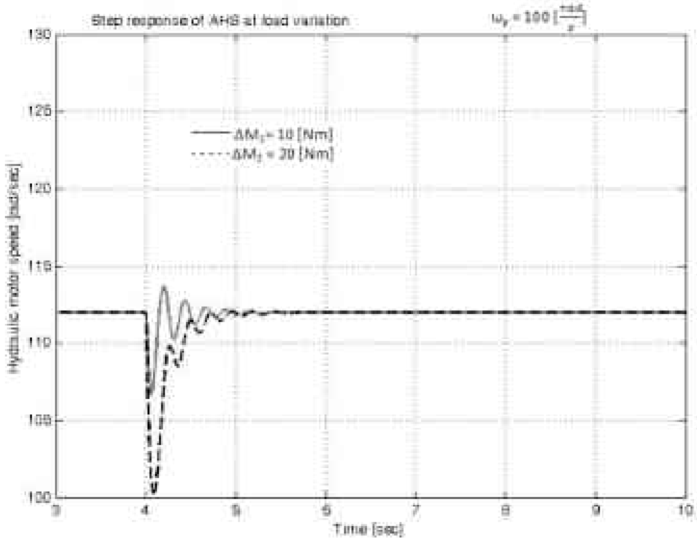

fig.3

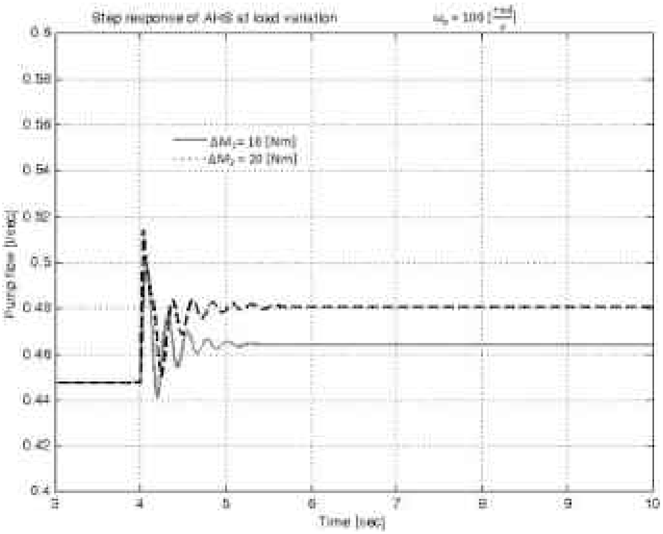

fig.4

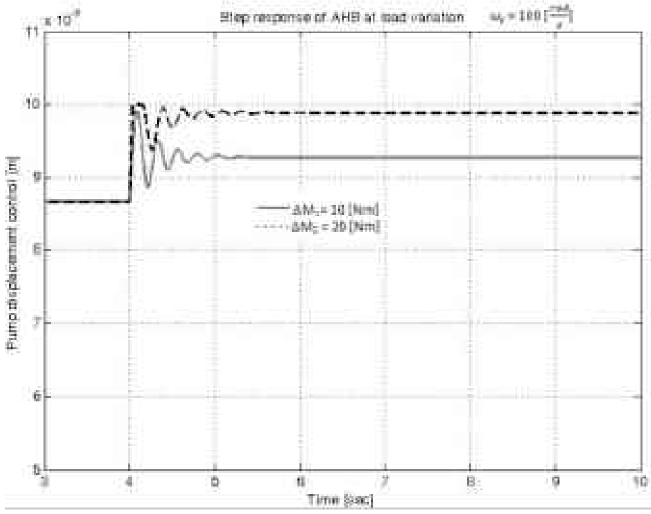

fig.5

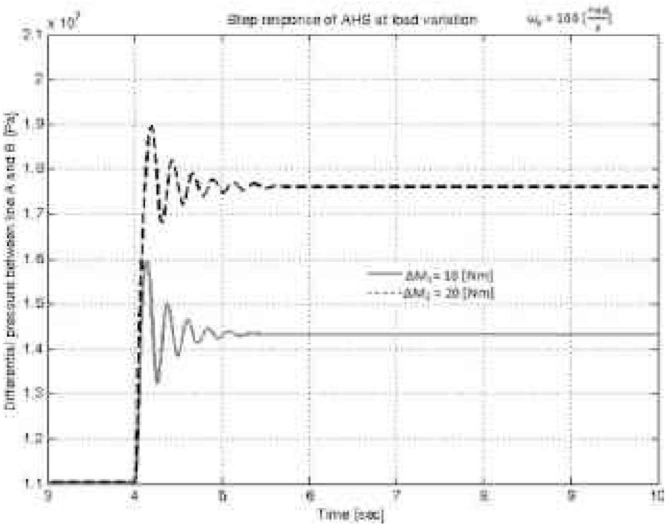

fig.6

5. Unit step responses of the adaptive transmission at variations in the driving speed of the hydraulic pump

Figures 7, 8, 9, 10 present unit step responses corresponding to angular velocity variations $\omega M(t)$ in the hydraulic motor, pump flow rate with unitary variable volume $QP(t)$, the stroke of the pump control element $c(t)$ and pressure drop on the hydraulic motor $\Delta p(t)$ at step changes in pump speed.

The adaptive hydraulic transmission requires a constant speed of the motor shaft ωM = cst. at fluctuations of the pump speed. Figure 7 shows the unit step response of hydraulic motor shaft speed under a constant load M at the hydraulic rotary motor and two variations in the pump speed $\Delta P1$, $\Delta P2$.

It can be observed that at the occurrence of step speed the response type is a periodically damped one, being stabilized on the size of the reference value. At pump speed changes, the variation tendency of the hydraulic motor speed detected by the speed gauge is transmitted as a reaction signal to the servomechanism that modifies the stroke of the pump's command element. An increase in pump speed initially leads to a flow increase, the stroke of the pump's control element is modified by decreasing the flow and correcting the speed error, respectively. Motor shaft speed remains constant.

The step response analysis shows that there is a tendency of the motor speed to increase when speed is increased, after which the motor speed returns to the reference value. The system is stable, of a damped oscillatory type.

Figures 8, 9, 10 show unit step responses of the $QP(t)$ pump flow, of the $c(t)$ stroke of the control element and of pressure drop on the hydraulic motor $\Delta p(t$.

The dynamic system analysis shows that the system is stable, of a damped oscillatory type. When the speed is increased, the stroke of the control element decreases. Proper tuning of the regulator can lead to an improved response from the system.

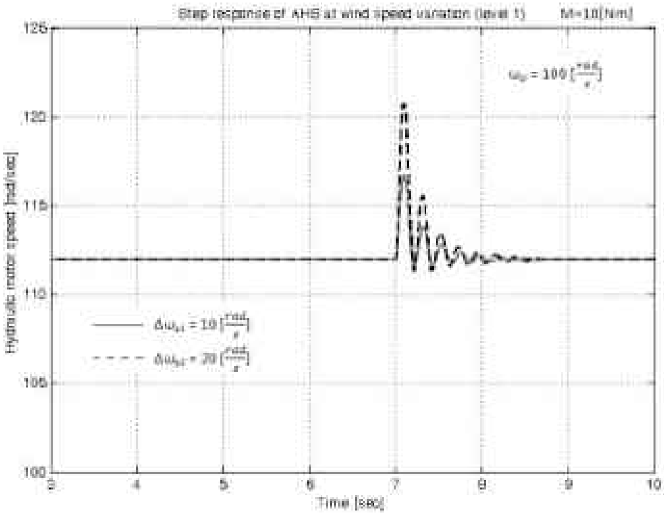

fig.7

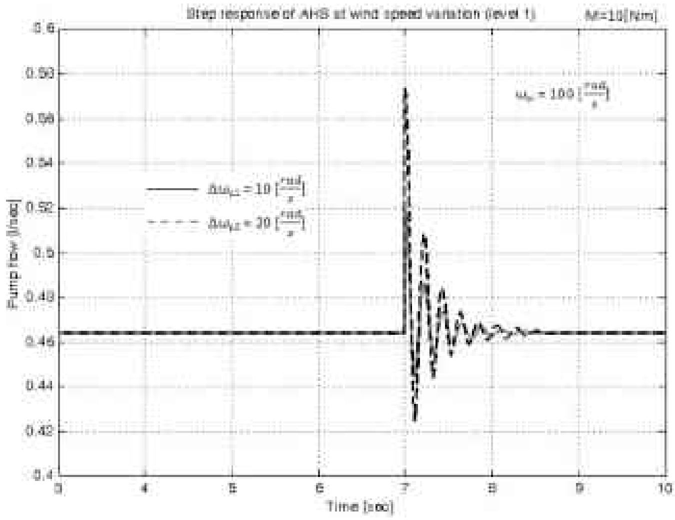

fig.8

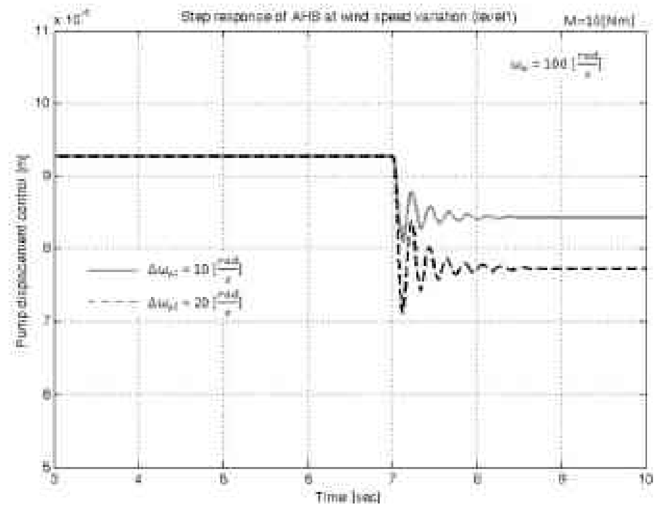

fig.9

6. Conclusions

The adaptive hydraulic transmission requires a constant speed of the motor shaft ωM = cst., imposed as a reference value for step fluctuations of the pump speed and load variations in the hydraulic motor shaft. For the cases analyzed, it is found that the adaptive hydraulic transmission behaves like a stable system of damped oscillatory type with good dynamic performance. The socio-economic impact of implementing LPWT will be amplified by the fact that nearly half of the country's population lives in rural areas, and LPWT are designed specifically for these areas.

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***MATLAB Simulink http://www.mathworks.com/products/simulin

AUTOMATIC LUBRICATING PLANT

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Abstract:
The invention (for which a patent application was filled at the OSIM – application no. A/00346 29.04.09) is an automatic lubricating system used for lubricating the shafts of the butterfly valves and globe valves in the hydroelectric power plants. The tecnichal problem solved by this invention is the automatized lubrication of the valves, process which permits the sustained functioning of the system with no intervention of the operating personnel.

Key words:
PLC. Energy, butterfly valve, globe valve, progressive feeder, electropump

Innovation

The lubricating plant has the following advantages:

- Constructive simplicity
- High safety in exploitation
- High reliabil ity
- Can be used for other types of applications

The system is made up of both hydraulic and electronic parts with high reliability and the control functions of the carrying out elements provided by a programmable automaton.

The automatic lubricating plant includes a main electropump framed by a grease reservoir, a progressive feeder and a programmable automaton

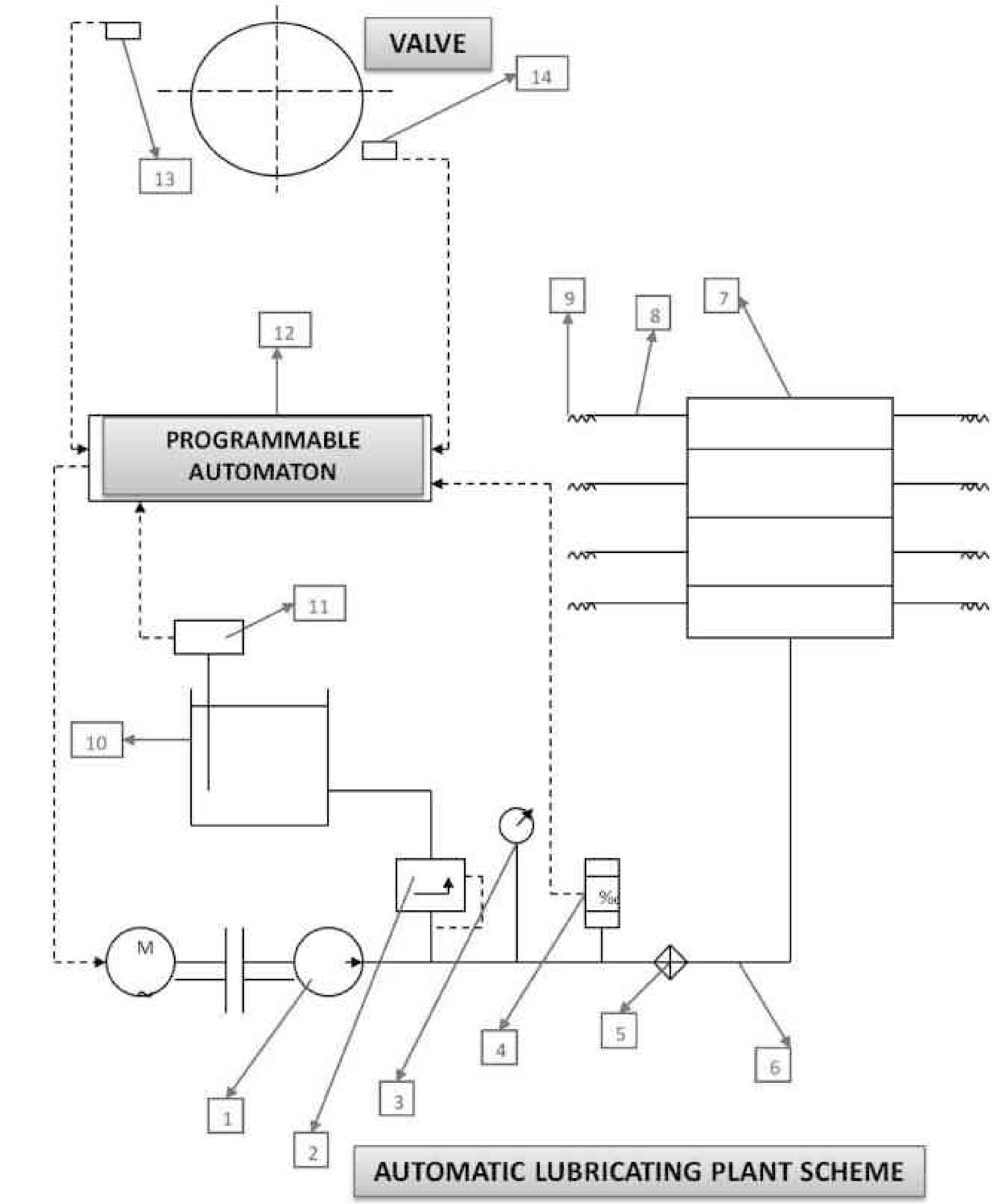
These are connected to both the main pump with level indicator and the pressure relay and to the position sensors installed on the channels of the valves.

The reservoir and the electropump are connected by a connection pipe fitted with a bypass valve that adjusts the pressure in the lubricating circuit.

The pipe is also fitted with a pressure gauge and a pressure filter for detaining the impurities in the lubricant.

The progressive feeder directs the lubricant to the shafts of the valves. The control and the monitoring of the system is established by a programmable automaton.

When the valves are opened/closed, the position sensors are activated by the programmable automaton .



Electropump (1)
Pressure valve(2)
Pressure gauge (3)
Pressure relay(4)
Pressure filter (5)
Connection pipe (6,8)

Progressive feeder (7)
Direction valve (9)
Reservoir (10)
Level indicator (11)
Programmable automaton (12)
Position sensors (13, 14)

A FEEDIND, MIXING AND DOSING DEVICE FOR SAWDUST USED AT PELLETS MILLS

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Abstract:
This article presents some aspects regarding the reduction of the negative impact generated by economical activities in the field of wood processing by realizing some equipments of pressed sawdust and refers mainly at the fuelling, dosage and homogenization mechanism which is a component part of the pellet grinders. The Fuelling, dosage and homogenization mechanism (picture 1) is installed on the pellet manufacture grinder is composed from a dosage device (position 1) and a fuelling and homogenization device (position 2).

Key words: pellets, waists, capitalizing, technologies, equipments

1. INTRODUCTION

Our country alignment to the ecological requests imposed by the UE environment standards, and the fulfillment of the assumed obligations by Romania early from the negotiation process in Chapter 22 of the communitarian acquis, demands the total elimination of wastes.

Romania, according to the official data, has a surface of forests of approximately 6.300 thousand ha, representing approx. 27% from the whole country surface. The forestry fund of Romania represents approx. 0,30 ha / inhabitant.

The regulations foreseen in the UE environmental legislation, namely to exploit the wood waste resulting from primary and secondary processing, can meet by placing stationary compacting equipments in the technological flux specific for the economical agents from this field.

The wood pellets are a approximately new fuel which appeared as a response to the new requests for using “clean” and regenerative energy.

These represent a cleaner alternative of domestic heating, and as the classic fuel prices are aligned to the European prices, it soon will become in Romania too a cheaper and in the same time a comfortable alternative.

Pellets are produced by pressing the sawdust resulted from the saw mill, from minced wood and in generally from the waste resulted from wood processing.
The pellet production in generally does not require any additives or binders due to existence of natural resins in the basic raw material.

2. TECHNOLOGY OF PELLET PROCESSING

The regulations included in EU legislation on environmental ecology on the almost full recovery of wood waste materials requires a processing technology for these wastes in order to have a efficient exploit. This technology includes:
- first a manual sorting, during which are removed the unwanted materials, such as: metallic objects, rocks, etc.;

- a mechanical separating operation , during which is selected only the wood waste with an optimum granulation for pelleting;
- an operation of wood waste pelleting;
- a packing in plastic bags, boxes, and wood or metallic containers, etc, for handling, storage and efficient transportations.

The packing operation brings to :

a) efficient handling of the pellet bales in the landfill and beyond it ;

b) possibility of bales storage vertically;

c) efficient transportation of waste bales to the consumers (a reduction of the transport by 5-25 for the same quantity of wastes) ;

d) growing the pellet quality by avoiding the contact with contaminant agents during transportation.

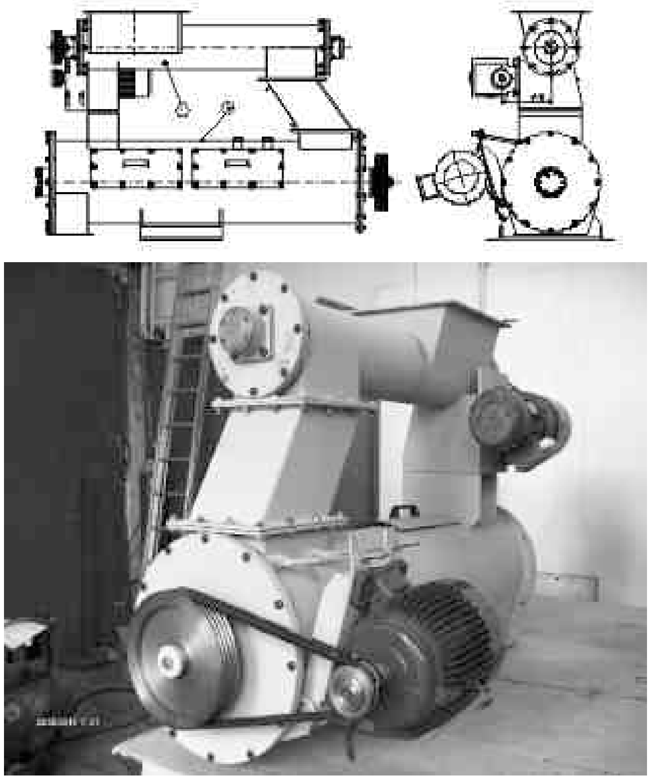
The technological flux for pellet production consists from: chopping and storing of wet sawdust; drying and storing the dried sawdust; pressing the sawdust for pelleting ; weighting and packing the pellets.

The technological flux contains the following main assemblies: Hammer mill; Pneumatically transporter; Sawdust drying installation; Snail transporter; Conditioning installation; Module for pellet pressing; Pellet evacuation transporter; Pellet elevator; Vibrating separator; Snail transporter; Pellet elevator; Exhausting unit; Pellet weighting machine; Automated packing machine; Electrical auctioning installation.

In a research project financed from research funds, will be realized a mechanism for fueling, homogenization and dosage of sawdust adapted for pellet manufacturing presses type CMP (California Pellet Mill)

3. DESCRIPTION OF THE FUELING, HOMOGENISATION AND DOSAGE MECHANISM.

The mechanism for fuelling, homogenization and dosage of sawdust adapted for a pellet manufacturing process type CMP (California pellet Mill) presented in picture 1 is composed from a dosage device (picture 1) and a fueling and homogenization device (picture 2).



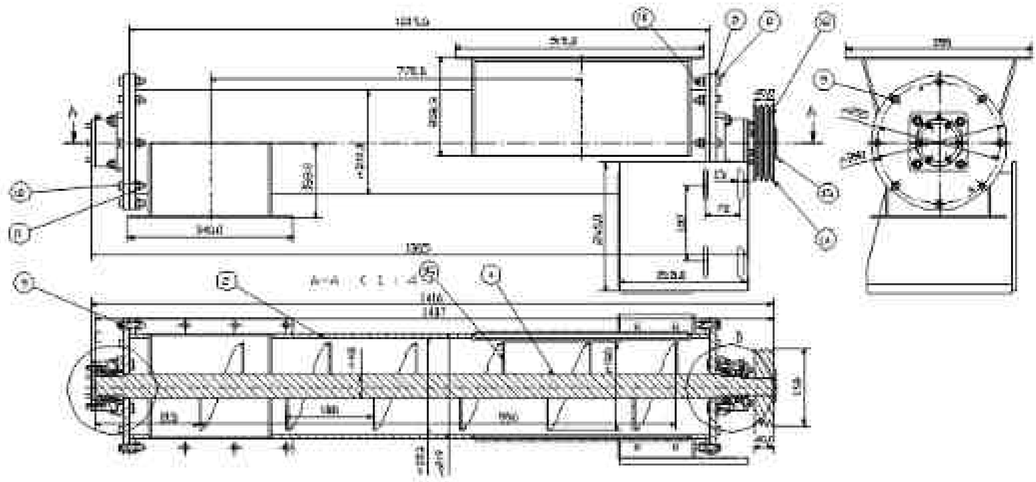
Picture. 1. Fuelling, homogenisation and dosage mechanism

The dosage device presented in picture 2 is composed from the following main assemblies: snec assembly (position4), snec body (position 2), bearings (position 1 and 3), motto-reducers (position 12), transmission V-belts (position 14).

The dosage device is fitted on the upper side of the pellet press and has the role of assuring a constant flow of sawdust according to the pressing capacity of the press.

The adjustment of the sawdust flow is made by changing the overall driving speed of the motto-reducer of the snec assembly with the help of the frequency converter.

The sawdust enters in the device by a superior trunk and is sent to the fuelling device and mixed by the inferior trunk.

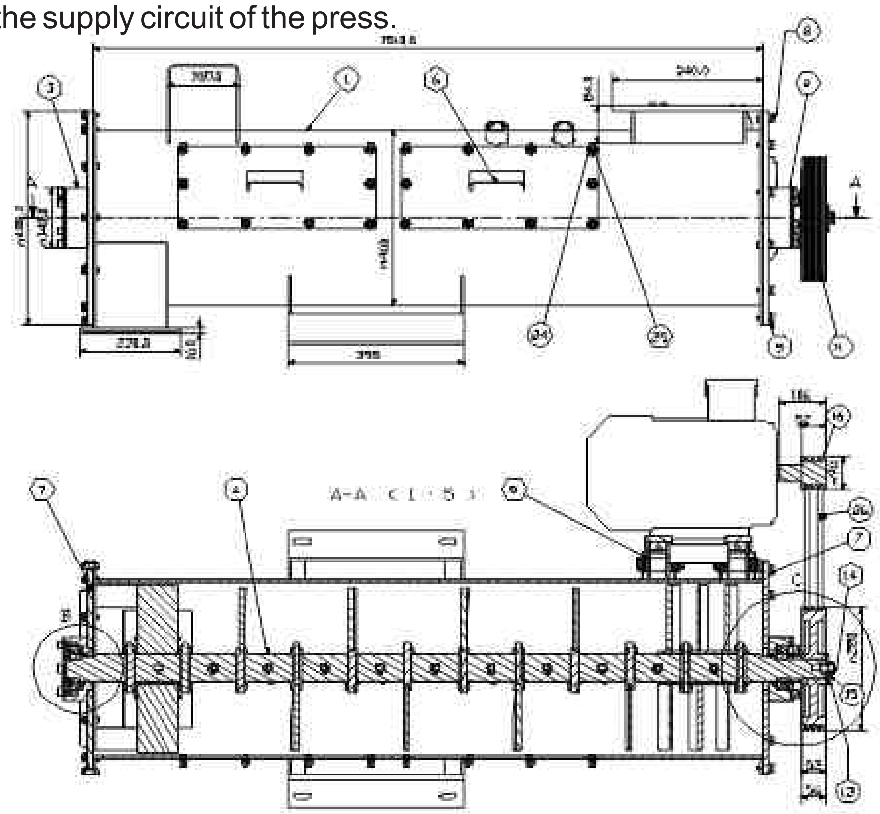


Picture 2. Dosage Device

The fuelling and homogenization device presented in picture 3 is composed by the following main components: case (position 1), bearings (position 2 and 3), mixer (position 4), electric engine (position 5), transmission V-belts (position 11).

Fuelling and homogenization device makes the connections between the dosage device and the upper side of the pellet press and has the role of assuring the fueling at a constant flow of the sawdust and its mixture according to the pressing capacity of the press. Also this device is foreseen with a water spraying installation over the received sawdust received from the dosage device and trained forward with the help of the motion mixer (position 4) which is foreseen with several blades. The aim of spraying a certain quantity of water and mixing the sawdust is to assure a smooth passing trough the mold pressing holes.

The adjustment of the sprayed water flow over the sawdust, passing towards the press, is correlated with the humidity of the sawdust moisture and is controlled with the help of a humidity sensor mounted in the supply circuit of the press.



Picture. 3.Fuelling and homogenization device

The sawdust enters in the device by the upper trunk and is sent towards the pellet press by the inferior trunk which makes a direct connection to the press.

The fuelling, dosage and homogenization mechanism in the presented variety is realized for the pellet presses type CMP (California pellet mill) with a maximum productivity of 1000 kg/hour.

5. Conclusions.

The implement of pellet production technologies and the realization in our country of the fuelling, homogenization and dosage mechanism will bring a major contribution to the reduction of environment pollution by capitalizing the sawdust wastes and not in the last the realization of supplementary achievements for the manufacturer of such devices.

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FORCE PNEUMATIC TRANSDUCERS WITH LOW ENERGY CONSUMPTION IN STOCHASTIC MEASUREMENT OPERATIONS

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Abstract:

It was created a pneumatic transducer purposefully for measuring forces in processes from agriculture or food industry and aat its conception were taken into account the principles of saving energy and money, conceiving an automatic system at low costs. This kind of unconventional pneumatic transducer does not require special source of compressed air, the consumption being extremely low, which simplifies its structure, operation and price. This represents a major advantage for the systems which are autonomously independent and have a low ecological impact.

The transducers taken into consideration are in the range of 20...500 N with supply pressures in the range of 25 up to 140 kPa. For the study of the dynamic behavior of this type of transducer in stochastic operational measurement, were realized a model and a simulation program for showing the performances and limits of this kind of transducer.

Keywords: transducer, force, pneumatic, dynamic characteristic, stochastic

1. General aspects

In many processes from agriculture and food industry it is required to measure forces and weights which vary in a low range.

It was created a group of compact, simple, cheap, pneumatic transducers, with a low energy consumption and a very high precision in measurement, which is not affected by hysteresis or the temperature of the environment. The use of the compressed air at low pressures is not dangerous, is ecological and needs very low amounts of energy. This kind of transducers may be used in Ex environments as well due to the fact that there is no risk of explosion. [1,5,6]

The transducers have nominal values in the range $F_{mas\ n}$ {20...400}N with 3 effective surfaces of the membranes S_{ef} {10, 20, 40}cm^2 at 3 supply pressures p_{al} {10, 20, 40} kPa.

In this article was studied the way it works the transducer with S_{ef} = 20 cm^2 , supplied with p_{al} = 75 kPa and a nominal value of the measuring force of F_{mn} = 150 N, which is used for measuring forces with aleatory variation.

For modelling the transducer, validating its structure and functionality and for determining the dynamic behavior and the consumption of compressed air was created a simulation program in the simulation environment MEDSIMFP 10 developed in Free Pascal.

2. The dynamic model of the transducer

The scheme of the pneumatic transducer is shown in figure 1.

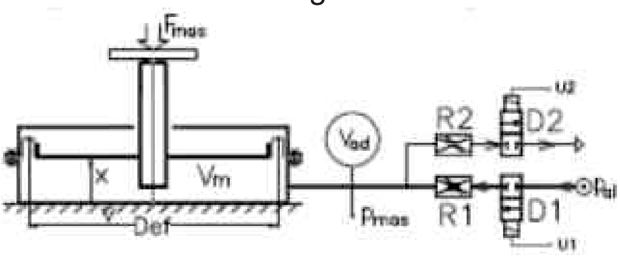

Figure 1 Functional scheme

The detailed functional scheme of the pneumatic measurement system is shown in [6,7,].

During operation the position H_t of the transducer rod may vary between H_{tmin} and H_{tmax} with an abatement to H_{tmed} (figure 2).

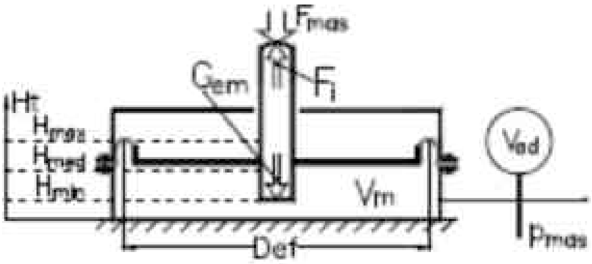

Figure 2 The pneumatic load cell

For developing the model of the whole measurement system was used the block scheme shown in figure 3.

The system has 5 components: load cell, position transducer, algorhytm of management, the block of the operational parts and the pressure voltage converter.

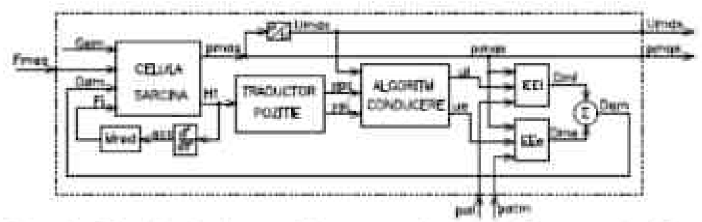

Figure 3 - The block scheme of the pneumatic system for measuring force

The main element, the load cell, has at the input the following values: the measurement force $F_{mas,}$ weight G_{em} of the mobile equipment, the inertial force F_i of the reduced masses M_{red} at rod and the mass air flow D_{am}. At the output are reached the measurement pressure p_{mas} and the rod stroke H_t.

From the position transducer exit 2 binary signals: y_{pj} and y_{ps} corresponding to the rod position in H_{min} and $H_{max.}$

These binary signals are applied to the algorhytm of control which elaborate the control values ui and ue corresponding to the access of air in the measurement chamber where is maintaned permanently a pressure $p_{mas.}$

The operational components EEi and EEe are 3x2 distributors, in serial connection with variable pneumatic resistance. Depending on the control values u_i and u_e may be introduced a flow Dm_i in the measurement chamber or may be discharged a flow Dm_e from the measurement chamber.

For coupling at the automatic control systems, the measurement pressure p_{mas} is converted in 0...5 V variant chosen cause it consumes less electricity.

The dynamic models used for the work of the pneumatic load cell are [6,7]:
- for the measurement pressure p_{mas}

$$p_{mas}(t) = \frac{F_{mas}(t) + F_i(t) + G_{em}}{S_{ef}} \quad (1)$$

where F_{mas} (t) is measured force, G_{em} is mobile equipment weight. And F_i (t) is inertial force:

$$F_i(t) = M_{red} \frac{dHt(t)}{dt} \quad (2)$$

- for the volume variation in the measurement chamber $V_m(t)$

$$\frac{dV_m(t)}{dt} = -\frac{dF_{mas}(t)}{S_{ef}dt} \frac{S_{ef}}{F_{mas}(t)} \left(V_m(t) + V_{ad}\right) \quad (3)$$

- for the deplacement $H_t(t)$ of the rod and the mobile equipment

$$\frac{dHt(t)}{dt} = -\frac{dF_{mas}(t)}{dt} \frac{\left(V_m(t) + V_{ad}\right)}{F_{mas}(t)} \quad (4)$$

The position transducer has discrete outputs defined similarly for H_{min} and H_{max}

$$if\ ABS(Ht(t) - Ht_{jos}) < \varepsilon \quad then\ ypj = 1\ else\ ypj = 0; \quad (5)$$

where ε is the position abatement (mm).

Because is studied the transducer dynamic in aleatory low operational ways it is assumed that themordynamic processesa re isothermal.

The pneumatic distributors are small, with electromagnetic drive, have low open and shut times below 20 ms, neglected in the simulation model created.

In the pneumatic resistances the air flow is subsonic so it was used for calculating the mass flow a model [2,7]

$$D_{ma}(t) = Kdm \frac{p_{int}(t)}{\sqrt{T_a}} \cdot \left(kp(t)^{2/\chi} - kp(t)^{(1+\chi)/\chi}\right) \quad (6)$$

where K_{dm} is a global flow coefficient in which is included the distributor.

$kp(t) = p_{ev}(t) / p_{int}(t)$ where $p_{int}(t)$ and $p_{ev}(t)$ are the supply and discharge pressure values

$\chi = 1,4$ – adiabatic coefficient

For keeping the isothermal character of the process are regulated resistances for reaching low flows with the isothermal characteristic.

Were calculated the values required for the flow coefficient Kdm for obtaining a flow, in average conditions, of 1 cm^3/s at supply and discharge as well.

With the model previously presented was developed a simulation program TRFRPN20ALEA.PP in software field MEDSIMFP 10.[4,7,8]

For determining the dynamic behavior of the pneumatic transducer were used specific input signals for processes with aleatory variation of the measured value.

Comparing it with the transducer presented and studied in [6,7], at this constructive variant the position of the mobile equipment is detected only at the edges H_{min} and H_{max} with 2 reed-relay sensors activated by an annular permanent magnet mounted on the rigid centre of the membrane. The mass of the magnet is part of the total reduced mass M_{red} at the transducer rod.

According to the control strategy developed above, the membrane is brought again in its medium position H_{med} when it reaches one of the edges H_{min} or H_{max}. Due to the simplification of the structure is equired that this load to be redirectioned to the algorhytm of control.

3. Input values with aleatory variation

For generating a stochastic operational variation of the measured force $F_{mas}(t)$ was used a generator of aleatory variables based on the principle of the transportable media and uses series of aleatory symmetrical numbers (SAU) evenly distributed. For increasing the continuity level was used a filtering of the signal. [3,4,10]

The basic relationship with which was generated the aleatory variable is:

$$F_{mas}(i) = F_{med} + A_F \cdot \sum_{i=k}^{i} SAU[i] \tag{7}$$

In figures 4 and 5 are shown the variations of the measurement force $F_{mas}(t)$ for periods of 20 and 40 s, where is evident the aleatory aspect. The main advantage of this method of simulation consists in reproducing the conditions in which are performed the tests which allows acquiring relevant information regarding the influence of modifications of structural parameters. Simulation was made with a generator specialised for pseudoaleatory functions GENALEAT developed at the department of Biotechnical Systems from UPB for modelling biotechnical processes with stochastic character and are characterized by a long time needed for repetition of minimum 2,3 x 10^9 generations.

Depending on the nature of the simulated process, if the character of the distribution is gausian in the biotehnical processes, instead of a series of aleatory numbers SAU[i] distributed evenly, may be used a series of aleatory numbers with normal distribution SAN[i]. Must be remarked that the variables generated with sequences SAU[i] have a high steady position, which makes them be preferably used in simulation. [3,10]

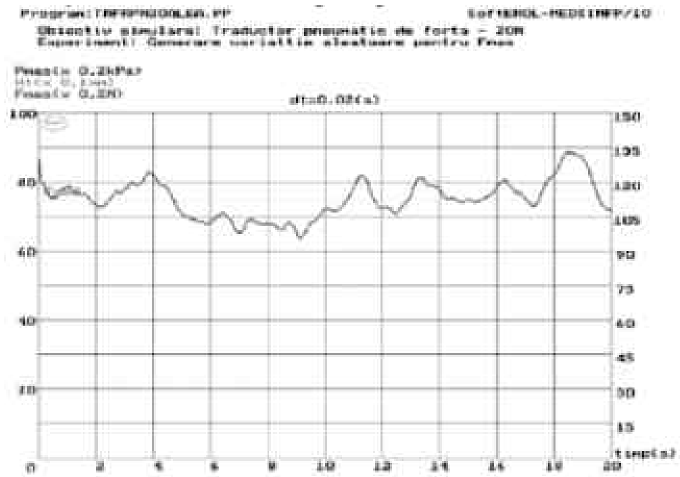

Figure 4 - Aleatory signal for $F_{mas}(t)$ for an interval of 20 s

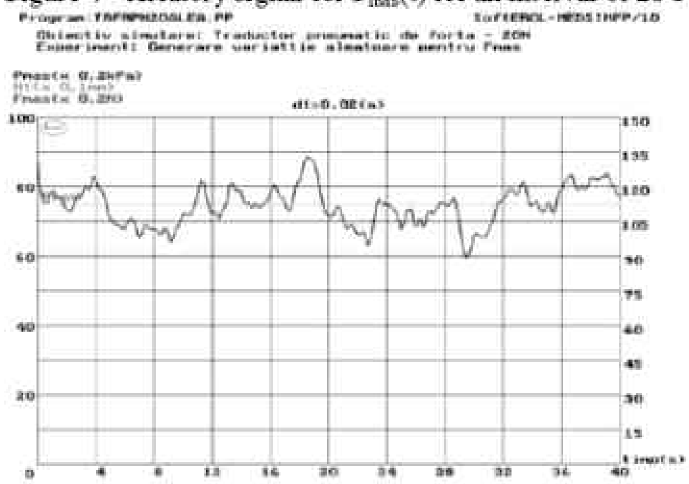

Figure 5 - Aleatory signal for $F_{mas}(t)$ for an interval of 40 s

4. Experiments performed with the simulation model

In figure 6 is shown the answer of the transducer at the aleatory input signal $F_{mas}(t)$ with an average value of F_{med} = 15 N and an amplitude ΔF = ± 3N. This experiment was performed for an interval of 20 s of simulation for noticing in detail how the transducer works in measuring period initialization, from the PLC coupling to the measurement regime stabilization for $p_{mas}(t)$. The normal measurement system starts when is finished the filling process of the measurement chamber up to an equal value to $p_{mas}(t)=F_{mas}(t)/S_{ef}$

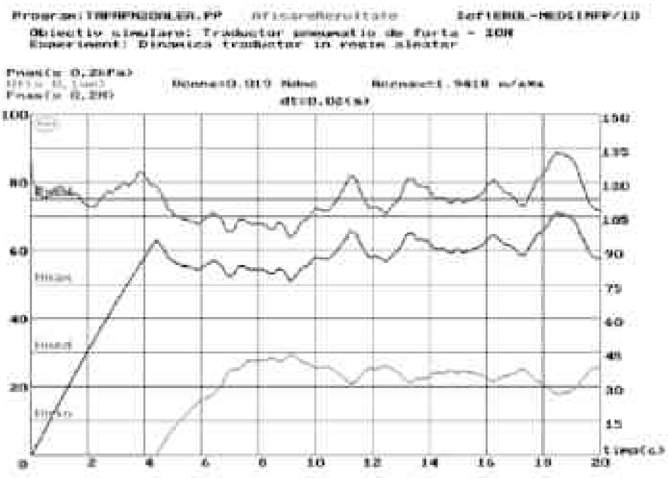

Figure 6 - The answer at aleatory input signal of 20 s

Figure 7 - The answer at aleatory input signal of 40 s

In fig.7 is shown the behavior of the transducer in an interval of 40 s for finding out if there appear high accelerations of the rod. It is found that for the simulation operational sample, the maxim acceleration is of 1,942 m/s^2, which is a low value that influences slightly the measurement accuracy. The reduced weight is very small - M_{red}=0,02 kg - and as a result the maxim inertial force is Fi = 0,03884 N and relating it to the medium force it results an error of max.0,26% which in the conditions of an aleatory measurement system is very good.

This behavior was obtained by fixing the average input flow at 1cm^3/s. As a result, for the simulated sequence there is a very small air consumption V_{cons} = 19 Ncm^3 in 20 s and 37 Ncm^3 in 40 s, which corresponds to a high level of autonomy in supplying with pneumatic power.

For the faster aleatory processes, the fixed set of the input resistance R1 may be changed for increasing the filling flow in order to make bigger the speed tracking the variation of measured parameters F_{mas}.

5. Estimation of the energetic consumption

At work in aleatory system was consumed from the pneumatic supply source 37 Ncm^3 in 40 s, which means 3,33 Ndm^3/h, a small value which confirms that in this kind of operating system it is reached autonomy in supplying with pneumatic power.

The position transducer does not use electric power cause it is driven by a permanent magnet mounted on the rod. The modern pneumatic micro distributors are very small and consume very small amounts of energy [11,12] An electro distributor of this kind manufactured by SMC is type SJY312MT5M-M3 which works at 24 Vcc with only 0,1W. It has a flow coefficient of 0,9 dm^3/s.bar and a coupling / uncoupling interval of 10 ms.

In an interval of control is of max.1 s and consumes 0,1 J. In an hour are about 190 prompts which consume 19 J/h electric power which means a continuous electric flow of 0,0053 W which demonstrates that can be supplied an entire year from 3 small batteries of 9V.

In the structure of the measurement system analyzed, another consumer of energy is the pressure voltage converter which was selected from the micro class.

The MPXV5100 Motorola converter is supplied with 5 Vcc and consumes about 7mA, which means 356 mW. It has a volume of 4 cm^3 and a weight of 4 g.[13]
Summing up all consumptions of electric energy it results a required power of 40 mW. This low value together with the very low consumption of compressed air 3,4 Ndm^3/h at 25 kPa meaning 5 mW pneumatic power confirm that the transducer corresponds to the requirements of use in autonomous systems with low energy consumption.

6. Conclusions

For measuring forces with low variation, it was elaborated a constructive principle and solution for a pneumatic transducer at which were applied the concepts of reducing the energetic consumption, of being autonomous energetically and having a low cost for the automation parts.

This kind of unconventional pneumatic transducer does not require a special source of compressed air the consumption in oscillatory system with 120 intervals/h is extremely low of about 3 Ndm^3/h and 5 mW pneumatic energy.

The consumption of electric energy is very low, being necessary an electric power of only 63 mW.

From the simulated experiments it results that due to the low filling and discharge flows of the measurement chamber are obtained negligible inertial forces, which means an operation without percussions or dead times, with a high measurement precision.

The results prove that the transducer corresponds to the requirements related to autonomous systems with low energy consumption.

It is necessary that in the future to be continued scientific studies against optimizing the structure and operation of the family of transducers, for increasing measurement accuracy and adaptability at the conditions required by the automatized systems.

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TEHNOLOGY AND EQUIPMENTS TO OBTAINETHE INDUSTIAL FUEL FORM COMPACT WASTE

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Abstract

The article covers how to use packaging waste as a fuel, suggesting a classical method like the tamping of those wastes. The article highlights some of the INOE 2000-IHP Bucharest achievements in the delivery of such equipment.

1. General considerations and the potential energy waste

The waste is that part of a product that obtained form an economic or consumption activity to be waived when it exhausts its lifetime or is discarded after a technical process. For that reasons the waste can be done a classification form the origin point of view:

- Primary waste, which were obtain from primary economic activities, like: agriculture, extraction, and others, that it represents the largest share of total volume of waste of 75%;
- Processing waste from the profit-making activities (industrial and services) that represent only 10%;
- Consumer waste (garbage) from the food industry or consumer activities, that represent 5%

From ecological point of view this waste can be classified as polluting or non-polluting waste that have a great impact on the environment on short or long period of time. Due to development of synthetic and composite material thetechnology it must be made a distinction of the non-degradable waste (that cannot be decomposed under the influence of natural factors, like: plastic, gals and synthetic materials) and biodegradable (materials that can be decomposed, absorbed and transformed).

The equipments that are used in this field are designed in accordance with technological process to eliminate them. The specific steps that are used for waste disposal are in number of four: collection with or without sorting; handling and transportation; the processing, when pursue to confer a new value of waste by other operation (crushing, pressing or briquetting, compacting, baling, packing) and storage.

To be aware of these stages it helps us to correctly estimate the costs of waste recovery, regardless of their use.

1.1. Methods to reinstate the wastes in the economic cycle

By reinstating the wastes in the economic cycle is intended to reappraise those materials in a technical circuit that would use the energetic and mass potential in generating energy or to be embedded on materials with inferior properties.

a) Recycling – in this technological process the collected and sorted waste upon a certain criteria (generally after material) undergo transformation processes in raw materials for new products. Waste using this method to reinstate the economic cycle must have several criteria: be made of materials that are recyclable (in our case all materials, except menage waste); materials may not be exceeded all stages of recycling (leverage).

b) Using waste as fuel in this process the collected (not even sorted) are tamping, are compacted, packed (balot) and used as raw material in some thermal and electrical. This waste must meet several key requirements: have exhausted all stages of recycling - one, two or more; have as much heating power (usually paper and plastics) and a lower degree of pollution as by burning.

c) Using as raw material for other activities – in this category are included menage waste, which can be sorted and be used as bioalternative to feed livestock, fish farms, and sow one.

1.2. Utilization of waste and their destination.

Worldwide at least two trends are manifested in the use of waste, depending on the level of exploitation.

A statistical research made in 2006 it was made regarding the waste recovery, shows the share of fuels used as an alternative to the classical waste in the European Union (Fig.1.A) and the United States-Canada (Fig.1.B). In this analysis it is shown that waste fuels are four times bigger in American continent then in Europe. This reflected lower costs for relief and the economic cycle in this form than with recycling

Reported but the pollution from the waste re-used as the environment, present opposite situation between the two continents.

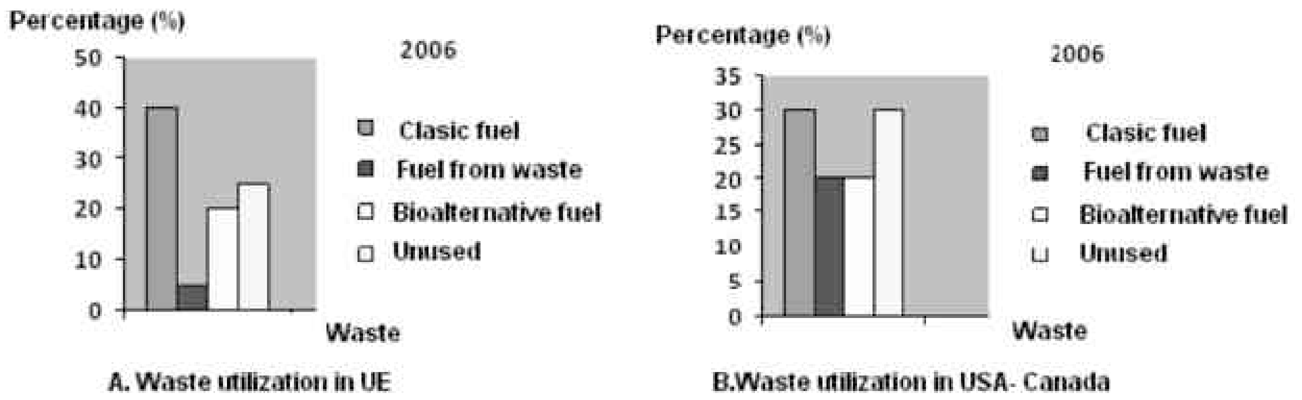

Fig. 1. Waste utilization in the world

The main categories of waste that can be used as fuel are non-industrial residues (Fig. 2). In figure 3, it can be observed the energetically power and usability

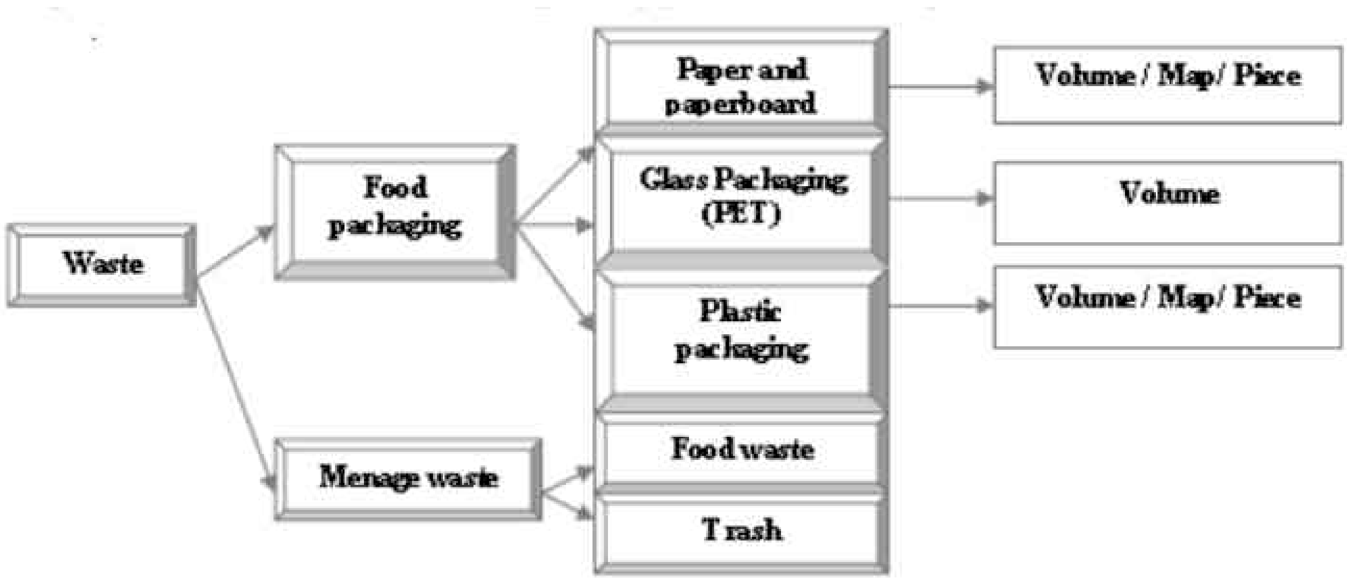

Fig.2. Waste that can be used as fuel

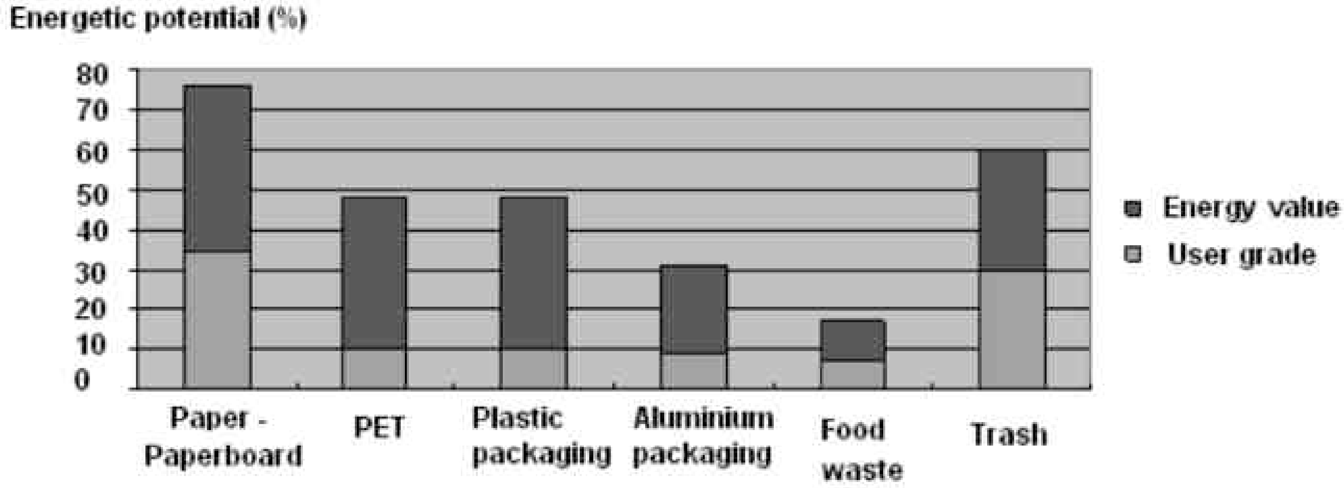

Fig.3. Energetic potential of the non-industrial waste

2. Flow map of waste transformation in fuel

The main technological operations that are operated on rough waste until there are baled (briquetted) for their use as fuels are presented in technical order, as follows:

- ***Waste Load*** (sorted or unsorted) from the collection point. These operations are usually done manually but are also automated equipments.
- ***Transportation of raw waste.*** This kind of technology makes the connection between collection point and processing stations technology, in order to prepare for the next phase.
- ***Preparing waste*** from technologic point of view that is taking in consideration the nature and the shape of the material to be compacted. This process is made form the next operations: crusher, mill land schredere.
- ***Compaction process - pressing or briquetting waste.*** In this process are used complex compress technologies like: the waste compress operation without homogenization (simple compression) or Compression with homogenization (proper compaction). In the briquetting operation are used equipments that have a hydraulic amplification system to obtain high compression forces in special chambers.

Compaction technology can be achieved in several ways: with a compression chamber closed or open (enclosure or tunnel), collecting vessels (containers) and in wrapping (plastic bags and cases).

Knock-out process (extraction) of the compacted waste and their transportation, which is happening to packing devices (baling, packing). This process it can be realized manually, mechanical (mechanic devices to extraction and dumping) and hydraulic

- ***Waste baling***, this process it can be achieved manual, mechanic or hydraulic.
- ***Waste packaging,*** that can be done in bags (commercial or organic); plastic sheets (single or double) and in the sumps (reusable or reusable).

Next we will refer to the compaction equipments and technologies.

3. Baling and compaction technologies. Description and operating parameters

Compaction of waste should include the following phases: pressurising waste mixtures of (a simple pressing) and compress the mixture itself.

Compaction is achieved when the stroke of pressure element is actuating upon materials that have a high heat transfer coefficient. When in compression processes are involved materials with lower coefficient of heat transfer the compression part can achieve many strokes.

The technologic parameters of these equipments are very important in order to carry out a grater compression. These parameters are: the volume of compression chamber V, the contain level K_u, the compression ratio K_c, the period of time in which is fulfilled the operation t_c and its productivity p_r.

The operating principles of waste compaction technologies are presented in figure 4.

The baling process of a mixture of waste contains the next operations: the forming of the ballot, its cutting and packing. The main technological parameters are: linear dimensions (m), the volume (m^3) and the weight (kg). The operating principles of waste balling technologies are presented in figure 5.

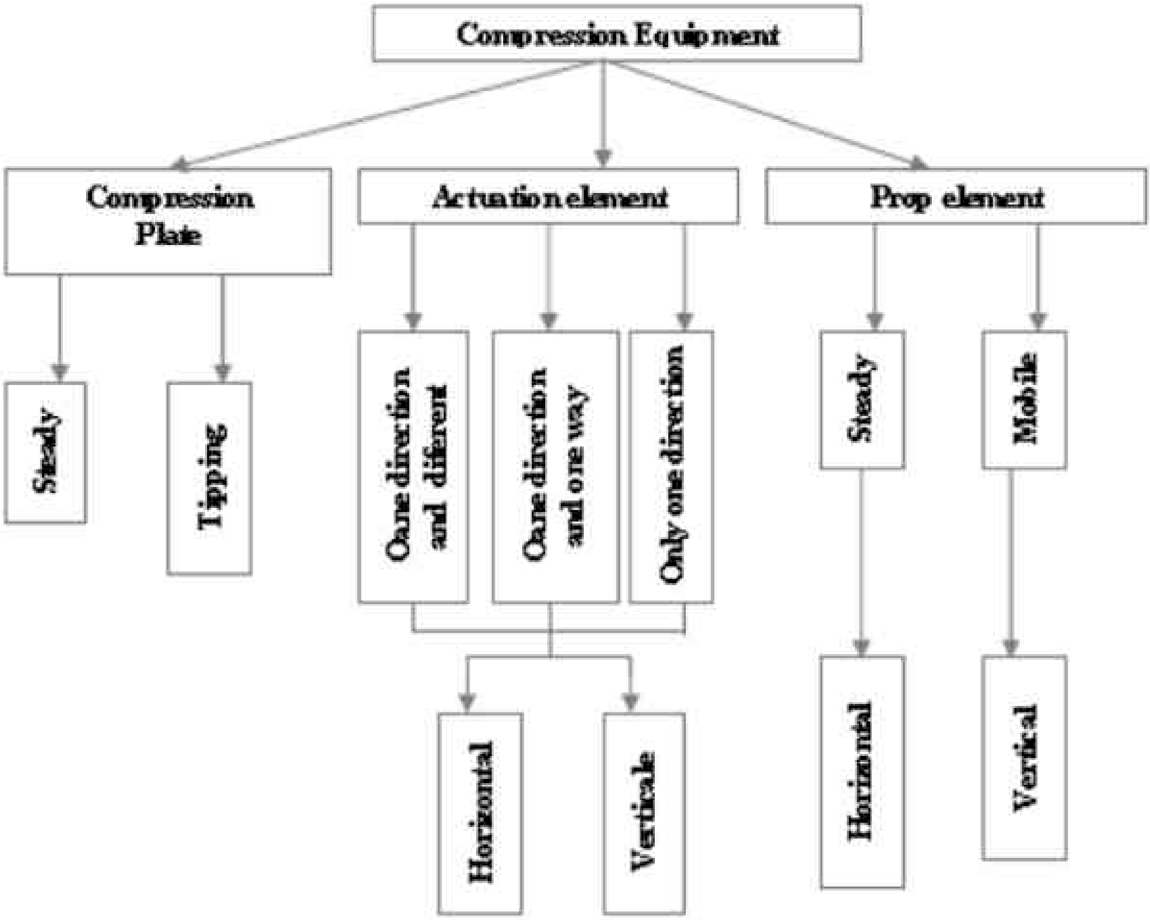

Fig.4. Operating principles of waste compaction technologies

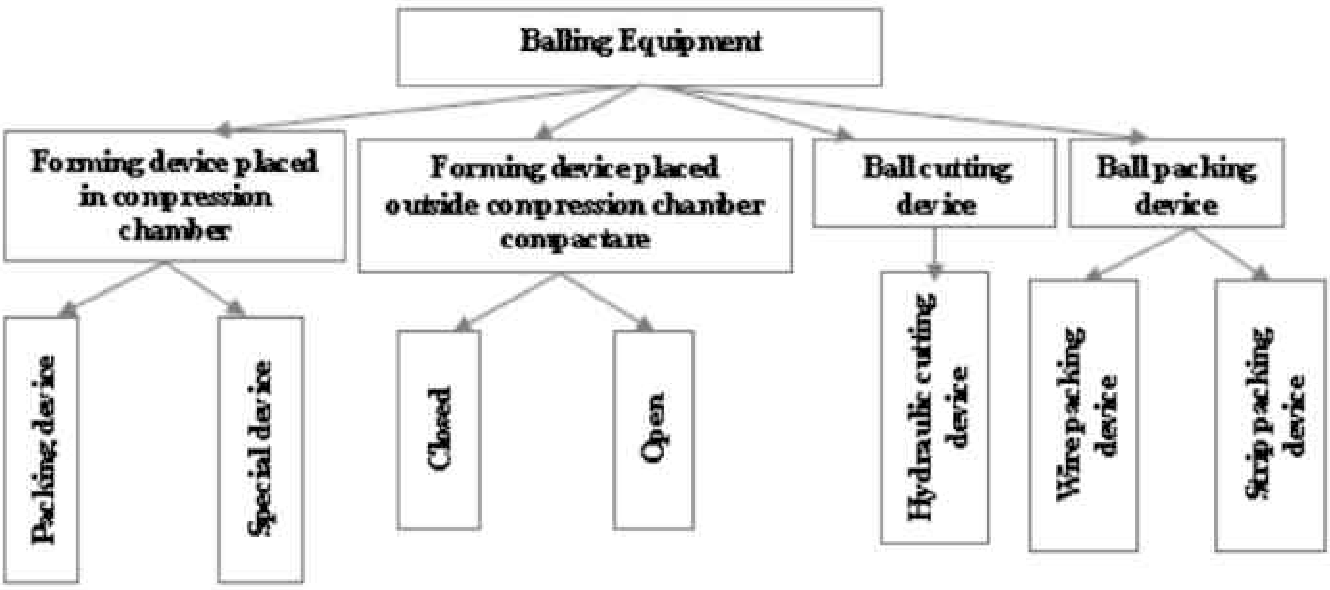

Fig.5. Operating principles of waste balling technologies

1. The processing through compression-baling installations of wastes

The processing through compression-baling installations are defined by the compression volume. Thus, these are classified in three categories: big capacity installations that can generate pressure forces over 16 tf and compression volume over 4 m^3; middle capacity installations with forces between 6 and 16 tf and compression volumes between 1 ....4 m^3, as well as small capacity installations that can develop forces below 6 tf and volume smaller than 1 m^3.

From productivity point of view these equipments can be:

a) Height productivity, that can process more than 100 balls per hour;
b) Middle productivity, that can process between 10 and 100 balls per hour;
c) Low productivity, fewer than 10 balls per hour.

Operating principles of a waste processing installation include sometime an preparing equipment that is presented in figure 6.

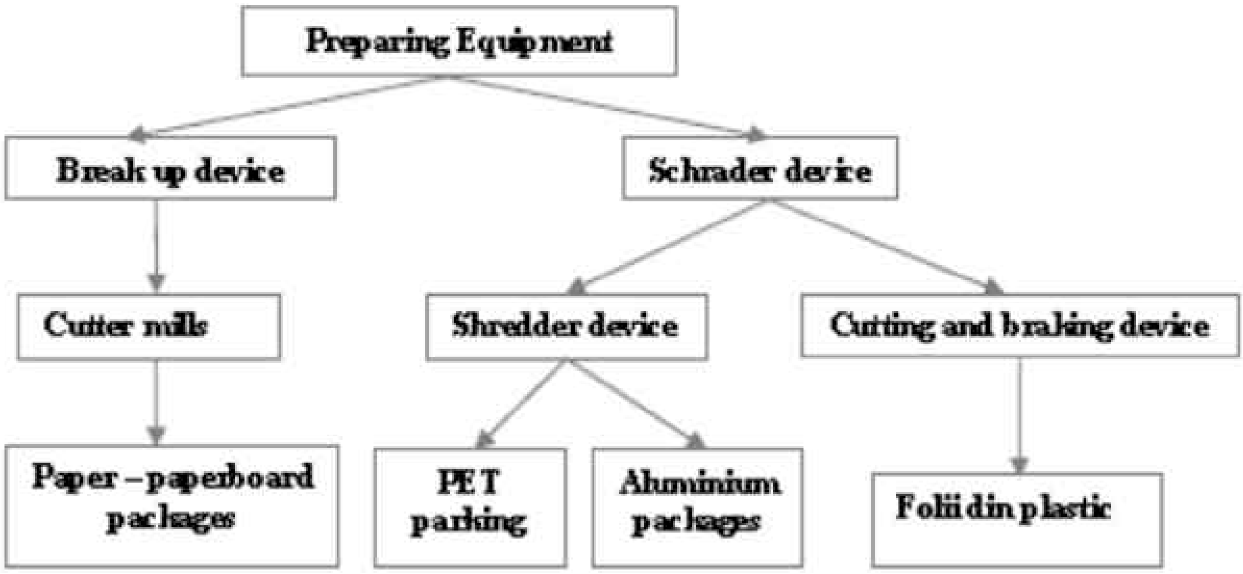

Fig.6. Waste processing installation

1. The technical–economic feature of the compression-balling machines, designed by IHP.

At INOE 2000 - IHP Bucharest, has been created two types of pressing machines with middle and small capacities, having in perspective the technical necessities of the companies which had participated in this project, like: S.C. ORASD 98 S.R.L. and S.C. Romfluid S.A.-Bucharest.

These pressing machines had been designed and manufacture with an accessible price, that can be compared with similar second hand techniques from import. Delivery price of a medium capacity press is 4500 until 5000 Euro (fig.7), including taxes and for a small capacity press is between 3500 until 4000 Euro, including taxes (fig.8).

Comparing the same capacity and productivity import presses (HSM, ORWAK, Meccanica DUE and others the prices are with 25-35% lower.

The energetic consumption for a normal working program (8 hours/day) is maximum 10 kW, the maximal compressible weight, regardless the waste nature, is 1200 kg/day and the maximum amortization is in 18 months.

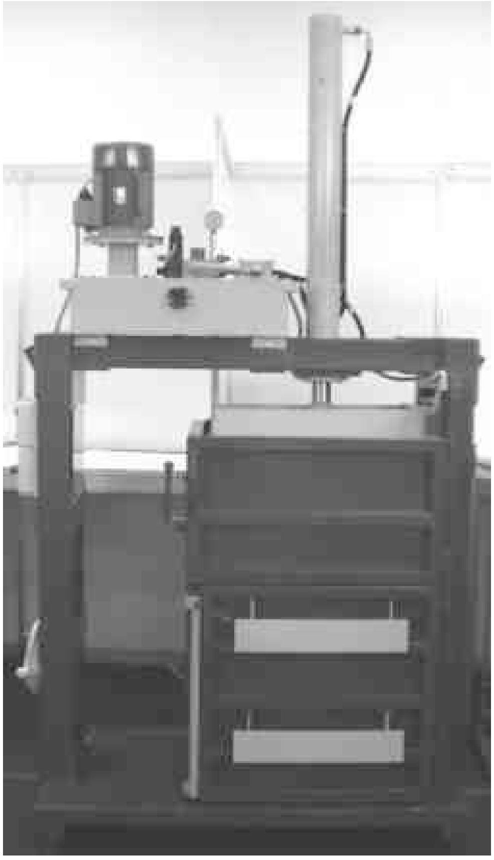

Fig.7. Medium capacity press

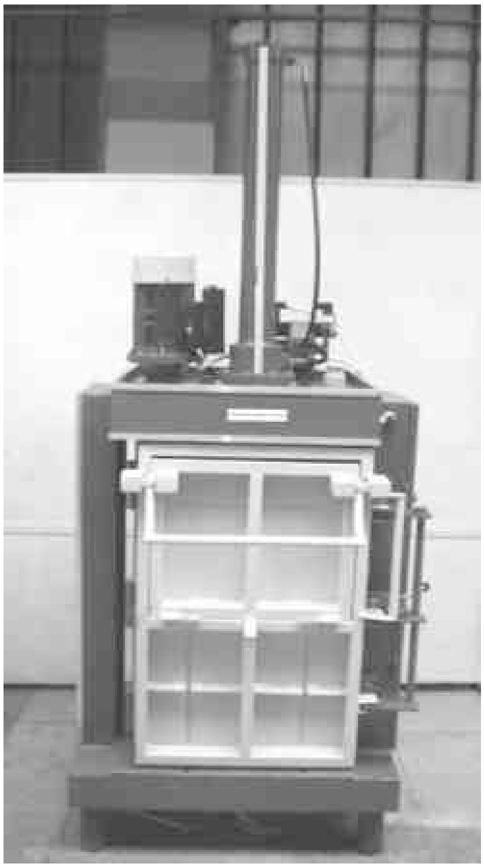

Fig.8. Small capacity press

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EMAF – MODULAR & FLEXIBLE HYDRAULIC EQUIPMENT FOR HYDROPOWER INSTALLATION IN THREADED FASTENERS

Adrian Constantin Hanganu, Constantin Chiriță, Cosmin Grosu

Abstract: *EMAF is a project geared towards developing a family of new, complex, innovative, highly technical, consisting of a modular system of hydraulic equipment for installation in threaded fasteners hydropower stations, assisted by dedicated software maintenance process.*

Keywords: hydraulic equipment, modular, flexible, hydropower, threaded fasteners, CAD

1. Introduction

Assembly by threaded fasteners in hydropower plants (HPP) was designed by UCM Resita an ongoing problem both commissioning of HPP and especially during maintenance works (Fig. 1 and 2).

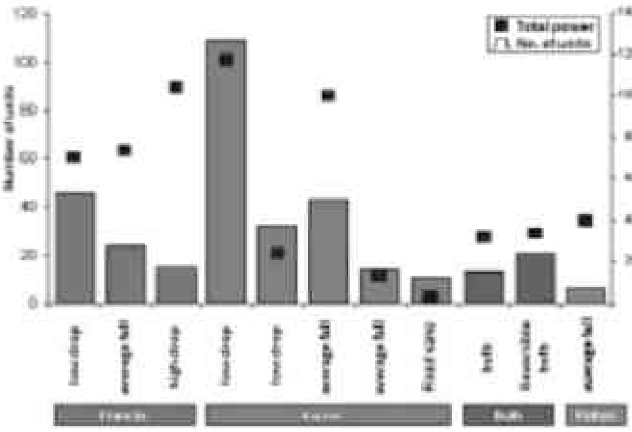

Fig. 1 - Number of units and total power the turbines (in operation 2009).

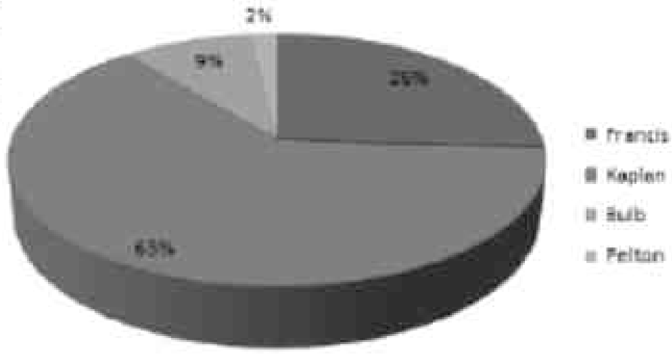

Fig. 2 - Types of turbines (in operation 2009).

2. Problems

EMAF is a project geared towards developing a family of new, complex, innovative, highly technical, consisting of a modular system of hydraulic equipment for installation in threaded fasteners hydropower stations, assisted by dedicated software maintenance process.

In the first stage by a technical study on hydropower plants in Romania have been identified, representative turbine (Fig. 3 ÷ 6), locations, activities and maintenance specifications:

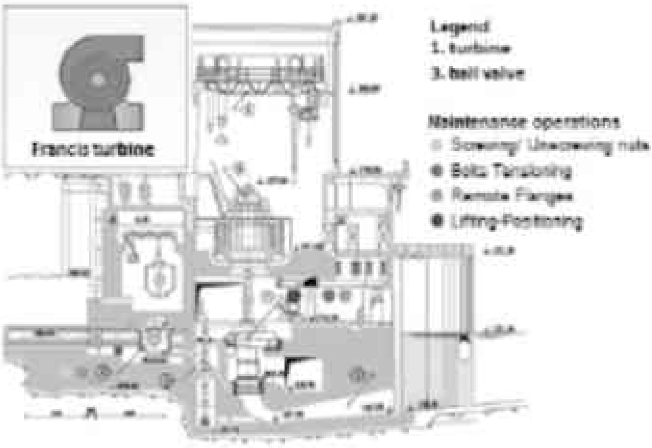

Fig. 3 – Maintenance Operations of EMAF equipment HPP equipped with a Francis turbine

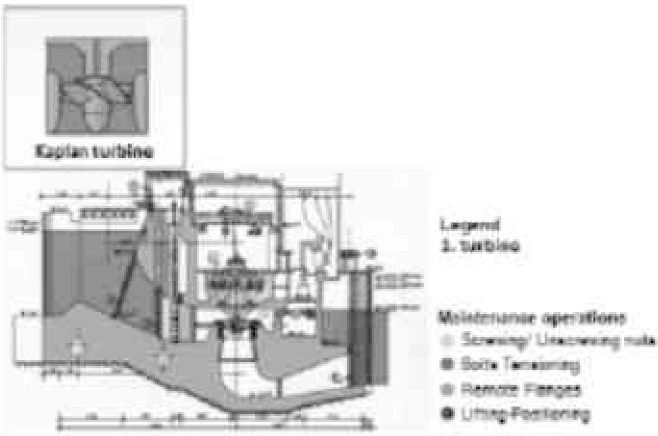

Fig. 4 – Maintenance Operations of EMAF equipment HPP equipped with a Kaplan turbine

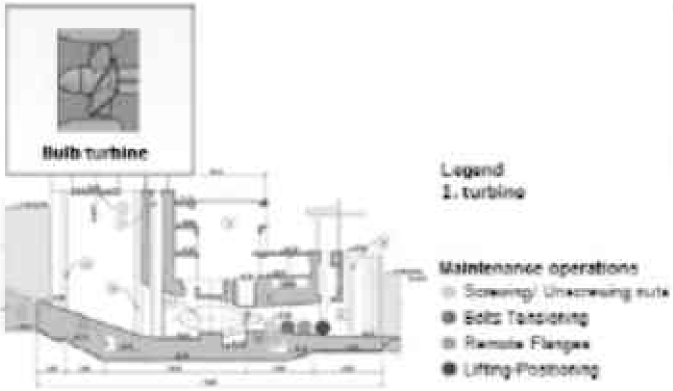

Fig. 5 – Maintenance Operations of EMAF equipment HPP equipped with a bulb turbine

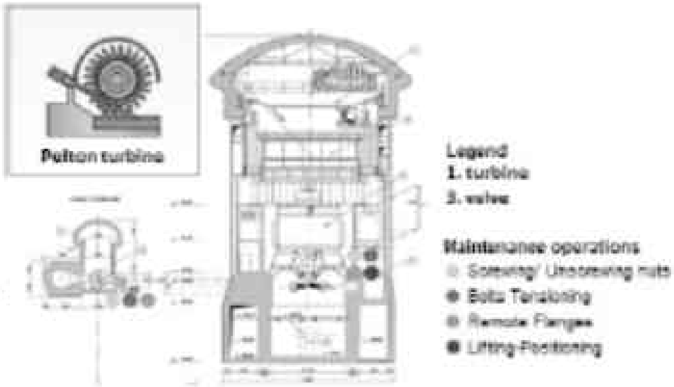

Fig. 6 – Maintenance Operations of EMAF equipment HPP equipped with a Pelton turbine

3. CAD

Fig. 7 – CAD Model1

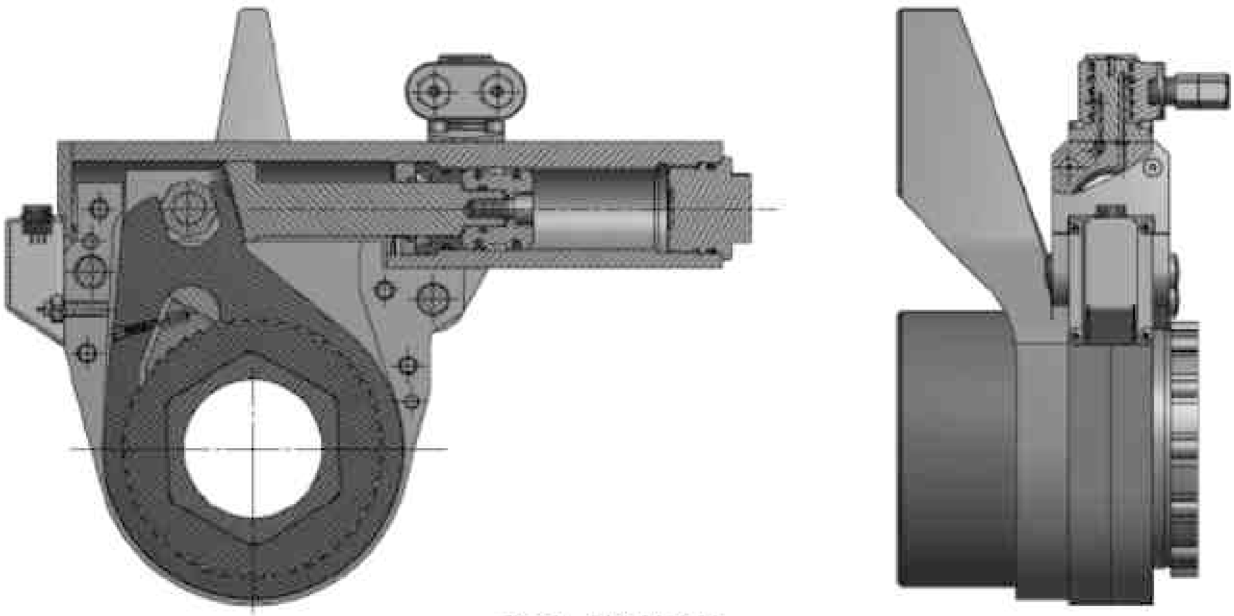

Fig. 8 – CAD Model2

Table 1. Bill of Material / Model 2

Item	Description	Part Number	BOM Structure	Unit QT	QTY	Stock Number	REV	Mass	Material
1	Carcasa inferioara	CHD-700.1500.1.0	Normal	1	1		0	11.093 kg	
1.1	Ansamblu semicarcasa stanga	CHD-700.1500.1.1.0	Normal	1	1		0	7.346 kg	
1.1.1	Semicarcasa stanga 1500 daNm	CHD-700.1500.1.1.1	Normal	1	1			3.354 kg	OL 60
1.1.2	Bucsa de uzura 1500 daNm	CHD-700.1500.1.1.2	Normal	1	1			0.3 kg	40 Cr 10
1.1.3	Brat 1059(M3)	CHD-700.1500.1.1.3	Normal	1	1			1.903 kg	OL 50
1.1.4	Antrenor T15(M3) 1500 daNm	CHD-700.1500.1.1.4	Normal	1	1			1.6 kg	51VMnCr11
1.1.5	Scaun clichet 1500 daNm	CHD-700.1500.1.1.5	Normal	1	1			0.1 kg	51VMnCr11
1.1.7	Cui impingator 1500 daNm	CHD-700.1500.1.1.6	Normal	1	1			0.0 kg	OL 60
1.1.8	Arc compresie	CHD-700.1500.1.1.7	Purchased	1	1	D-078		0.000 kg	Steel
1.1.9	Stift filetat special 1500 daNm	CHD-700.1500.1.1.8	Normal	1	1			0.0 kg	OL 42
1.1.11	Clichet var 3	CHD-700.1500.1.1.9	Normal	1	1		0	0.123 kg	Steel
1.2	Ansamblu semicarcasa dreapta	CHD-700.1500.1.2.0	Normal	1	1		0	3.573 kg	
1.2.1	Semicarcasa dreapta 1500 daNm	CHD-700.1500.1.2.1	Normal	1	1			3.276 kg	OL 60
1.2.2	Bucsa de uzura 1500 daNm	CHD-700.1500.1.1.2	Normal	1	1			0.3 kg	40 Cr 10
1.4	Surub cap imbus	ISO 4762 - M10 x 35	Purchased	1	4		0	0.035 kg	Steel
1.5	Stift cilindric	ISO 2338 - 8 h8 x 45	Purchased	1	2		0	0.018 kg	Steel
2	Bolt Diam 16	CHD-700.1500.2	Normal	1	2			0.1 kg	40 Cr 10
3	Surub special	CHD-700.1500.3	Normal	1	2			0.0 kg	OLC 45
4	Senzor inductiv M8	CHD-700.1500.4	Normal	1	1			0.014 kg	OL 34
5	Capac senzor	CHD-700.1500.5	Normal	1	1			0.039 kg	Aluminiu
6	Brat reactie 1500 daNm	CHD-700.1500.6	Normal	1	1			5.3 kg	OLC 45
7	Ansamblu actionare cheie	CHD-700.1500.7.0	Inseparable	1	1		0	10.331 kg	C. sudata
7.1	Corp cheie 15 VT 1500 daNm	CHD-700.1500.7.1	Normal	1	1			6.783 kg	OLC 45
7.2	Tija-culisa	CHD-700.1500.7.2.0	Normal	1	1		0	1.408 kg	
7.2.1	Tija piston 1500 daNm	CHD-700.1500.7.2.1	Normal	1	1			1.202 kg	18 MnCr 10
7.2.2	Culisa 1500 daNm	CHD-700.1500.7.2.2	Normal	1	1			0.1 kg	51VMnCr11
7.2.3	Ax culisa 1500 daNm	CHD-700.1500.7.2.3	Normal	1	1			0.100 kg	OL 50
7.3	Ansamblu piston	CHD-700.1500.7.3.0	Normal	1	1		0	0.331 kg	
7.3.1	Piston	CHD-700.1500.7.3.1	Normal	1	1			0.3 kg	OLC 45
7.3.2	Garnitura piston	PO55-210-0450-N	Purchased	1	2		0	0.004 kg	Dynaflon 10508
7.3.3	Banda de ghidare	EV85-40x4.5x9.7	Purchased	1	1		0	0.005 kg	B/PF 26201
7.3.4	Inel O radial intern hidraulic	ISO 3601-1 - C 0200 G 20(5)	Purchased	1	1		0	0.001 kg	Rubber
7.4	Surub cap imbus	ISO 4762 - M10 x 25	Purchased	1	1		0	0.028 kg	Steel
7.5	Bucsa ghidare	CHD-700.1500.7.5.0	Normal	1	1		0	0.155 kg	
7.5.1	Bucsa ghidare 1500 daNm	CHD-700.1500.7.5.1	Normal	1	1			0.149 kg	CuSn12
7.5.2	Inel O radial extern hidraulic	ISO 3601-1 - C 0387 G 45(4)	Purchased	1	1		0	0.001 kg	Rubber
7.5.3	Garnitura tija	TTI 30 40	Purchased	1	1		0	0.005 kg	Dynathan 8314
7.7	Dop filetat	CHD-700.1500.7.6.0	Normal	1	1		0	0.603 kg	
7.7.1	Capac filetat 1500 daNm	CHD-700.1500.7.6.1	Normal	1	1			0.602 kg	OL 50
7.7.2	Inel O radial extern hidraulic	ISO 3601-1 - C 0437 G 50(4)	Purchased	1	1		0	0.001 kg	Rubber
7.8	Capac 1500 daNm	CHD-700.1500.7.7	Normal	1	1			0.2 kg	OLC 35
7.9	Surub cap semiinecat si locas hex	ISO 10642 - M5 x 12	Purchased	1	2		0	0.002 kg	Steel
7.10	Ax alimentator 1500 daNm	CHD-700.1500.7.9	Normal	1	1			0.194 kg	OLC 45
7.11	Surub cap imbus	ISO 4762 - M6 x 12	Purchased	1	4		0	0.006 kg	Steel
7.12	Ansamblu racord rotativ	CHD-700.1500.7.11.0	Normal	1	1		0	0.470 kg	
7.12.1	Racord rotativ 1500 daNm	CHD-700.1500.7.11.1	Normal	1	1			0.5 kg	OL 34
7.12.2	Inel O radial intern hidraulic	ISO 3601-1 - B 0200 G 20(5)	Purchased	1	3		0	0.000 kg	Rubber
7.13	Saiba de retinere 1500 daNm	CHD-700.1500.7.12	Normal	1	1			0.0 kg	OLC 35
7.14	Surub cap semiinecat si locas hex	ISO 10642 - M3 x 12	Purchased	1	2		0	0.001 kg	Steel
7.16	Piulita presare garnituri	CHD-700.1500.7.14.0	Normal	1	1		0	0.124 kg	
7.16.1	Piulita M52x1.5 1500 daNm	CHD-700.1500.7.14.1	Normal	1	1			0.115 kg	OL 60
7.16.2	Bucsa ghidare 1	CHD-700.1500.7.14.2	Normal	1	1		0	0.009 kg	Steel
7.17	Inel O axial extern	DIN 3771-4x18-N-NBR70(2)	Purchased	1	2			0.000 kg	Rubber
7.18	Dop conic	CHD-700.1500.7.16	Normal	1	1		0	0.002 kg	Steel
10	Mufa 5 pini	P5	Purchased	1	1		0	0.002 kg	Thermopl.Resin
11	Surub cu cap bombat si locas cruci	ISO 7045 - M4 x 8 - 4.8 - H	Purchased	1	4		0	0.002 kg	Steel
12	Piulita hexagonala	ISO 4032 - M8	Purchased	1	1		0	0.006 kg	Steel
27	Niplu hexagonal cu filet conic NP	1/4-18 NPT-6S	Purchased	1	2			0.066 kg	Steel
29	Reductie hexagonala 55 1500	Reductie hexagonala 110 1500	Normal	1	1		0	7.093 kg	51VMnCr11

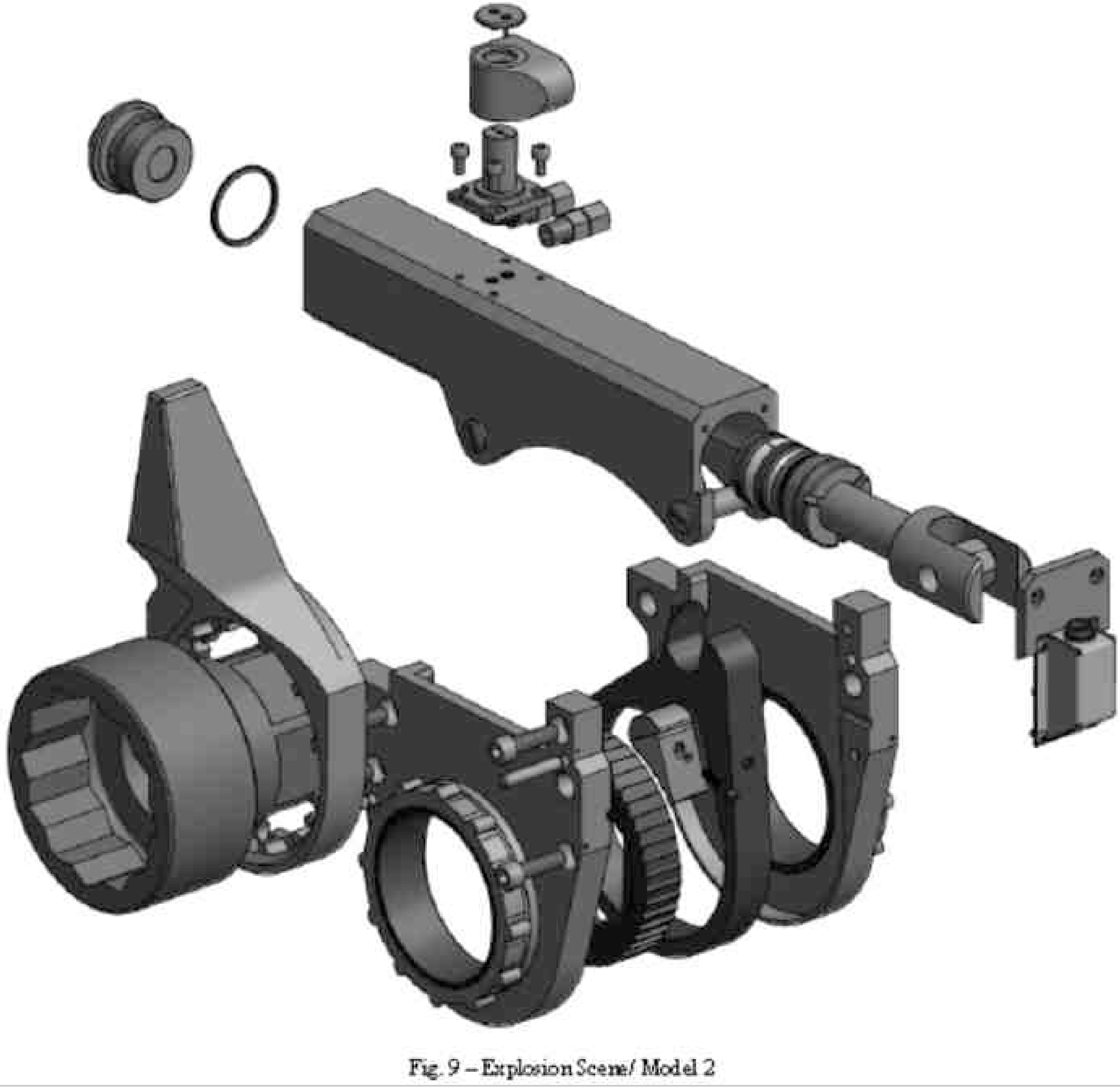

Fig. 9 – Explosion Scene/ Model 2

4. Prototype Solutions

EMAF project has led to the 4 new prototypes of modular & flexible hydraulic equipment, threaded fasteners for mounting the hydroelectric plants, consisting of 7 new products (Table 2):

Table 2

Equipment		Modular product			
No.	Name	No.	Name/ code	Prototype Photo	Technical Features
1	EMAF for Bolts Tensio-ning	P1	Multiplex Power Units / UEH-1500		- Maximum pressure..... 1.500 [bar] - High pressure rate ...... 0,3 [l/min] - Multiplex branched - Installed power .... 1,5 [kW] - Voltage .... 220 [V ca] - Net weight.................... 87 [kg] - Remote desktop
		P2	Hydraulic Bolts Tensioning Single Cylinder/ DTH-205		- Maximum force .... 2.300 [kN] - Maximum pressure ... 1.500 [bar] - Maximum stroke .... 10 [mm] - Bolt .... M100x4 - Net weight .... 26 [kg]
		P3	Hydraulic Bolts Tensioning Double Cylinder/ DTH-180		- Maximum force .... 1.770 [kN] - Maximum pressure.... 700 [bar] - Maximum stroke .... 10 [mm] - Bolt .... M80x4 - Net weight.................... 36 [kg]
2	EMAF for Remote Flanges	P4	Hydraulic Remote Flanges/ DHF-014		- Maximum force .... 140 [kN] - Maximum pressure ...... 700 [bar] - Open .... 6 ÷ 66 [mm] - Net weight .... 9 [kg]
3	EMAF for Screwing/ Unscre-wing nuts	P5	Multiplex Programmable Power Units/ UEH.P-700		- Maximum pressure..... 700 [bar] - High pressure rate..... 0,45 [l/min] - Multiplex branched - Installed power .... 0,75 [kW] - Voltage .... 220 [V ca] - Net weight .... 58 [kg] - Remote desktop
		P6	Hydraulic Screwing/ Unscrewing nuts/ DIH.700-15000		- Maximum torque..... 15.000 [Nm] - Maximum pressure..... 700 [bar] - Housing .... hex. 70 [mm] - Wide key .... 55÷105 [mm] - Net weight .... 17 [kg]
4	EMAF for Lifting-Positio-ning	P7	Handling & Positioning System/ SMPF-10		- Maximum pressure ...... 250 [bar] - Maximum load .... 10 [kN] - Arm length................. 2.550 [mm] - Riding diameter...... 6.000 [mm] - Net weight .... 460 [kg]

THE AUTOMATIC TOOL READJUSTMENT FUNCTION IN USED AT HORIZONTAL SPINDLE FMC AND SOLUTIONS FOR THE IMPLEMENTATION OF THE FUCTION AT THE TMA OP 55 SYSTEMS

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1. Manufacturing and flexibility.

Manufacturing is the industrial activity that changes the form of raw materials to create products. The derivation of the word manufacture reflects its original meaning: to make by hand. As the power of the hand tool is limited, manufacturing is done largely by machinery today (1). In order to be able to achieve the standards required by the global market an important characteristic of any manufacturer is flexibility. Flexibility was introduced as the mean to obtain high quality products with minimal cost, but also for reducing the amount of time needed from changing from a product to another. The development of the flexible manufacturing systems is made possible by advances in machine tools and industrial robots.

Flexibility is defined as the capacity of the machine tool to adapt to the variations either in quantity or type, influenced by technological diversity with random variations, in conditions of imposed and constant standards of quality and optimal work load (2).

The goals regarding the quality and quantity of the products realized using a flexible cell manufacturing system and also maintaining a low operation cost which will transfer less operational cost to the product price can be achieved with a high autonomy of the system in reference to the operator. The autonomy to the operator is defined as the capacity of the machine to produce in condition of flexibility with the partial presence or lack of the operator (2). The autonomy of the machine in relation to the operator has a mathematical expression (1.1).

$$a = \frac{\sum t_{ai}}{t_{tot}}$$

Where: t_{ai} = operation time without user intervention.

t_{tot} = total operation time.

In order to achieve a greater autonomy of machine tools and of flexible manufacturing systems a series of specialized functions have been implemented eater in on machine tools or on the entire manufacturing systems. Among this we mention the most important:

- Management function.
- Automatic tool change function (ATC).
- Automatic tool readjustment function (ATR).
- Automatic work pallet change (APC).
- Automatic pallet readjustment function (APR).
- Automatic work process monitoring function.
- Automatic Work piece changing (AWPR).
- Automatic determination of work piece and tool offset.

Tool malfunction detection. (3)

1. Automatic tool readjustment function – methods of implementation.

As factory automation has progressed, NC machine technology has also progressed to allow construction of Flexible Automation (FA) or Flexible Manufacturing Systems (FMS) by connecting machines with production equipment such as robots, Autonomous Guided Vehicles (AGV), automated warehouses and computers (1). In this complex system the need for reducing and even eliminating the down time of the system for different tasks such as tool readjustment and pallet readjustment had appeared. This need haze arisen for several reasons, most importantly being the hazard of having the operator in the flexible manufacturing cell, work area at every product change and another reason being the need of a minimal downtime of the system.

The automatic tool readjustment function is specific to the FMC (Flexible Manufacturing Cell) and FMS (Flexible Manufacturing System) and consists of automatic setup of a new set of tools in “hidden” time necessary for the next work piece. The solutions vary depending on the type of ATC mounted on the main machine tool in the cell or system (2).

The main methods for realizing the ATR function are:

× Readjustment with high flexibility having a double tool magazine (active and passive) and an ATR manipulator.

× Readjustment with medium/large flexibility using a tool rack.

× Readjustment with limited flexibility using a monorail manipulator and the double subordination of the tool magazine management.

× Readjustment with medium flexibility using ATR robot behind the machine tools and an ATC tool magazine with double subordination.

× Readjustment with reduced flexibility using a tool rack type pallet that can be accessed by the ATC.

2.1. Readjustment with high flexibility having a double tool magazine (active and passive) and an ATR manipulator.

The method is based on the existence of two tool magazines both accessible to the manipulator, one of which is "active available to the CNC for the piece that is being worked and the 2nd is "passive" available to the ATR function PLC's (connected to the DNC) with a 2nd manipulator to update (ATR). It makes the automatic tool changing in the "passive" tool magazine by using the ATR manipulator, with tools from the reserve supply of tools on board a tool rack, brought the machine tool on by the ATR function control system.

2.2. Readjustment with medium/large flexibility using a tool rack.

The method is used for tool racks serviced by an ATC coordinated programmable manipulator and where the rack is fixed. The manipulator workspace is divided by removable sectors, which consist of tool racks, which can be replaced with others containing new set of tools for the next work piece. The method of replacing a portion of the tool magazine (average limited flexibility), not suitable to replace the complete set of tools related to the ability of the tool magazine (5).

2.3 Readjustment with limited flexibility using a monorail manipulator and the double subordination of the tool magazine management.

This type of tool readjustment method is based on a manipulator which moves on a monorail track above the flexible manufacturing cell, in order to rearrange "tool by tool" the tool magazine of the ATC system, in order to prepare the next set of tools for the next wok piece. This solution is used by Yasda and Csepel firms (2).

The monorail manipulator is moving over the tool magazine, which have their maximum point over the rail, and have the same tool direction as the tools form the PIDS, in this way the mechanic arm of the manipulator can grip all the tools from the system just as the ATC system (6).

A software problem that is specific to this variant of the ATR is "double subordination" of tool magazines: CNC for the ATC function and d DNC for the ATR function.

2.4. Readjustment with medium flexibility using ATR robot behind the machine tools and an ATC tool magazine with double subordination.

This type of readjustment with the robot behind the machine tool involves the machine tool's ATC double subordination: to the machine CNC for the priority ATC function and to the robot's CNC for the tool readjustment function. This is essentially similar in terms of the previous case (readjustment with limited flexibility using a monorail manipulator and the double subordination of the tool magazine management), with differences in the software driving of the robot. The differences is that the robot is headed by his own CNC subordinated to the machine DNC just as the machine's CNC, robot motion is done by CNC subprograms assembled after a graphic cycle representation having the sequenced composed of CNC subprograms inter-conditioned with initial conditions and final confirmations which enter in the assembler. The machine tool has a chain type tool magazine and an ATC manipulator which is subordinated to the machine CNC and during work time the ATR magazine is subordinated to the robot's CNC and after finalization of the readjustment operation the list with the changes is transmitted from the DNC to the machine CNC.

2.5. Readjustment with reduced flexibility using a tool rack type pallet that can be accessed by the ATC.

In this type of readjustment system stock pallet type tool rack, which is a technological pallet (ISO) accepted by the palletizing device (PCA) of the machine tool, but it contains a set of tools instead of the work piece. Tools are attached using pliers as type tool rack magazines, which catch the V-shaped flanged tool. Tools are located on 4 levels and are positioned in polar coordinates.
The work ode for updating the tool is:
Step 1- Discharge cycle of a machine tool from the tool magazine (this is done by the machine spindle, with the stop of the work piece processing);
- The old tool is selected and placed in the machine spindle using the machine's ATC
-A CNC subprogram is launched to place the tool from the machine tool spindle in the ATC's magazine.
Step 2- cycle for acquisition of a new tool.
- A CNC subprogram is launched to pick up a tool from the stock pallet according to its management system.
- The ATC function will place the new tool for the machine spindle in the ATC system tool magazine.
- The tool management list is updated with the new tool brought in the tool magazine.
- This method is adequate for readjustment of a reduced number of tools and only when needed in order to not affect the flexible manufacturing cell's autonomy in regard of the operator.

1. The TMA AL550 flexible cell.

The TMA AL 550 flexible manufacturing system is situated in the Laboratory for Robot Programming, CNC Programming and Robot Control Development of the Mechatronics and Fine Mechanics department of the Faculty of Management and Technological Engineering in Oradea.

The flexible manufacturing cell is composed of several key components. The main components are:

- The horizontal spindle CNC machine.
- Two ABB IRB 1600 industrial robots.
- The modular system conveyor.
- The Regal storage system.

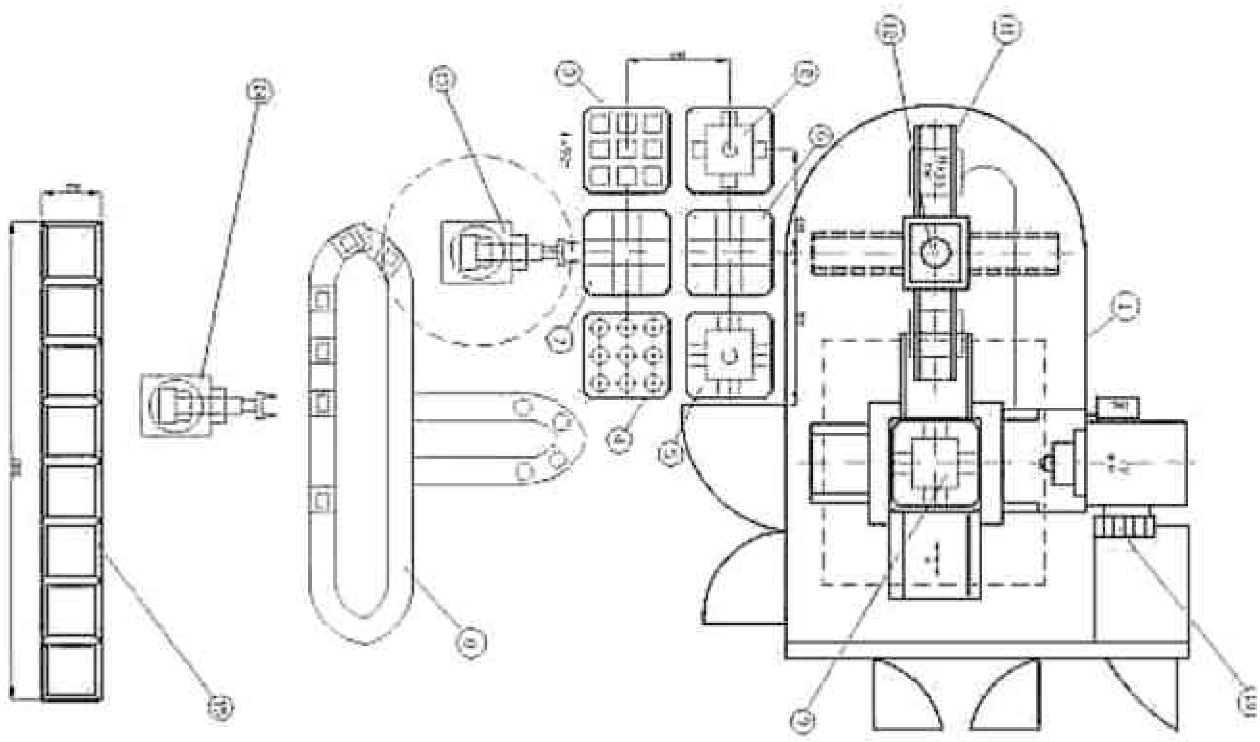

Figure 1- The TMA AL 550 flexible manufacturing system

4. Analysis of the optimal solution for tool readjustment function at the TMA AL 550 flexible manufacturing system.

In order to establish the optimal method for realizing the automatic tool readjustment function at the TMA AL 550 flexible manufacturing system the criteria's upon which the solution will be analyzed must be established. Since the main function of the flexible manufacturing cell in the use in educational environment, research and PhD studies the high flexibility of the chosen solution is not a prime ranking criteria. Also the need for “hidden time”, meaning the possibility of performing the automatic tool readjustment while the machine is working on the work piece, is not a high priority. High ranking criteria's are the amount of space required for implementing the solution, the amount and type of alteration needed to be realized on the machine tool and on the other components of the flexible machine tool, and the cost of implementing the solution.

Several options are available for the automatic tool readjustment function at the TMA AL 550 flexible manufacturing cell.

The optimal solution was determined by applying the criteria presented earlier. The best option for this situation was determined to be the tool readjustment with reduced flexibility using a tool rack type pallet that can be accessed by the ATC.

This solution was chosen for several reasons among which we mention the fact that this method in using the least space, it doesn't need a high number of additional components (additional tool magazines, rails, a new manipulator etc) and it has low implementation cost. The disadvantage is the low flexibility, the time required to realize the tool readjustment function and the impossibility of having any “hidden time” in the system.

The ATC o the machine tool is used to perform the task in conjunction with other systems. In figure 5 is presented the ATC of the TMA 55OP machine tool.

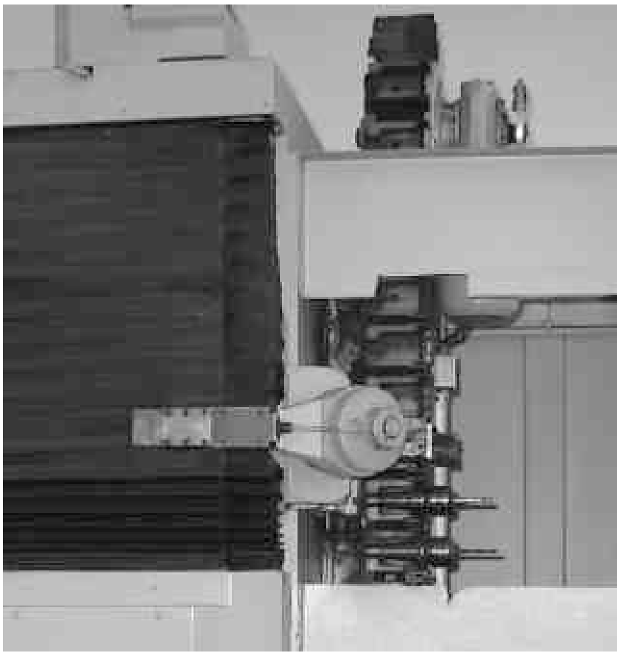

Figure 2 - The ATC of the TMA OP 55 machine tool.

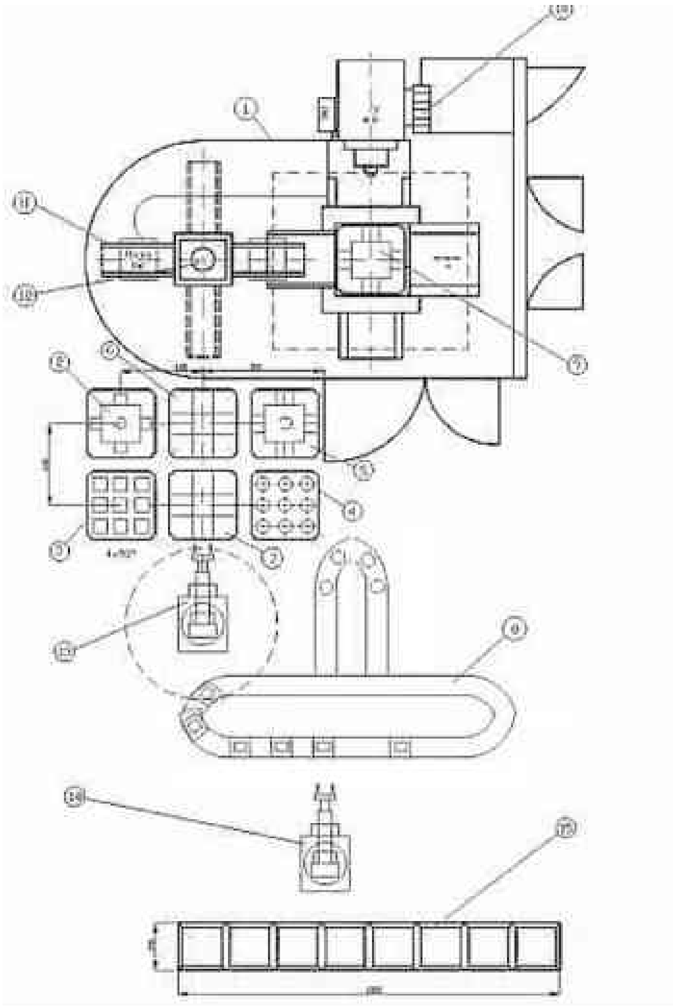

Figure 3 - Proposed solution fot the ATR function at the TMA OP 55 FMS

Where:
1- Flexible manufacturing cell
2- Tombstone fixture
3- AWPC temporary magazine
5- ATR tool support load station.
6- Pallet load-unload station.
7- Tool offset station.
8- Conveyor.
9- Work table.
10- Automatic tool changer.
11-2 axis rotary table
12-Automatic pallet changing.
13, 14- ABB Robots.
15 -Regal lager.

As specified earlier the best option for this situation was determined to be the tool readjustment with reduced flexibility using a tool rack type pallet that can be accessed by the ATC. This is realized using all the components of the flexible cell. The robot (14) has access to the regal lager (15) where the tools for the cell are stored. This tools are transferred to the ATR tool support load station (5) using the conveyor (8) and the second robot (13). The order of the tool in the tool rack is established in by the flexible cells management software. Using the automatic pallet changing function of the flexible cell the tool rack is transferred on the machine tool. Here the tools are transferred in the tool magazine using the ATC (Automatic tool changer) function of the machine.

7. Conclusion.

Since manufacturing has become an industrial phenomenon, the problem of adequately sizing plants has always been discussed. Capacity in general can be defined as the set of any kind of resources that can be used to create value for the customer and, in general, the cost of capacity is lower than the value the customer pays to acquire the product or the service provided (7).
The dimensions of manufacturing capacity are:
- Type.
- Amount
- Cost.

Cost is defined as the total economic value that is necessary to spend for acquiring, running, maintaining and dismissing a manufacturing system (7).

In the cost dimension of manufacturing a major role have the flexible manufacturing systems. This system can be cost effective only if they are used properly these meaning that the use of this systems must be done according the specifications provided by the supplier of the manufacturing cell. This means that all processes done on manufacturing cells ideally must be realized at maximum speeds with minimum use of resources and minimum tool ware. This problems are addressed by a highly computerized design systems meant to optimize the use of raw material when a new manufacturing program is developed for the CNC and by advanced system for process and tool monitoring, systems meant to monitories the work process in order to archive the high speeds of the process but continuously monitor the parameters of the tools in order to avoid unnecessary ware.

The second aspect related to the cost effectives of the flexible manufacturing systems is their ability to manufacture a large number of pieces with minimum percentage of defective products. The key word here is “large number”. In order to achieve these large number of pieces produced per unit of time of coursed a major roll it haze the sped at which the machine operates. The speed although it haze seen considerable advances in the last decade is limited by mechanical parts. In this condition another way to increase the production capacity and trough it the cost efficiency of a flexible manufacturing cell is to have the additional operations required in the manufacturing cell, done automatically. Such functions are the automatic pallet changing and the automatic tool readjustment (ATR) function. The method chosen for realizing the ATR function at the TMA 55AL flexible cell is not the best option from an economic point of view, because the tool rearrangement can only be made with “down time” (the pallet loading and unloading system and the ATC function of the machines are used) and because the function can be realized by using the majority of the system's components.

This leads to low productivity and high duration of the ATC function. Whiten a flexible manufacturing cell used in a factory this criteria would have make the presented solution a disregarded one. In the presented case, being a system for didactic use the advantages of the methods overcome its disadvantage. A major importance in choosing this method is the possibility to implement the function whiteout major modifications to the present structure of the cell and whiteout significant additional components (such as overhead manipulators).

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ECHIPAMENT TEHNIC DE RECOLTARE A RIZOMILOR DE MISCANTHUS

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Rezumat: *Lucrarea prez*intă descrierea *constructiva a unui echipament tehnic destinat* recoltării rizomilor de Miscanthus care este astfel conceput încât să poată realiza o dislocare prin afânarea adâncă a solului fără întoarcerea acestuia şi o mai bună separare de pământ prin scuturare a rizomilor de Miscanthus cu un consum energetic redus.

Cuvinte cheie:*e chipament, recoltat, rizomi, Miscanthus*

INTODUCERE

Una dintre sursele regenerabile care asigură biomasa necesară generării bioenergiei, larg raspândită în ultimile decenii în țările UE este cultura de Miscanthus, care prin valorificare asigură o serie de avantaje economice, dar mai ales asupra mediului. Aceasta poate fi folosită pentru producerea energiei electrice şi/sau termice atât în termocentralele mari (30 MW +), care folosesc mii de tone de biomasă anual, cât şi în sisteme mici casnice care folosesc câteva tone, în timpul lunilor de iarnă.

Miscanthus prezintă un potențial interesant şi pentru țara noastră, cu atât mai mult cu cât România deține un potențial agricol neexploatat în totalitate, iar în mediul rural principala sursă de încălzire în cursul iernii este reprezentată de biomasa lemnoasă, provenită din zonele forestiere aflate în extincție. Din cauza caracterului de perenitate, Miscanthus-ul nu intră în asolament, ci se cultivă extensiv pe anumite soluri mai puțin indicate pentru alte culturi. Cultura perenă prezintă avantajul că se reduc cheltuielile de pregătire a terenului şi de plantare.

Cultura de Miscanthus se înființează primăvara devreme şi poate fi exploatată timp de 15...20 ani. Primul an de vegetație nu asigură o cultură suficient de dezvoltata pentru a fi recoltată în condiții economice. În fiecare an rizomii produc muguri care răsar o dată cu încalzirea vremii, în cursul lunii martie. Din aceşti muguri se dezvoltă nişte tulpini erecte şi robuste care la sfârşitul lunii august a primului an de vegetație ajung la o înălțime de 1...2 m şi o grosime de cca. 10 mm.

Tulpina care seamănă cu trestia de bambus este neramificata şi are un miez plin. La sfârsitul lunii iulie frunzele bazale încep să se usuce. Uscarea plantelor începe cu luna octombrie când asimilatele se translocă în organele de depozitare (rizomi). Uscarea completă a plantelor şi căderea frunzelor se desăvârşeşte odata cu căderea primei brume. În timpul iernii conținutul de umiditate din tulpini scade continuu până în luna februarie când ajunge la 15...20% şi se recoltează mecanic.

Folosirea materialului de calitate este esențială pentru obținerea unor bune înființări a culturii. Rizomii ar trebui procurați din câmpuri de Miscanthus special dedicate obținerii de material biologic şi să fie recoltați din categoria plantelor tinere, nu dintr-o recoltă înaintată şi îmbătrânită. Manipularea şi transportul rizomilor până în momentul plantării sunt de asemenea esențiale pentru a asigura viabilitatea.

Datorită caracterului de noutate al tehnologiei de înființare şi recoltare a culturilor de Miscanthus, în țara noastră neexistând echipamente tehnice destinate acestei tehnologii, INMA Bucureşti a proiectat şi realizat modelul experimental al unui echipament tehnic pentru recoltat rizomi.

Echipamentul tehnic conține soluții noi legate de brăzdarul de dislocat şi scos rizomii de Miscanthus, separatorul cu excentric şi mecanismul oscilant cu excentric pentru de antrenare. Soluțiile tehnice şi tehnologice adoptate la conceperea echipamentului tehnic sunt moderne astfel încât respectă, din punct de vedere al cerințelor esențiale de securitate şi de sănătate, directivele europene, respectiv: Directiva de Maşini 98/37/CEE.

Totodată, echipamentul tehnic asigură parametrii calitativi de lucru superiori şi conține soluții care îi conferă siguranță în exploatare, întreținere, reglaje simple şi uşor de exploatat de către un singur operator (tractoristul).

DESCRIERE CONSTRUCTIVĂ

Miscanthus-ul este o planta ierboasă perenă care, fiind sterilă, se înmulțeşte doar pe cale vegetativă, prin divizarea rizomilor. Rizomii de culoare bronzată (fig. 1) au forme neregulate, cu protuberanțe şi chiar ramificații pronunțate, grosimea lor variind între 7 si 12 mm. La suprafață se observă nodurile rizomilor sub forma unor inele transversale solzoase al căror număr variază în funcție de lungimea rizomilor iar pe inele se formeaza mugurii vegetativi. Pentru plantare în câmp se folosesc rizomi tineri (cel mult de trei ani), sănătoşi, fără zbârcituri sau vătămari mecanice, cu lungimea de 10...15 cm şi greutatea de 40...60 g, având cel puțin 3...4 muguri viabili.

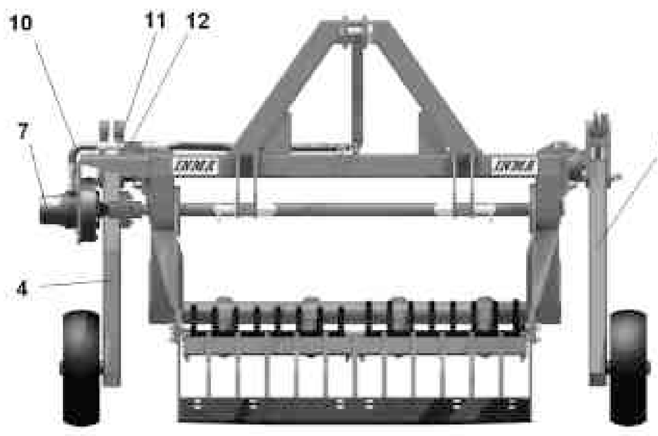
Fig. 1. Rizomi de Miscanthus

Rizomii având o geometrie aparte, pentru a uşura procesul de separare ulterioară a acestora de bulgării de pământ care aderă de suprafața lor, terenul va fi supus unei prelucrări cu un cultivator rotativ. Această operație va realiza pe langă mărunțirea particulelor de sol (afânarea solului) şi reducerea în dimensiune a ramificațiilor rizomilor facilitând în acelaşi timp decolmatarea cuiburilor de rizomi. Această operație se realizează într-o singură trecere. După ce terenul a fost prelucrat utilizând cultivatorul rotativ, se trece la recoltarea rizomilor.

Ținând cont de cele prezentate mai sus, INMA Bucureşti a conceput şi realizat un echipament tehnic de recoltare a rizomilor de Miscanthus, care răspunde cerințelor agrotehnice pentru înființarea şi recoltarea culturilor de Miscanthus, care lucrează în agregat cu tractoarele de 70...80 CP pe roți prevăzute cu mecanisme de suspendare în trei puncte de categoria 2 conform SR ISO 730-1+C1.

Echipamentul execută operația de dislocare a rizomilor de Miscanthus din masa de sol şi separarea acestora de pământ. Procesul de dislocare constă în afânarea adâncă a solului fără întoarcerea acestuia, distrugerea legăturilor dintre sol şi rizomi şi împingerea în sus a acestora către grătarele oscilante, care prin cernere separă rizomii de impurități şi pământ şi îi lasă pe sol în brazdă, urmând a fi încărcați în mijloace de transport.

Echipamentul tehnic (fig. 2) este o construcție robustă şi are în componentă următoarele subansambluri principale:
- Cadru, poz. 1;
- Separator cu excentric, poz. 2;
- Brăzdar de disclocat, poz. 3;
- Roată stanga, poz. 4;
- Roată dreapta, , poz. 5;
- Suport motor hidraulic, poz. 6;
- Motor hidraulic OMEW F 400 produs de firma SAUER DANFOSS, poz. 7;
- Tub flexibil cu supapă, reper 31.50.050. II, poz. 8;
- Racord 1, poz. 9.
- Tub flexibil 31.50.049. II, poz. 10.;
- Racord 2, poz. 11;
- Regulator de debit HK V2 190 A800 produs de firma HANSA FLEX, 12.



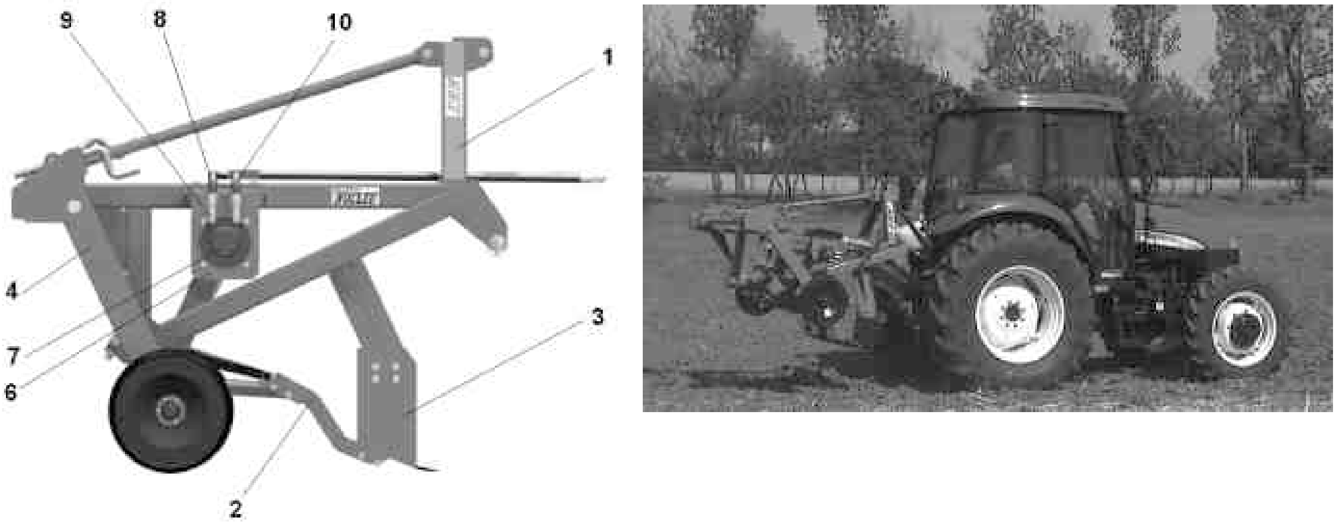


Fig. 2. Echipament tehnic de recoltare a rizomilor de Miscanthus

Cadrul echipamentului(fig. 3) este este o construcție sudată din țevi de secțiune pătrată şi rotundă şi o bară de secțiune rotundă pentru rigidizare. Partea anterioară a cadrului sudat este o construcție sudată, din țeavă de secțiune pătrată, pe care sunt prevăzute cele trei puncte de prindere la mecanismul de suspendare în trei puncte al tractorului.

Fig. 3. Cadru

Separatorul cu excentric (fig. 4) este destinat pentru curățirea de pământ prin scuturare şi transport a rizomilor de Miscanthus dislocați spre spatele maşinii. Acesta are în componență un suport pe care sunt prevăzute nişte muchii tăietoare pe direcția de înaintare care fac un unghi de g cu verticală, două grătare oscilante care preiau masa de pământ dislocată împreună cu rizomii şi un mecanism oscilant cu excentric care realizează un efect vibrator optim astfel încât să se desprindă de rizomi şi să cadă pe sol printre vergelele grătarului.

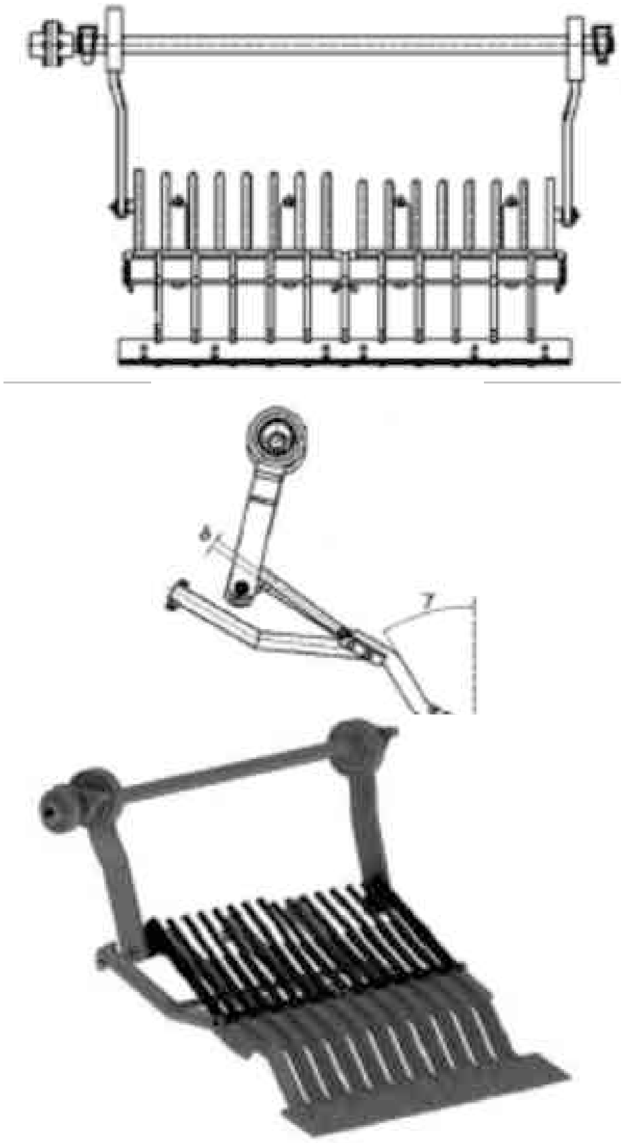


Fig. 4. Separator cu excentric

Brăzdarul de dislocat (fig. 5), pentru a da rezultate bune şi pentru a intra în toate tipurile de sol, este conceput cu o muchie tăietoare care taie solul într-un plan perpendicular pe direcția de înaintare cu un unghi acu orizontala şi cu un ridicător ce face cu orizontala un unghi b care, în timpul lucrului se deplasează sub rizomii pe care îi ridică pe un separator care are în componență un suport pe care sunt prevăzute nişte muchii tăietoare pe direcția de înaintare care fac un unghi g cu verticala, două grătare oscilante, montate defazat unul față de celălalt cu un unghi d, care preiau masa de pământ dislocată împreună cu rizomii şi un mecanism oscilant cu excentric acționat de un motor hidraulic care realizează un efect vibrator optim astfel încât pământul să se desprindă de rizomi şi să cadă printre vergelele grătarului.

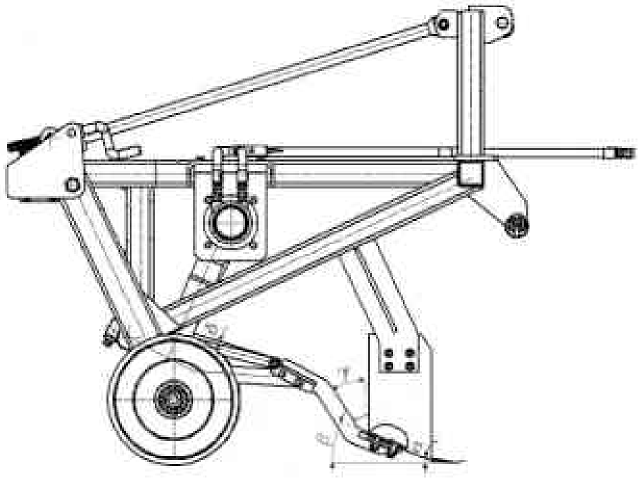


Fig. 5. Brăzdar de dislocat

Motorul hidraulic rotativ se alimentează prin intermediul unui regulator de debit de la pompă într-un sens sau altul prin comanda dată corespunzător distribuitorului, astfel încât rotația de la ieşirea motorului rotativ se aplică unui mecanism cu excentric (fig. 6). Se poate astfel regla comod şi stabil efectul vibrator al grătarului cu vergele, sistemul fiind şi foarte rigid.

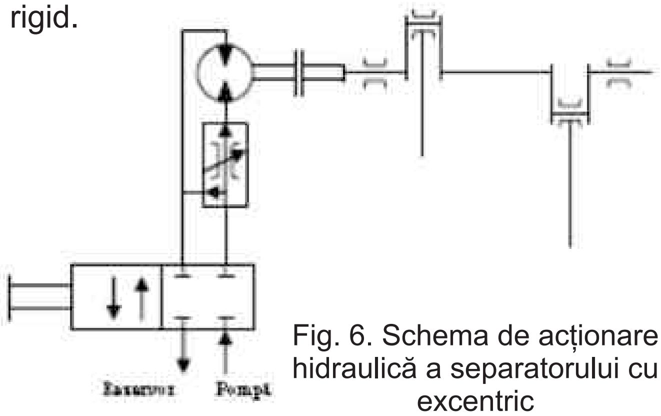


Fig. 6. Schema de acționare hidraulică a separatorului cu excentric

Roata stânga (fig. 7) şi roata dreapta (fig. 8), sunt destinate pentru reglarea şi limitarea adâncimii de lucru. Acestea sunt montate cu şuruburi pe bara anterioară a cadrului, simetric față de axa tractorului. Roțile sunt cu obadă iar pentru evitarea încărcării cu sol, acestea sunt prevăzute cu discuri laterale ambutisate şi sudate pe obadă şi butuc. Roțile sunt prevăzute cu rulmenți şi se rotesc pe axele sudate pe suporții metalici din țeavă de secțiune dreptunghiulară. Reglarea poziției roților se face prin intermediul unei manivele filetate, care reglează continuu la valoarea dorită nălțimea roților față de planul tăişului brăzdarului de dislocat.

Fig. 7. Roată stanga Fig. 8. Roată dreapta

CARACTERISTICI TEHNICE

Principalele caracteristici tehnice ale echipamentului tehnic de recoltare a rizomilor de Miscanthus ERR sunt prezentate în tabelul 1

Modelul experimental, realizat de INMA Bucureşti, va fi încercat în condiții de laborator şi exploatare la recoltat rizomi de Miscanthus, în vederea determinării indicilor calitativi de lucru şi de exploatare. În urma încercărilor se vor definitiva cerințele tehnologice ale acestui model experimental şi se vor definitiva cerințele tehnico-economice ale tehnologiei de cultivare în țara noastră a culturii de Miscanthus.

CONCLUZII

- Conform cu scenariile prevăzute de UE, este probabil ca Miscanthusul să fie unul din contributorii majori la mix-ul energetic regenerabil al viitorului; - Echipamentul tehnic pentru recoltat rizomi de Miscanthus prezintă următoarele avantaje față de echipamente similare aflate în exploatare:- o mai bună dislocare a rizomilor de Miscanthus datorită soluției constructive a brăzdarului de dislocat; - o mai bună separare de pământ a rizomilor de Miscanthus datorită soluției constructive a separatorului prevăzut cu muchii tăietoare pe direcția de înaintare şi două grătare oscilante montate defazat unul față de celălalt; - un consum energetic redus datorită soluției de acționare a mecanismului oscilant cu excentric cu un motor hidraulic - o construcție simplificată datorită soluțiilor noi alese care îi conferă realizare uşoară din punct de vedere tehnologic, siguranță în exploatare, întreținere, reglaje simple şi uşor de exploatat de către un singur operator (tractoristul).

Tabelul 1

Caracteristica tehnică	Valoarea
Lățimea de lucru, m	1,2
Adâncimea de lucru, cm	max. 25
Modul de acționare a transportorului de separare	hidraulic
Dimensiuni de gabarit, mm	
- lățime	2090
- lungime	1590
- înălțime	1395
Garda la sol, mm	350
Masa, kg	565

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MODERN MANUFACTURING FROM RESEARCH TO INDUSTRIAL APPLICATIONS BY ELABORATION OF METHODS, PROCESSES AND NEW MULTIPURPOSE AND FLEXIBLE PROCESSING EQUIPMENTS, WHICH ARE NEEDED IN THE MANUFACTURING PROCESSES FROM THE MACHINE BUILDING INDUSTRY

Eng. Nicolae Ştefan POPESCU, Eng. Valeriu AVRAMESCU, Dr. eng. Ştefan Tudorel CRĂCIUNOIU, Eng. Gheorghe ORASANU, Eng. Catalin Horia ORASANU

The main objective of the project is the development of a multipurpose machine tool which to offer the possibility of the development and using, on the same equipment, of the following processing technologies: electrical discharge machining, electrochemistry, electro-chemical-thermal treatment, spark deposit, welding.

The project is developed by a consortium mode of:

1. SC ICTCM Institutul de Cercetare si Proiectare Tehnologica pentru Constructii Maşini SA, Bucureşti – CO;
2. Asociația Romana pentru Tehnologii Neconvenționale – ARTN, Filiala Bucureşti – P1;
3. Fundația Profesor Constantin Popovici, Bucureşti – P2;
4. SC EAST ELECTRIC SRL, Bucureşti – P3;
5. Institutul National de Cercetare-Dezvoltare în Sudura şi Încercări de Materiale, ISIM Timişoara – P4.

The multipurpose machine tool (which to offer the possibility of the development and using, on the same equipment, of the following processing technologies: electrical discharge machining, electrochemistry, electro-chemical-thermal treatment, spark deposit, welding) that is developed in this project has the next main characteristics:

·Maxim volume of the work piece: 500x300x200 mm,
·The volume of the work tank: 700x500x350 mm,
·Displacement on X,Y,Z,U,V: 400x225x200x100x100 mm,
·Machine tool size: 2650x1700x2200 mm,
·Total space of the machine tool (including all equipments): 4500x3500 mm,
·Installed power: 56 kW,
·The work piece and the tool, electrical isolated, are connected to the impulse electrical generator,
·When it is at a distance equal to the work interstitium, depending on the type and duration of the electrical impulse made by the electric generator and the type of the work fluid that is between the work piece and the tool, it is made the process of piece material removal by melting, vaporization, boiling, anodic displacement and / or combinations,
·The mechanical structure of the multipurpose machine tool does the necessary movement between work piece and tool to facilitate the energy concentrated transfer between the two elements of the technological system and for proceeding the technological process as necessary,
· The multipurpose machine tool generator has a force equipment made of a transformer and its protection systems, and the command part, made of a computer, offer the form, duration and intensity of the electrical impulses that are specific to each technological process,

·The equipment for technological fluids regeneration and management has a mechanic subassembly of filtration made of pomp for fluid and a module for the separation of the micrometric particles, as well as other systems for a better filtration.The multipurpose machine tool has the main components:

The frame on which are placed the elements for work piece or tools displacement for trajectory generation,

·Command equipment,

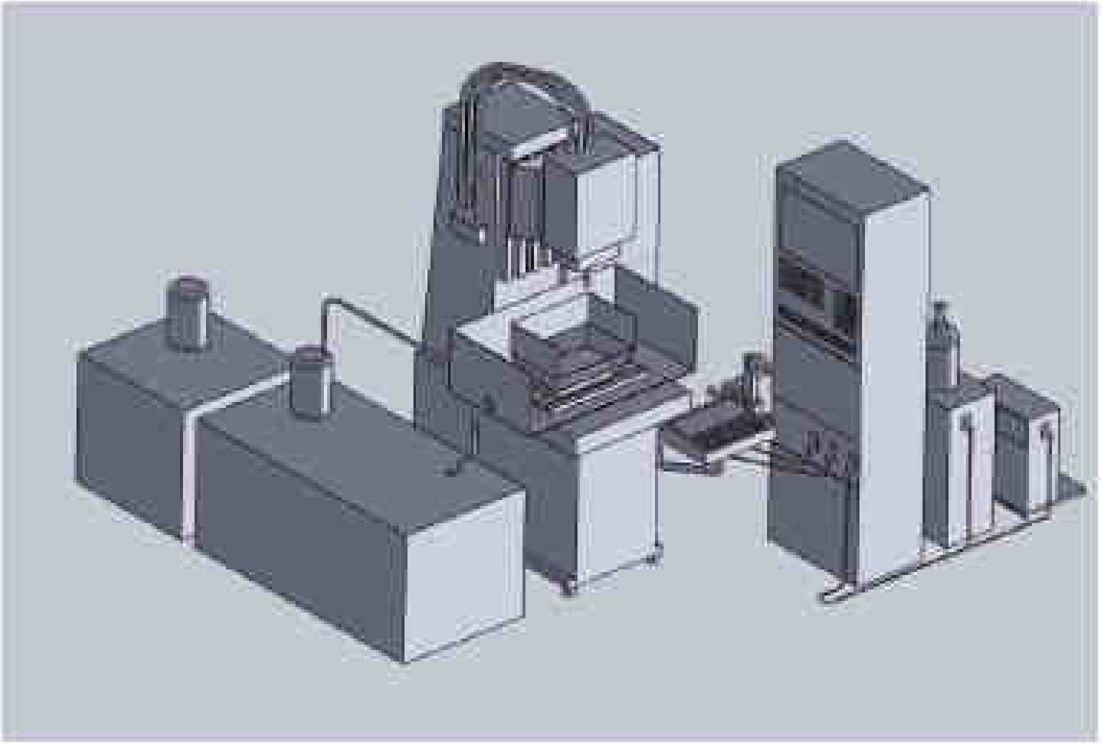
·Electric generator for work parameters,

·Equipments for work fluid storage, management and using, Mechanical structure for the trajectory generation of the machine tool, equipped with at least 5 axis for movement controlled by a CNC system, being made, partial or total from non metallic materials (fiber composites, robber), which offer both electrical isolation between work piece and tool, and the necessary mechanical resistance necessary for the loads which appear during the specific nonconventional processing, ·The machine tool is equipped with an impulse electrical generator that is controlled by computer, which offer, by operating the movement axes, the work regimes specific to each process, the necessary protections, as well as the monitoring of the specific work parameters,

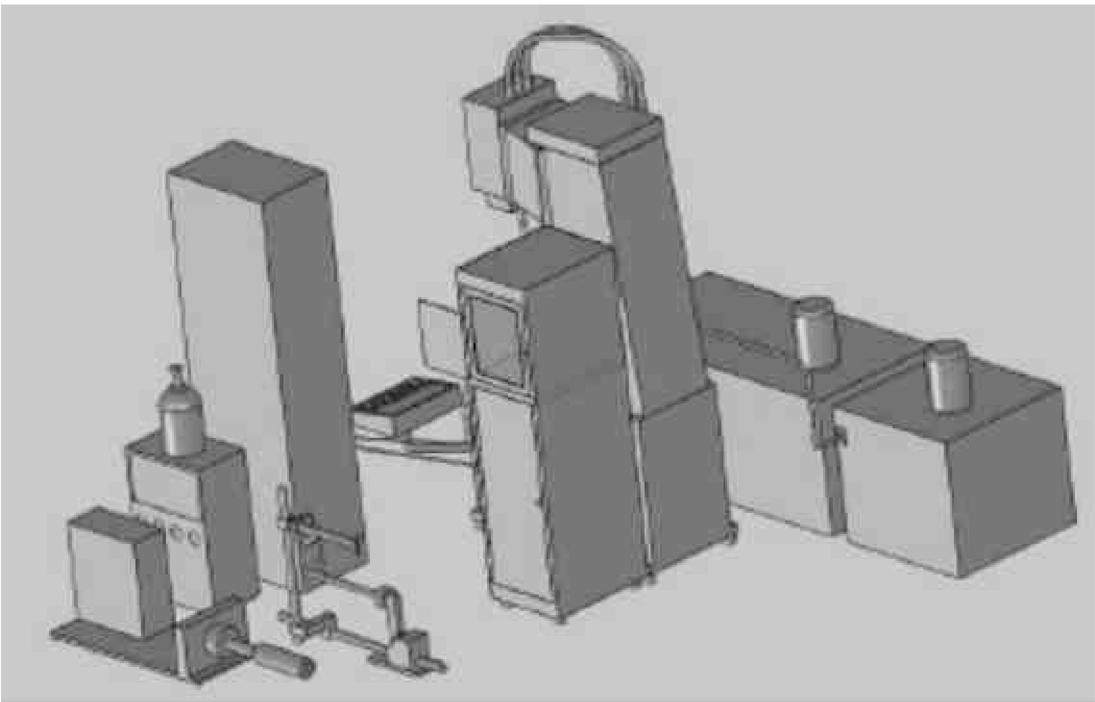
·The machine tool has an equipment for work fluid storage, management and using, installations equipped with a tank for each work fluid, one or more for the liquid for installation washing, with circulation pumps and installations for mechanical filtration with spin and filtrations elements made of paper, ceramic and canvas. The multipurpose character of the machine tools is provided also by the specific characteristic of an electric generator and by a structure that is generating trajectories which allow on the same machine tool, to be made other processing like: welding, spark deposit. The processing and electrical fluxes are complementary. So, electrical discharging processing with solid electrodes used for work pieces with complex configurations, usually concave, like auto body frame components. The minimum obtained roughness is Ra=0,6. For getting high geometrical qualities for surfaces is recommended electrochemical polish. Also, the electrochemical process is used for complex work piece deburring. The electro-chemical-thermal treatment and spark deposit are used for increasing the mechanical properties of the pieces surface, the first one for small piece and the second one for big piece.From this machine tool can't be taken out the oldest electrical process – welding, which has a new dimensions when applied on a CNC mechanic frame.

Obtained results:

- The research report which presents the analyses and data base processing for establishing the technical-scientific principles and the potential solutions for the conceptual elaboration and technological system dimensioning (multipurpose machine tool) for nonconventional processing with concentrated electrical fluxes.
- The lab technology for the verification of the processing processes.
- Manufacturing documentation for the technological components system (multipurpose machine tool), together with specification.
- Identification and protection of the intellectual property rights. The original solutions were protected with a patent with title “Multipurpose machine tool for electrical processing with CNC” registered at OSIM cu no. A/01044/14.12.2009. - Business plan.

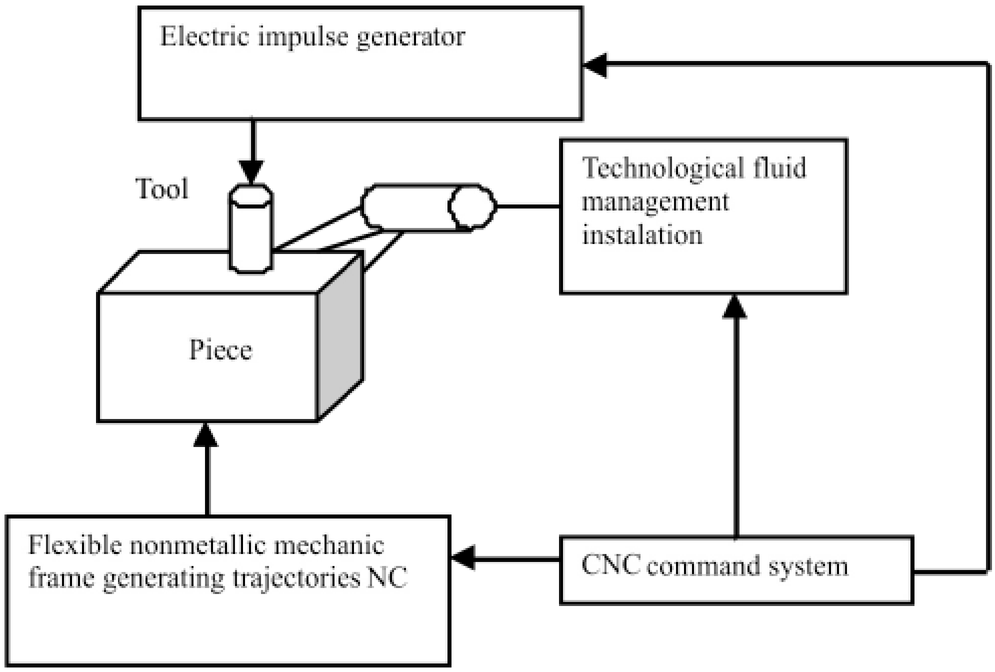


Multipurpose machine tool for nonconventional processing with concentrated electrical fluxes, with CNC – front view



Multipurpose machine tool for nonconventional processing with concentrated electrical fluxes, with CNC – back view

Machine tool diagram



Economical effects

1. Effects at manufacturer:
- Recovery period of the expenses is 2 years.

2. Effects at users:
- the possibility of the processing for a high diversity of work pieces,
- costs decreasing with 60-80%,
- the exploitation cost decreasing ~ 15%,
- the productivity increase ~ 100% - 150%,
- the maintenance cost decreasing ~ 10%,
- eco-efficient technologies: there are no contaminant and noises.

ANALIZA COMPARATIVA A ACTIONARILOR ELECTROMECANICE SI ELECTROHIDRAULICE INTILNITE IN COMPONENTA MASINILOR DE DEFORMARE PLASTICA LA RECE

ing. Florin Georgescu, ing. Sandu Lucian - INOE 2000-IHP Bucuresti

Abstract:

The article makes a comparative analysis of various electromechanical and electrohydraulic drives component encountered in cold metal forming machines. Also, the article makes reference to several types of cars that will be run in partnership between INOE 2000-IHP Bucharest and an enterprise of our country.

In ultimii ani, s-a constatat o crestere semnificativa din partea IMM-urilor pentru masini de prelucrare prin deformare plastica la rece, echipate cu dispozitive anexe capabile sa execute operatii si forme specifice (spiralare, rasucire, indoire la unghi etc.).

Majoritatea acestor IMM-uri provin din domeniul constructiilor civile si industriale, dar si a micilor ateliere cu activitati de prelucrari mecanice.

Astfel de masini se vor realiza in viitorul apropiat printr-un parteneriat format de INOE 2000-IHP BUCURESTI si o intreprindere din tara, cuprinzind un numar de 4 masini:

*masina de indoit profile echivalent bara rotunda 15, cu actionare electromecanica a rolelor si reglaj manual

*masina de indoit profile echivalent bara rotunda 30, cu actionare electromecanica a rolelor si reglaj manual

*masina de indoit profile echivalent bara rotunda 45, cu actionare electromecanica a rolelor si reglare hidraulica

*masina de indoit profile echivalent bara rotunda 60, cu actionare electrohidraulica a rolelor si reglare hidraulica.

In componenta acestor masini de deformare plastica la rece se regasesc actionari electromecanice si electrohidraulice, tipul de actionare fiind decis de dimensiunile si caracteristicile mecanice ale profilurilor necesare a fi deformate.

In fig. 1 se prezinta schema cinematica a unei actionari de tip electromecanic, in care:

Me = motor electric mono sau trifazat, cu 2 turatii n_1 / n_2 (3000 / 1500 rpm sau 1500 / 750 rpm)

Rm = reductor mecanic

Ta = tren de angrenaje

Ra = 2 role de actionare

Rf = 1 rola de fixare

Am = actionarea manuala (tip surub-piulita) a rolei de fixare

n_i = diversele turatii, obtinute datorita angrenajelor

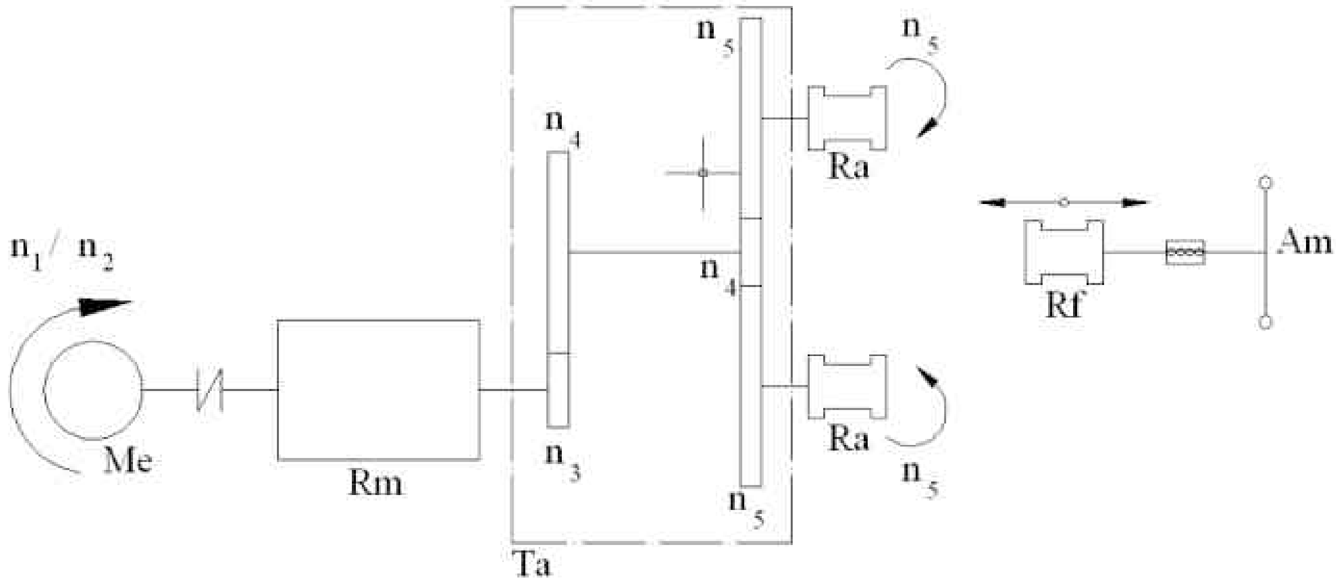


Fig. 1: Schema cinematica a unei actionari de tip electromecanic

In figura nr. 2, se prezinta o vedere generala a unei masini de indoit profile echivalent bara rotunda 15...30, cu actionare electromecanica a rolelor si reglaj manual.

Partile principale ale unei masini cu actionare electromecanica sunt:

-subansamblul electromotor-reductor, compus din motorul electric care furnizeaza puterea de antrenare si o transmisie de tip melc – roata melcata care are rolul de a reduce turatia acestui subansamblu si asigura totodata o mai buna uniformitate a transmisiei;

-subansamblul constituit dintr-un set de roti dintate, care preia miscarea de la transmisia melc - roata melcata, o reduce in continuare si o transmite rolelor de deformare a profilelor;

-batiul masinii, respectiv subansamblul mecanic care sustine toate celelalte subansamble si dispozitive de lucru utilizate in procesul tehnologic;

-dispozitivele de lucru necesare in procesul tehnologic pentru realizarea formelor dorite;

-subansamblul elementelor de automatizare, cu care se realizeaza comenzile de lucru in procesul tehnologic.

Avantajele si dezavantajele actionarii electromecanice:

1. Avantaje:

-complexitatea redusa a structurii, avind in componenta, de regula, elemente din fabricatia curenta;

-intretinerea relativ usoara, care nu necesita cunostiinte speciale (in mod deosebit reglajele) din partea operatorului;

-costuri scazute legate de realizarea masinii, ceea ce permite o amortizare rapida a investitiei.

2. Dezavantaje:

-turatie constanta de antrenare a rolelor de deformare, care nu poate fi reglata la diverse nivele cerute de natura materialului folosit la profile (caracteristici mecanice si rigiditati diferite);

-imposibilitatea realizarii unei variatii de putere convenabile in timpul actionarii;

-uzuri mecanice in sistem care influenteaza la rindul lor forma profilelor prelucrate.

Acest tip de actionare se utilizeaza de regula in unitatile de productie ce confectioneaza profile cu aceeasi configuratie (numar restrins ca forma) in cantitati mari folosind un singur set de dispozitive.

Fig.2: Masina de indoit profile echivalent bara rotunda 15…30, cu actionare electromecanica a rolelor si reglaj manual.

In fig. 3 si 4, se prezinta schemele de actionare electrohidraulice in doua variante:
*Actionarea electro-hidraulica (varianta 1 / fig. 3), in care:
Uh = unitate hidraulica de actionare
Ch = cilindru hidraulic de pozitionare-fixare a rolei de fixare
Mhr = motoare hidraulice rotative
Ra = 2 role de actionare
Rf = 1 rola de fixare
*Actionarea electro-hidraulica (varianta 2 / fig. 4), in care:
Uh = unitate hidraulica de actionare
Ch = cilindri hidraulici de pozitionare-fixare a celor 2 role de actionare
Mhr = motoare hidraulice rotative
Ra = 2 role de actionare
Rf = 1 rola de fixare

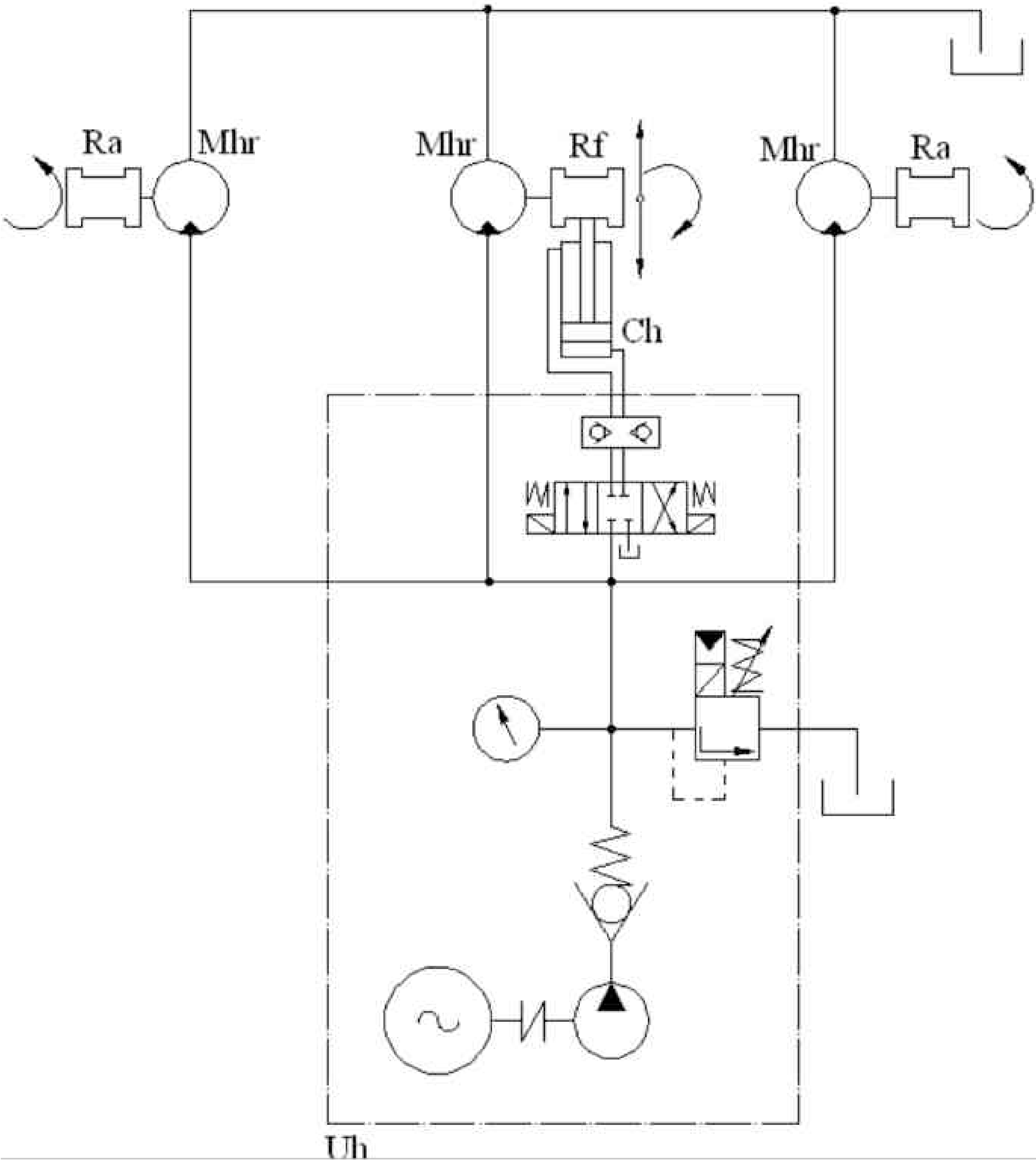


Fig. 3: Schema de actionare electro-hidraulica (varianta 1)

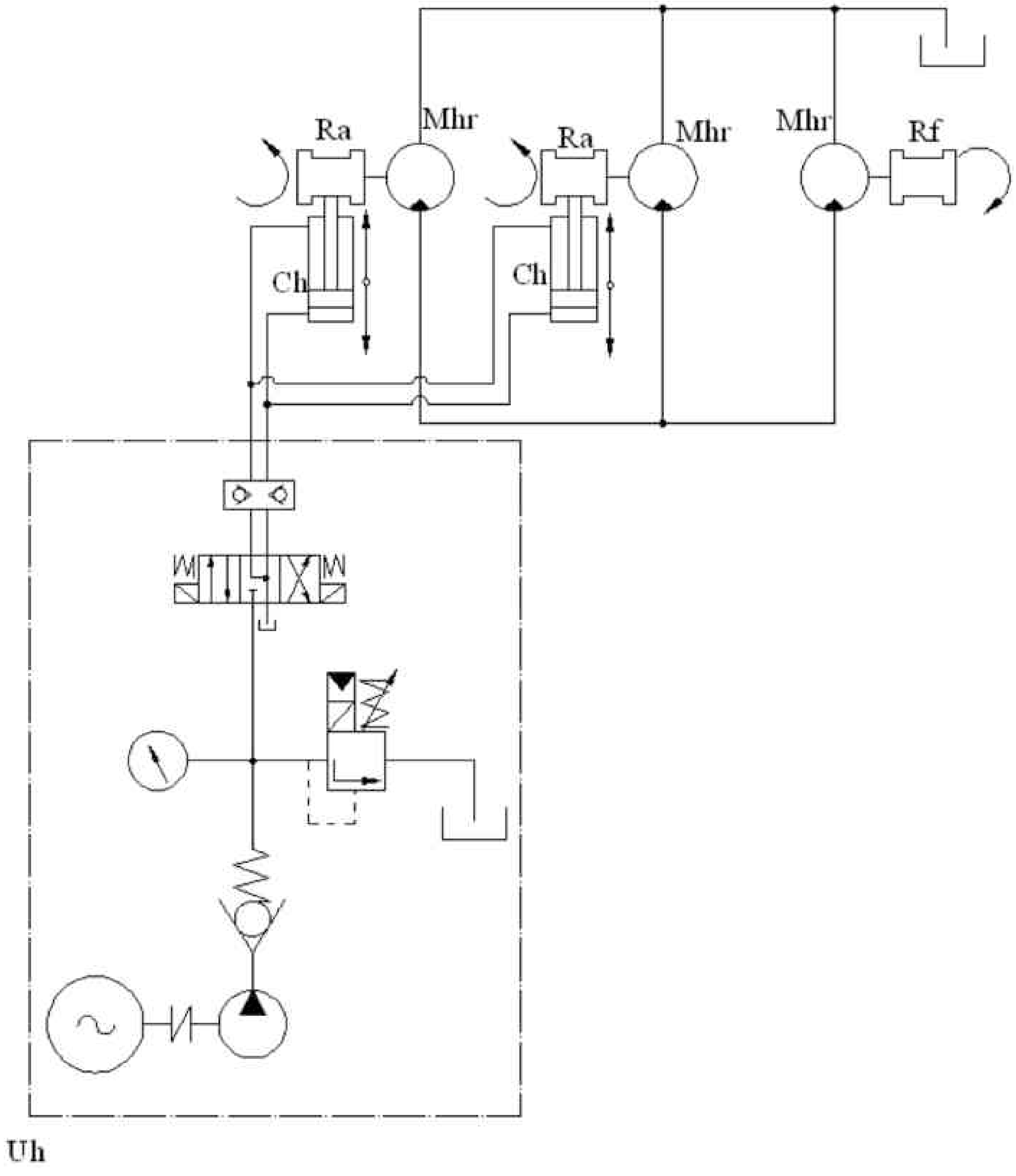


Fig. 4: Schema de actionare electrohidraulica (varianta 2)

Cele doua variante de actionari electro-hidraulice, se deosebesc prin:

-varianta 1: pozitia pe verticala a rolei de fixare este reglabila, datorita actionarii prin intermediul unui motor

hidraulic liniar, in timp ce rolele de antrenare sunt fixe;

-varianta 2: pozitiile pe verticala a rolelor de actionare sunt reglabile, realizata prin pozitionarea a doua motoare hidraulice liniare, in timp ce rola de fixare este fixa.

Partile principale ale acestui tip de actionare sunt:

-grupul hidraulic de actionare (motor electric mono / trifazat cu 2 turatii de antrenare, pompa hidraulica de alimentare, aparatura de reglaj-distributie etc.) si motoare hidraulice liniare (sau rotative);

-echipamentele de automatizare si reglare.

Avantajele si dezavantajele actionarii electrohidraulice:

1. Avantaje:

-grupul hidraulic de actionare poate fi amplasat pe masina in pozitie convenabila, atit vertical cit si orizontal, in scopul asigurarii unor conditii optime de manevrabilitate pentru operator, dar si acelor impuse de tipul de profil de deformat;

-posibilitatea reglarii turatiei de antrenare a rolelor laterale, conform cu rigiditatea materialului profilului, reglare posibila prin folosirea motoarelor hidraulice rotative;

-posibilitatea utilizarii unei game largi de dispozitive pentru deformare, datorita avantajelor oferite de actionarea hidraulica prin posibilitatile largi de reglare a parametrilor acestui tip de actionare (presiune si debit, respective forta si moment de deformare).

2. Dezavantaje:

-costuri mult mai mari legate de realizarea fizica a masinilor, care pot fi amortizate pe o durata mai indelungata de timp

-o pregatire superioara pentru personalul destinat sa lucreze pe masina, lucru care implica si costuri superioare.

Ca urmare a celor prezentate, se poate concluziona ca finalizarea parteneriatului dintre INOE 2000-IHP BUCURESTI si o intreprindere din tara prin executarea celor 4 masini de prelucrare prin deformare plastica la rece si a dispozitivelor anexe, isi va atinge scopurile initiale, printre care:

-cresterea productivitatii unei intreprinderi românesti si reducerea decalajelor fata de productivitatea medie la nivelul Uniunii Europene;

-realizarea unui parteneriat viabil intre un institut national de cercetare-dezvoltare, prin derularea de activitati de cercetare-dezvoltare in sprijinul unei intreprinderi din tara;

-satisfacerea cererii de astfel de produse de pe piata interna, reducindu-se astfel efortul valutar al tarii;

-cresterea nivelului tehnic al intreprinderilor românesti prin dotarea cu masini si utilaje necesare productiei respective, achizitionate prin fonduri proprii, precum si a experientei tehnologice respective dobindite prin punerea in practica a rezultatelor de cercetare - dezvoltare.

SOLUȚII DE ACȚIONARE UTILIZATE ÎN CONSTRUCȚIA MAŞINILOR DE TIP PIRAMIDAL PENTRU ÎNDOIT PROFILE

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Abstract: profile bending machines are found in the work of many companies in mechanical engineering, construction and facilities, etc. For SME type businesses, a particularly suitable choice through price / quality ratio is the roller bending machine, pyramidal type. For their operation is used mechanical, electro-mechanical or electro-hydraulic drive, depending on the size of the processed profiles.
Keywords: bending machine, roll, hydraulic drive

1. Introducere

Deformarea profilelor este o operație întâlnită în majoritatea proceselor tehnologice de prelucrare a materialelor metalice, permițând obținerea de forme complexe; mijloacele de prelucrat sunt diverse, de diverse complexități, deseori în funcție de capacitatea agentului economic care utilizează acest tip de maşină. Pe plan mondial, profilele deformate plastic au o utilizare foarte largă la ora actuală; câteva domenii de utilizare ar fi:

- Industria navală: cadre din componența vaselor de diferite mărimi, sisteme de închidere etanşă, pasarele şi accesorii pe puntea navelor, mobilier, bărci de agrement şi pescuit, construcții de docuri şi instalații portuare, barje, etc.
- Industria petrochimică: serpentine ale schimbătoarelor de căldură, şevi, tuburi, flanşe, structuri din fabrici (balustrade, cuşti pentru scări), rezervoare de stocare, turnuri de răcire
- Industria energetică şi electrotehnică: generatoare hidro-electrice, uzine nucleare, conducte de protecție şi conductori
- Construcții civile: poduri, autostrăzi, stații pentru desalinizare, tratare ape uzate, drenaje, canale colectoare, componente de tuneluri, arhitecturi speciale, cadre pentru ferestre şi uşi, scări în spirală, escaladoare, elevatoare speciale.
- Industria aeronautică: hangare pentru aeronave, corpuri de rachete şi aeronave, componente pentru sateliți, avioane, elicoptere, rampe de lansare, cupole pentru radare, antene parabolice, mobilier interior şi ornamente
- *Echipamente grele: cuşti de protecție şi servodirecții pentru utilaje, componente şasiu sau cabină, ghidaje, scripeți*
- Echipamente pentru agricultură: componente de tractoare, echipamente de lucru ale acestora, utilaje diverse, silozuri, structuri pentru surse de energie verde
- *Industria auto: bare de protecție, componente sistem direcție, componente pentru autobuze, scaune şi banchete, componente ale sistemelor de evacuare*
- Industria militară: arme grele sau uşoare, rachete, comunicații
- Mobilier divers domestic şi comercial: scaune, mese, dotări pentru baruri, semne de circulație, mobilier stradal, suporturi pentru iluminare stradală, mună artizanală, hobby, mobilier de baie
- Articole sportive şi de recreere: echip ment pentru camping, echipament pentru sporturi diverse, pentru exerciții

Din punct de vedere al tipului acționării maşinilor de deformat profile, acestea pot fi:

a. Cu acționare manuală, utilizate pentru secțiuni mici ale profilelor, în situații în care nu se cere o precizie deosebită; aceste maşini pot avea:

· acționare manuală directă, cu şablon sau cu role – forța manuală este amplificată prin mijloace mecanice: pârghii, roți dințate, etc.

· acționare manuală cu cilindru hidraulic – maşina dispune de o pompă manuală care alimentează cu fluid sub presiune un cilindru hidraulic, în capătul tijei acestuia aflându-se un profil de îndoire (accesoriu), pe care se mulează materialul de îndoit; pentru obținerea de forțe mari, sunt necesare presiuni de lucru ridicate, din domeniul 400...700 bar.

Pentru ambele variante, se impune existența unui număr mare de accesorii de îndoire, coroborat cu razele ce se doresc a se obține şi cu dimensiunile semifabricatelor.

b.Cu acționare mecanică, pentru îndoirea profilelor mai mari decât în cazul anterior :

· maşini cu acționare pneumatică, utilizate pentru diametre mici / medii şi unghi limitat de îndoire; sunt asemănătoare cu cele din prima categorie, forța de acționare manuală fiind înlocuită cu cea de la un cilindru pneumatic, alimentat la rețeaua de aer comprimat industrială

· maşini cu acționare electrică şi cu demultiplicare mecanică, utilizate pentru profilele de până la echivalent Ø 30 – sursa de energie este un motor electric + reductor, pentru a asigura forța de tragere necesară

· maşini cu acționare electro-hidraulică, utilizate pentru profile mai mari decât cele prezentate anterior

2. Maşini de tip piramidal utilizate pentru îndoirea profilelor – soluții de acționare adoptate

Maşinile pentru deformat profile de tip piramidal se bazează pe principiul tragerii materialului de deformat printre 3 role dispuse în formă de triunghi cu baza în jos; raza de îndoire se obține prin modificarea distanței dintre centrele rolelor – practic prin deplasarea uneia sau mai multor role față de celelalte, pe o traiectorie verticală sau apropiată de verticală; există şi varianta deplasării pe orizontală a rolelor inferioare, mai puțin folosită.

Tragerea se realizează datorită legării uneia sau mai multor role la un motor de antrenare; indiferent de natura motoarelor (electrică sau hidraulică), între acestea şi rola antrenată se interpune un reductor de turație, pentru a se trece de la turațiile relativ ridicate ale motoarelor la turațiile de ordinul 3...10...20 rpm ale rolelor antrenoare.

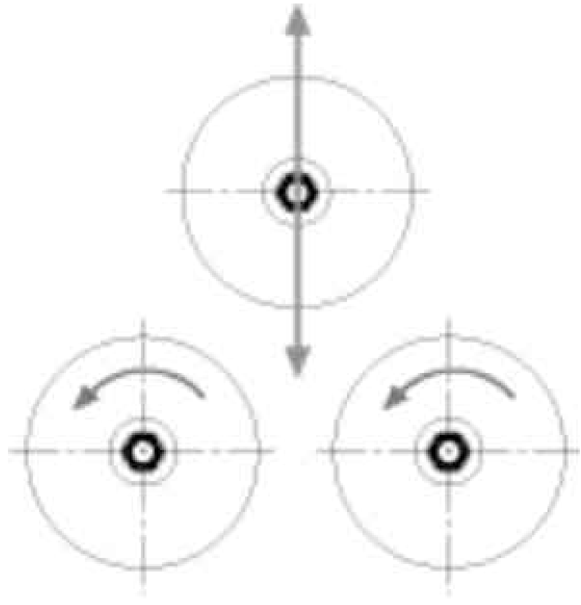


Figura 1 – Schema de principiu a maşinii de îndoit profile de tip piramidal

Modificarea poziției uneia sau mai multor role se face manual pentru variantele mai putin puternice de maşini, şi hidraulic pentru maşinile care prelucrează profile de dimensiuni mai mari.

Maşinile de tip piramidal – sunt cele mai performante maşini de îndoit profile de mici şi medii dimensiuni, fiind caracterizate de câteva particularități:

- 1, 2 sau 3 role de antrenare, ceea ce duce la o putere mare într-o structură compactă
- Manevrare facilă, fără efort din partea operatorului, mai ales în cazul reglării hidraulice a razei de îndoire
- Calitate ridicată a produselor obținute şi productivitate

Complexitatea este una medie, maşinile pot fi realizate în unități productive de tip IMM, având la bază un proiect specializat, realizat de o unitate cu experiență în domeniul acționărilor electro-mecano-hidraulice.

Firma SC PRESTCOM SA Focşani activează de aproape 20 de ani în domeniul producției de unelte şi scule metalice şi al echipamentelor hidraulice; la ora actuală, firma doreşte să îşi consolideze oferta de produse prin introducerea în fabricație a unei linii proprii de produse, orientându-se către o gamă de maşini de îndoit profile.

Pentru realizarea proiectului pentru întreaga gamă de maşini, firma a apelat la experienţa Institutului de Cercetări pentru Hidraulică şi Pneumatică, o unitate cu profil de cercetare, proiectare si productie in domeniul hidraulicii si pneumaticii, având experienţă şi în domeniul electronicii, mecanicii şi mecatronicii.

Întrucât firma a dorit ca în afara gamei de maşini să producă şi 3 tipuri de dispozitive, suma necesară derulării întregii lucrări este semnificativă, prin urmare s-a ales soluţia accesării unor fonduri europene, în cadrul Programului Operaţional Sectorial Creşterea Competitivităţii Economice, operaţiunea 2.1.1; această variantă permite diminuarea semnificativă a contribuţiei agentului economic şi derularea unui proiect mai amplu, care să acopere toate aspectele dorite.

La ora actuală, au fost analizate cele mai importante variante de maşini de îndoit profile de tip piramidal, stabilindu-se că pentru acoperirea gamei de profile uzuale ce se vor prelucra sunt necesare 4 mărimi de maşini, cu diverse tipuri de antrenare a rolelor şi de reglare a razelor de îndoire.

Soluţiile în baza cărora se preconizează că vor fi proiectate şi executate cele 4 maşini de îndoit profile sunt prezentate în continuare.

Schema din figura 2 se foloseşte în cazul maşinilor de mică / medie putere, de obicei pentru profile cu dimensiuni echivalente barelor rotunde pline cu $Ø_{max.}$ = 30 mm.

Deformarea iniţială a profilului, după aşezarea pe rolele inferioare, se realizează manual, cu ajutorul sistemului de reglare rază îndoire, care este un surub de forţă; în capul şurubului este fixată rola 1, iar deplasarea este vizualizată pe o rigletă. Cursa rolei superioare este marcată cu k.

Antrenarea se face datorită legării rolelor inferioare la un motor electric, prin intermediul unui ambreiaj care are rolul de a decupla motorul de trenul de role în caz de suprasarcină.

Demultiplicarea turaţiei motorului se face cu ajutorul unui reductor de turaţie P, care antrenează cele 2 roţi dinţate RD1 şi RD2 solidare cu rolele inferioare 2 şi 3. Pe durata prelucrării, profilul este susţinut de un sistem de sprijin SSp pentru a evita deformările nedorite înainte sau după ieşirea dintre role.

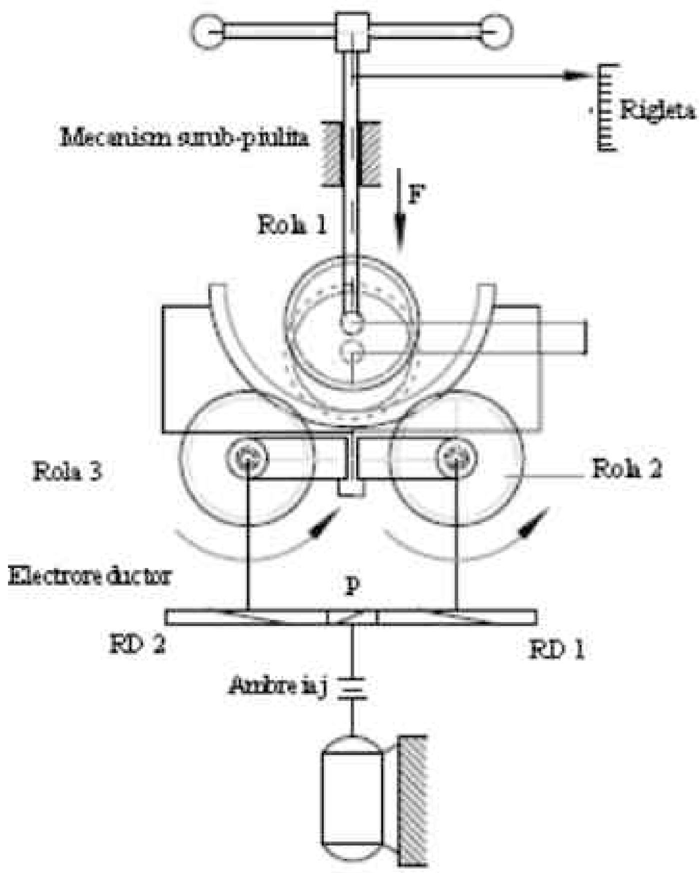
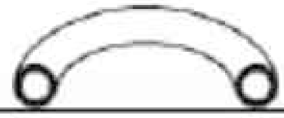
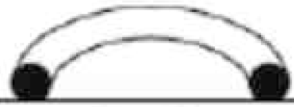
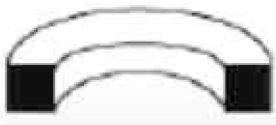
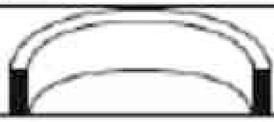


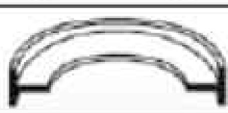
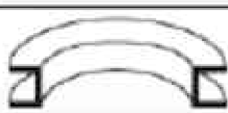
Figura 2 – Schema maşinii cu deformare manuală şi antrenarea rolelor inferioare (maşinile 1 şi 2)

Această schemă principială se utilizează în cazul maşinilor destinate îndoirii profilelor mai mici, cu dimensiuni echivalente barelor rotunde $Ø_{max}$ 15, respectiv 30 mm, pe baza ei urmând a se proiecta şi realiza cele mai mici 2 mărimi de maşini de îndoit profile. Profilele principale care se pot prelucra cu aceste 2 mărimi de maşini sunt prezentate în tabelele de mai jos; prin modificarea setului de role care se montează pe maşină în vederea deformării profilelor, capacitatea de utilizare a amaşinilor se poate extinde.

Tabelul 3.1 – Profile principale prelucrate cu maşini din categoria 1

Nr. crt	Tip semifabricat	Mărimea (mm)	Raza minimă de îndoire (mm)
1		Ø 25 x 2	100
2		Ø 15	100
3		15 x 15	100
4		25 x 5	125
5		40 x 10	100

Tabelul 3.2 – Profile principale prelucrate cu maşini din categoria 2

Nr. crt	Tip semifabricat	Mărimea (mm)	Raza minimă de îndoire (mm)	Nr. crt	Tip semifabricat	Mărimea (mm)	Raza minimă de îndoire (mm)
1		20 x 6 ... 50 x 10	200...350	7		20 x 20 x 3 ... 50 x 50 x 7	250...400
2		30 x 6 ... 80 x 15	200...350	8		20 x 20 x 3 ... 50 x 50 x 7	250...400
3		10 x 10 ... 30 x 30	100...600	9		30 x 15 x 4 ... 50 x 25 x 5	250...300
4		Ø 10...30	100...600	10		50 x 25 x 5	400
5		40 x 40 x 1,5	350	11		60 x 1,5	125...200
6		40 x 40 x 1,5	350	12		40 x 40 x 3	800

În cazul profilelor de dimensiuni mai mari, se utilizează antrenarea hidraulică pe verticală a rolei superioare, care reprezintă o soluție mai comodă şi care exclude efortul uman pentru deformarea inițială a profilului.

În acest caz, schema maşinii cuprinde şi subansamblul de acționare hidraulică a rolei superioare, compus din electropompă, aparatura pentru reglarea presiunilor şi debitelor la motorul liniar (pentru realizarea forțelor necesare şi a vitezei de deplasare a rolei), precum şi elementul de execuție, cilindrul hidraulic cu rol de motor (MR).

Pentru antrenare, se foloseşte ca şi în cazurile anterioare, un motor electric MA legat la rolele 2 şi 3 prin intermediului unui reductor cu roți dințate; pentru protecția mecanică la suprasarcini se intercalează un ambreiaj între motor şi reductor.
Profilul este sprijinit pe toată durata prelucrării pe sistemul de sprijin SSp.

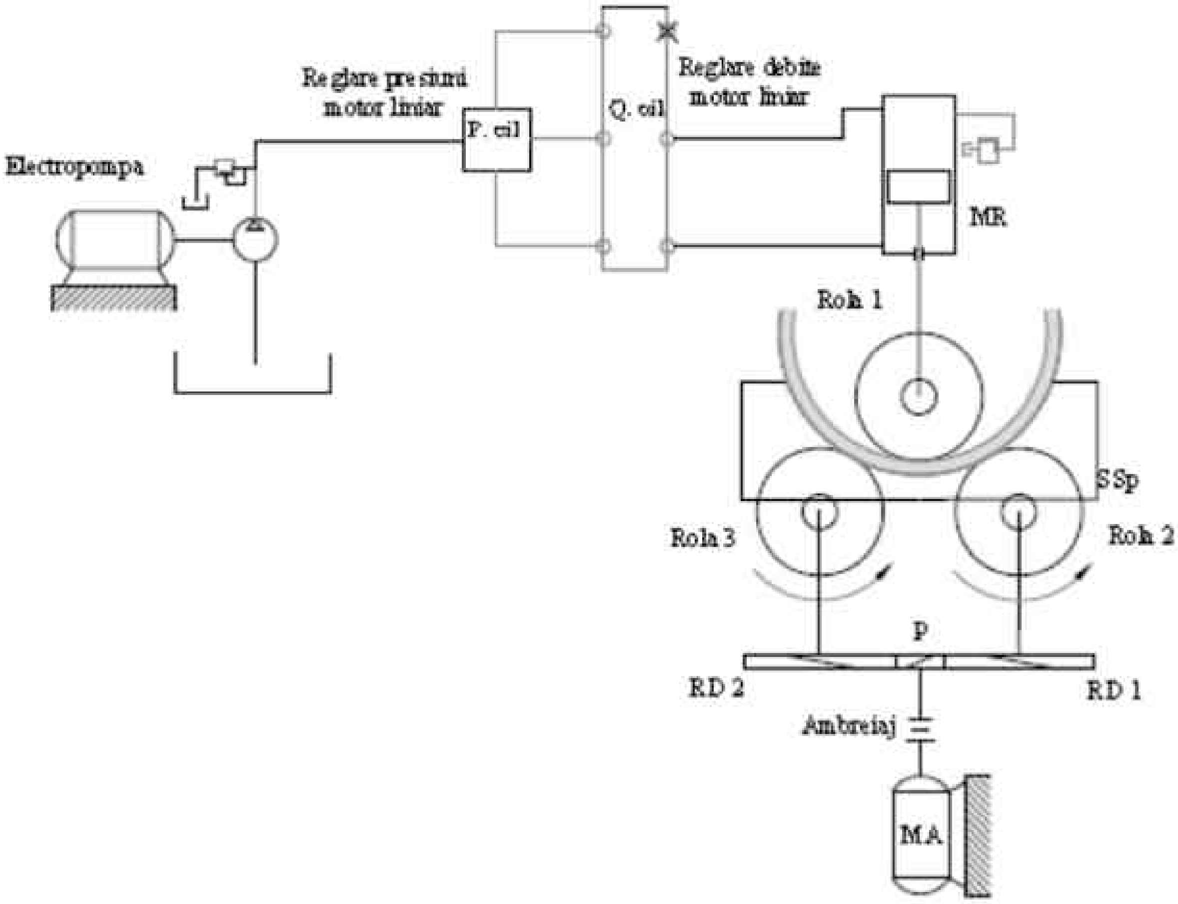


Figura 3 – Maşina cu deplasare hidraulică a rolei superioare (mărimea nr. 3)

Schema din figura 4 reprezintă o variantă a acestei maşini de deformat profile, la care antrenarea rolelor inferioare se face cu ajutorul a 2 motoare hidraulice lente, MA1 şi MA2, legate direct sau prin intermediul reductoarelor mecanice la rolele de antrenare a profilelor; în acest caz, rolele antrenate sunt cele inferioare, iar deformarea inițială a profilului este realizată tot hidraulic, cu un motor hidraulic liniar.

Grupul de alimentare cu energie hidraulică este reprezentat în schemă de electropompă şi el mai cuprinde toate componentele hidraulice care asigură presiunea şi debitele necesare la motoarele hidraulice liniar şi hidraulice; pentru alimentarea motoarelor rotative se poate utiliza o unitate de acționare hidraulică proprie.

Profilele ce se pot prelucra cu această maşină, în ambele variante de acționare a rolelor inferioare, sunt prezentate în continuare.

Tabelul 3.3 – Profile principale prelucrate cu maşini din categoria 3

Nr. crt	Tip semifabricat	Mărimea maximă (mm)	Raza minimă de îndoire (mm)	Nr. crt	Tip semifabricat	Mărimea maximă (mm)	Raza minimă de îndoire (mm)
1		90 x 12	450	7		60 x 60 x 4	1400
2		100 x 20	450	8		60 x 60 x 6	350
3		45 x 45	500	9		60 x 60 x 6	350
4		Ø 45	500	10		70 x 70 x 8	400
5		70 x 3	750	11		70 x 70 x 8	450
6		70 x 40 x 3	1200	12		U 100	500

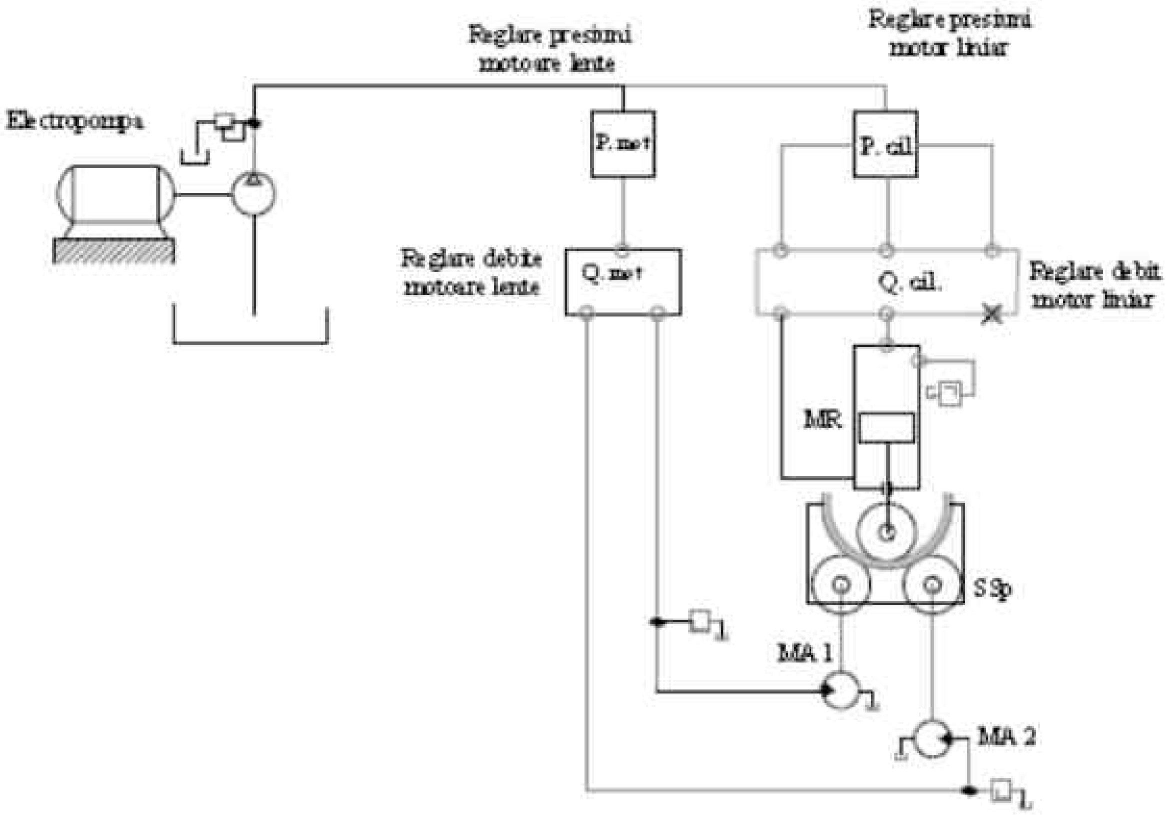


Figura 4 – Maşina cu deplasare hidraulică a rolei superioare şi antrenare hidraulică a rolelor (mărimea nr. 3 – variantă)

Pentru deformarea unor profile comparabile ca dimensiuni cu cele mai mari care se doresc a se realiza în cadrul proiectului actual, respectiv profile tip bară rotundă cu $Ø_{max}$ 60 mm sau profile diverse echivalente, este necesară o forță de deformare inițială mai mare (peste 20.000 daN), care se realizează cu ajutorul a 2 cilindri hidraulici, dispuşi astfel încât să acționeze asupra rolelor inferioare (figura 5).

În acest caz, nu mai este necesar cilindrul de reglare a poziției rolei superioare, deformarea inițială făcându-se cu ajutorul cilindrilor din partea inferioară a schemei, notați cu MR1 şi MR2; antrenarea rolelor inferioare se face cu ajutorul motoarelor hidraulice rotative de antrenare MA1 şi MA2.

Cei doi cilindri de reglare pot fi acționați unitar sau separat; în acest caz se pot obține raze de îndoire diferite la un profil – sistemul double-pinch.

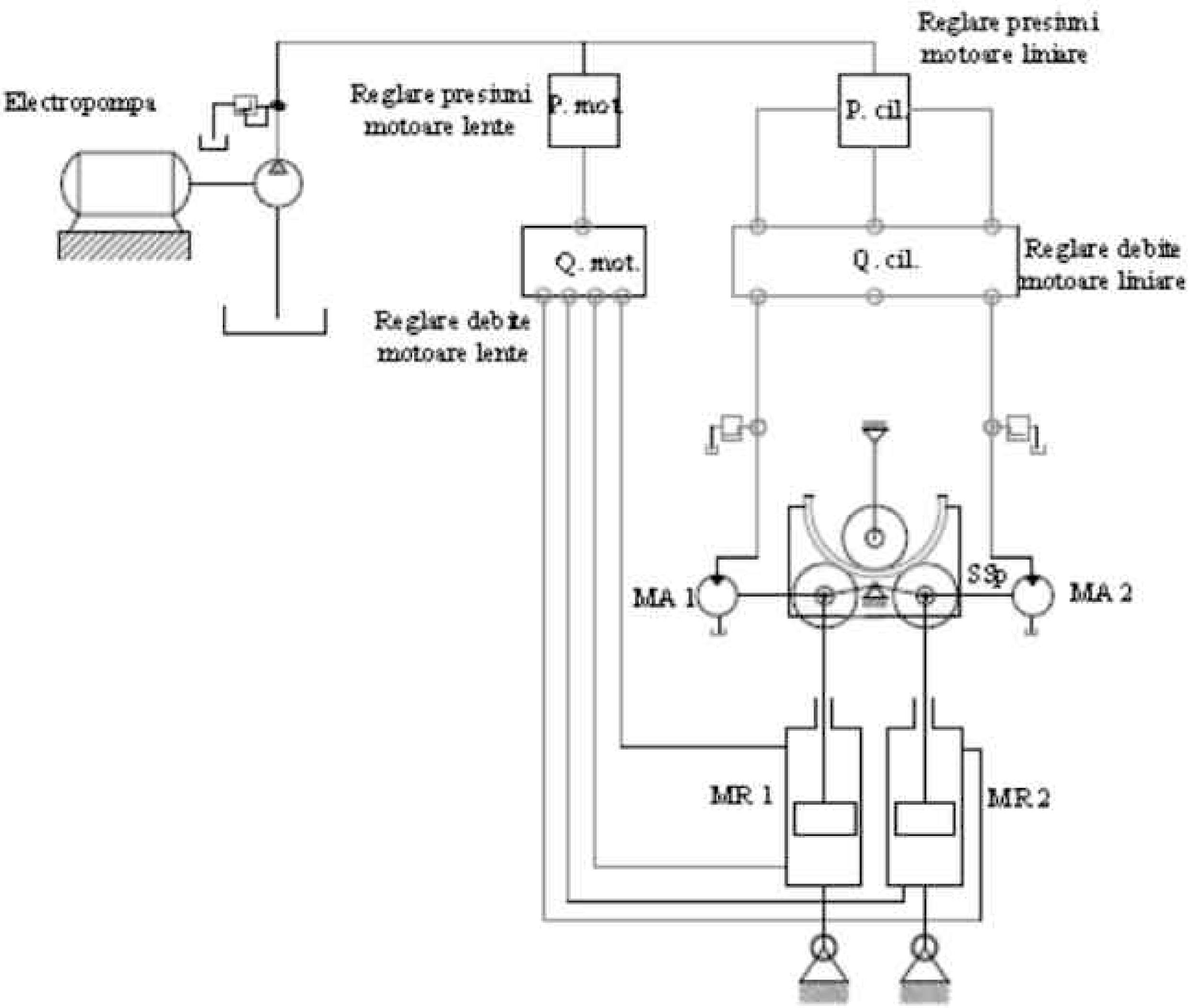


Figura 5 – Maşina cu deplasare hidraulică verticală a rolelor inferioare (maşina nr. 4)

Tabelul 3.4 – Profile principale prelucrate cu maşini din categoria 4

Nr. crt	Tip semifabricat	Mărimea maximă (mm)	Raza minimă de îndoire (mm)	Nr. crt	Tip semifabricat	Mărimea (mm)	Raza minimă de îndoire (mm)
1		130 x 20	600	8		80 x 80 x 10	500
2		140 x 30	550	9		60 x 60 x 6	500
3		60 x 60	550	10		100 x 100 x 10	600
4		Ø 60	550	11		100 x 100 x 10	600
5		120 x 2,5	1000	12		U 160	600
6		120 x 60 x 4	2000	13		U 160	600
7		100 x 100 x 5	2500	14		I 100	600

3. Concluzii

Maşinile pentru îndoit profile de tip piramidal sunt cele mai performante mijloace de prelucrat materiale metalice şi se utilizează pentru prelucrarea unui mare număr de profile, iar prin utilizarea seturilor de role profilate în concordanță cu profilul de lucru, aria de aplicabilitate a maşinilor se extinde.

La momentul actual, sunt stabilite soluțiile de acționare pentru cele 4 maşini din gama pe care SC PRESTCOM SA doreşte să o realizeze; soluțiile au fost alese în concordanță cu mărimea maşinilor, respectiv cu forțele de lucru necesare pentru deformarea inițială şi tragerea profilelor, după cum urmează:

- pentru cele 2 cele mai mici mărimi de maşini, deformarea inițială a profilelor se face manual, cu ajutorul şuruburilor de forță, iar antrenarea se face cu ajutorul unui electromotor şi reductor, pentru a se obține turații de lucru la nivelul rolelor de tragere în domeniul 3...10 rpm
- maşina de deformat profile mărimea nr. 3 va utiliza pentru deformarea inițială un cilindru hidraulic, iar antrenarea va fi electro-mecanică, asemănătoare cu cea din cazul anterior
- pentru maşina nr. 4 se va folosi deformarea hidraulică, cu 1 sau 2 cilindri, iar antrenarea va fi deasemenea hidraulică, cu ajutorul a 2 motoare hidraulice lente. În condițiile asigurării unei finanțări corespunzătoare prin fonduri nerambursabile în cadrul POS CCE – op. 2.1.1, dar şi din partea agentului economic SC PRESTCOM SA, partenerul INOE 2000-IHP Bucureşti va putea realiza, până la nivelul de prototip, cele 4 maşini de îndoit profile, urmând ca după finaliozarea proiectului, care are o durată totală de 2 ani, rezultatele să fie introduse în fabricație la agentul economic direct interesat.

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CML International – SUA, Italia

3D ABRASIVE WATERJET CUTTING AND MECHANICAL MACHINING EQUIPMENT

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A. Innovative aspects of the equipment

The innovative aspects of the equipment are:
- There are known equipment for water jet cutting and equipment for machining (boring and milling) which are manufacturing parts and/or subassemblies with complex shapes in 3D successively;
- The disadvantages of these manufacturing methods applied successively on the same part are:
- the positioning and orientation errors of the part are accumulating when the part is transferred from one equipment to another one;
- the positioning and orientation time is accumulating;.
- The method of combined manufacturing of parts with water jet and machining technologies on the same equipment avoid above mentioned disadvantages as follows:
- the part is oriented and clamped on the work table of the equipment one time only;
- all needed manufacturing operations (water jet cutting, boring etc) are performed successive, without other human intervention / process interuption;

B. Competitiveness of the equipment

The competitivness of the technical solution is sustained by the following considerations:
- Technological flexibility: the equipment was designed to comply with requests of every small or medium company shop floor, for water jet cutting and machining of materials as aluminum, steel, waterproof steel, wood or granite;
- Increased quality of manufacturing operations;
Flexibility for manufactured part shape;

C. Equipment's configuration

The equipment consist of the following functional units *(fig. 1):*

1. – Waterjet cutting and mechanical machining table with CNC command;
2. – CNC command unit;
3. – Very high pressure unit.

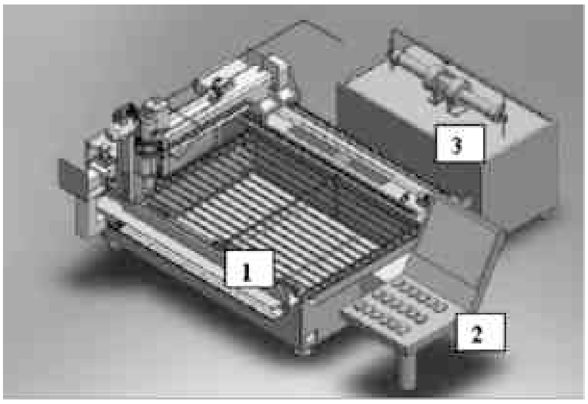

Fig. 1 – 3D abrasive waterjet cutting and mechanical machining equipment

Figure 2 presents a general view of Waterjet cutting and mechanical machining table with CNC command. The notations have the following meaning:

1- longitudinal slide X;
2 – cross slide Y;
3 – vertical slide Z.

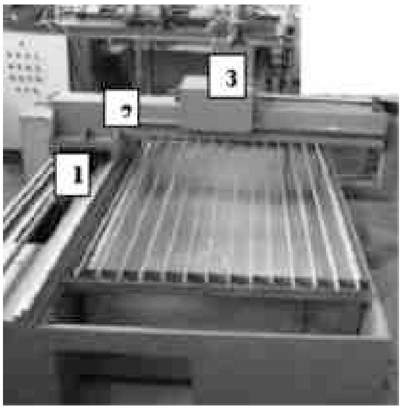

Fig. 2 – Waterjet cutting and mechanical machining table with CNC command – general view

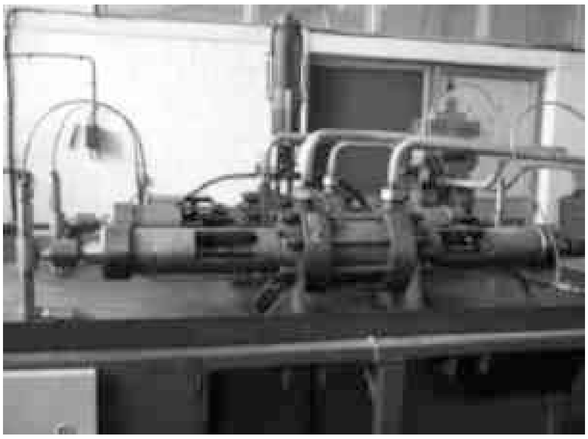

Fig. 3 – Very high pressure unit

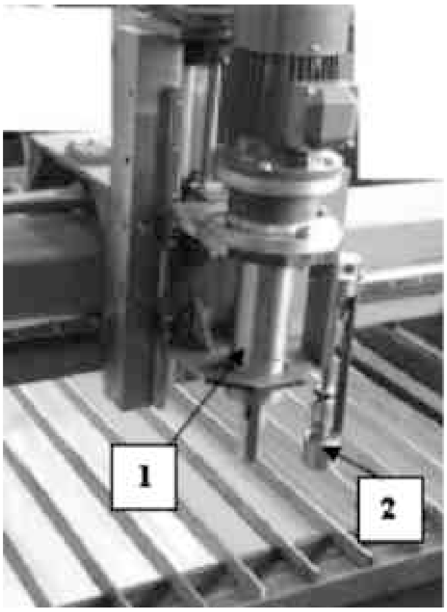

Fig. 4 – Vertical slide Z

Figure 4 presents vertical slide Z. The notations have the following meaning:

1- mechanical machinning head (drilling);

2 – waterjet cutting head.

<u>Equipment's technical characteristiques:</u>

- maximum (longitudinal x cross x vertical) strokes: ... 1500 x 1000 x 200 mm;
- working table's surface: ...1800 x 1600 mm;
- longitudinal / cross speeds (max.): ...10 m/min;
- vertical speed (max):... 0,22 m/min;
- water jet cutting pressure (max).:...4000 bar;
- cutting water flow (max.): ... 1,2 l / min;
- motor of mechanical machining tool (380 V/50 Hz) :... 750 W / 2950 rot/min;
- X, Y and Z axes servo-motor... 660 W/2,1 Nm
- vertical feed force (max.): ... 5000 N;
- boring diameter max. (carbon steel). Ø10mm;
- water jet cutting depth max. (carbon steel) ... 20 mm;

D. Estimate of economical results

Estimated economical efects/results for the user/owner of this combined technology equipment comparing with users of two special equipments for each technology (waterjet cutting and mechanical machining) are the following:

- Increase of market offered product range, both for actual and perspective products);
- Possibility to offer of customer personalised products;
- Possibility to realise and implement in production/on market new products, with new design;
- Decrease of manufacturing cost with 10.. 15%;
- Increase of product port-folio with 10%;
- Increase the overall product quality.

E. Supplementary informations

Supplementary informations are available from this paper's authors or on webpage**: www.ictcm.ro/pncdi2007_2008/2008_tehjet3d/index.**

VINDROVER TRACTAT PENTRU RECOLTAT FURAJE

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Condiţiile pedoclimatice din ţara noastră favorizează cultivarea unei game variate de plante furajere, iar tehnologiile moderne de înfiinţare şi exploatare ale acestora permit obţinerea unor producţii însemnate de furaje, cu calităţi nutritive superioare. Un rol important pentru valorificarea superioară şi cu eficienţă sporită a furajelor îl are sistema de maşini utilizată în cadrul tehnologiilor de recoltare şi conservare a plantelor furajere care trebuie să asigure recoltarea într-un timp relativ scurt, corespunzător perioadei optime de recoltare, transportul şi depozitarea unei cantităţi mari de masă vegetală, cu un consum redus de forţă de muncă şi cheltuieli materiale minime.

În vederea satisfacerii cerinţelor de producţie privind obţinerea unor nutreţuri de bună calitate şi la preţuri convenabile INMA a dezvoltat ample cercetări în domeniul tehnologiilor de recoltare şi conservare a plantelor furajere, realizând echipamente tehnice moderne care să permită rentabilizarea şi efienticizarea proceselor tehnologice de producere a furajelor. Pentru recoltarea plantelor furajere în perioadele optime a fost realizată o gamă largă de cositori cu aparat de tăiere clasic sau cu discuri rotative care satisfac cerinţele fermierilor, precum şi vindrovere tractate precum vindroverul tractat VTR care în anului 2010 a fost introdus în fabricaţie la SC Mecanica Ceahlău SA Piatra Neamţ (fig. 1).

Fig.1 Vindroverul VTR în agregat cu tractorul U650

Vindroverul tractat VTR, care efectuează la o singură trecere operaţiile de cosire, strivire şi aşezare pe sol în brazdă continuă şi uniformă a plantelor furajere ierboase (lucernă, trifoi, ierburi, amestecuri de ierburi cu leguminoase) în vederea uscării naturale. În funcţie de tehnologia de lucru adoptată, plantele furajere aflate în brazdă pot fi adunate când au ajuns la umiditatea de 50…55% pentru însilozarea la umiditate scăzută, sau lăsate să se usuce până la umiditatea de cca 20%, urmând a fi adunate şi depozitate sub formă de fân vrac sau balotat.

Descrierea constructivă funcţională

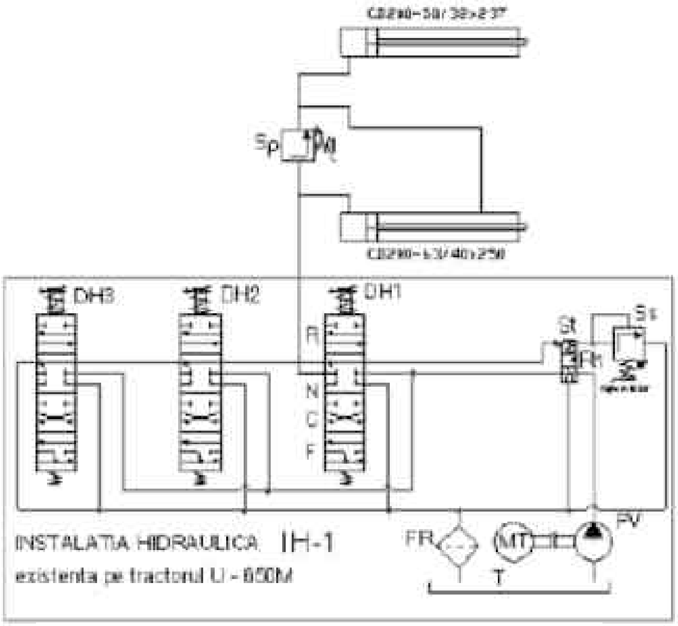
Vindroverul tractat VTR lucrează în agregat cu tractorul U 650, fiind cuplat la bara de tracţiune, iar organele de lucru sunt acţionate de la priza de putere, prin intermediul unei transmisii cardanice. De asemenea vindroverul poate lucra cu orice tractor pe roţi cu putere de 55…85 CP, care este dotat cu bară de tracţiune cu găuri şi priză de putere cu turaţie de 540 rot/min.Vindroverul este purtat pe un cadru de rulare prevăzut cu două roţi cu pneuri de joasă presiune şi un proţap pentru

cuplarea la bara de tracțiune a tractorului. Echipamentul de lucru (vindroverul propriu-zis) se compune în principal dintr-un aparat de tăiere cu discuri rotative şi un strivitor de tipul cu valțuri, pentru strivirea plantelor.
Aparatul de tăiere, este ansamblul care realizează efectiv cosirea plantelor furajere din lan şi are 6 discuri rotative acționate de o transmisie cu roți dințate montate într-o carcasă metalică. Discurile rotative sunt de formă ovală, plasate deasupra carcasei metalice şi au articulate câte două cuțite prin intermediul unor şuruburi speciale.

Strivitorul de plante, este plasat în spatele aparatului de tăiere. Valțul superior are posibilitatea flotării pe verticală în funcție de grosimea stratului de plante ce trece prin strivitor, iar valțul inferior este fix ca poziție. Forța de apăsare a valțurilor asupra stratului de plante ce trece prin strivitor este asigurată de două arcuri elicoidale. Pentru adaptarea strivitorului la recoltarea diferitelor culturi furajere, valțul superior este realizat în două variante: o variantă metalică cu nervuri înclinate recomandată pentru strivirea plantelor mai rezistente la scuturare, şi o variantă cu suprafața cauciucată recomandată pentru plante furajere sensibile la scuturare (lucernă, trifoi).

Transmisia la organele de lucru ale vindroverului este de tipul mecanică, constituită din transmisii cardanice, curele trapezoidale si transmisii cu lanț. Pentru protejarea la suprasarcini transmisia este prevăzută cu cu un cuplaj de suprasarcină de tipul cu fricțiune.

Instalația hidraulică care dotează vindroverul (fig. 2), este utilizată pentru ridicarea echipamentului în poziție de transport, sau coborârea lui în poziție de lucru. Instalația hidraulică este formată dintr-un circuit de alimentare prevăzut cu doi cilindrii hidraulici tip CD 200-50/32x237 şi tip CD 200-63/40x250 şi un furtun cu sistem de cuplare rapidă la instalația hidraulică a tractorului. Soluția adoptată pentru realizarea circuitului hidraulic de alimentare a celor doi cilindrii hidraulici se caracterizează prin faptul că asigură o ridicare sau coborâre rapidă a echipamentului menținând în poziție orizontală echipamentul de lucru față de sol.



LEGENDA

IH-1 instalatia hidraulica a tractorului

T-tanc-baia de ulei a transmisiei

MT-motor termic

PV-pompa volumica cu roti dintate cu angrenaj exterior

Ss-supapa de siguranta

Sp-supapa de presiune

St-supapa de traseu normal inchisa

Rh-drosel (rezistenta hidraulica)

DH-distribuitor hidraulic D3-40/75

CD200-63/40x250 -Cilindru hidr. pt. poz. transport

CD200-50/32x237-Cilindru hidr. pt. poz. transport

Fig.2 Schema constructivă a instalației hidraulice a vindroverul VTR

Orizontalitatea platformei echipamentului față de sol, la ridicarea sau la coborârea sa este realizată prin introducerea unui circuit suplimentar care asigură dirijarea uleiului hidraulic evacuat din primul cilindru către cel deal doilea cilindru.
Vindroverul este prevăzut cu un sistem de cuplare pe cadru de rulare care îi permite să copieze microrelieful solului în timpul lucrului, atât pe direcția de deplasare cât şi transversal, rezultând o înălțime de tăiere uniformă. Pentru limitarea apăsării echipamentului de lucru pe sol, s-au prevăzut două arcuri elicoidale care limitează forța de apăsare a echipamentului pe sol la 10…30 kg

Caracteristici constructive şi funcționale:
- lățimea de lucru, m - 2,4;
- tipul aparatului de tăiere- cu discuri rotative;
- frecvența de rotație a discurilor, min^{-1} - 2700;
- numărul discurilor rotative, buc - 6;
- numărul cuțitelor pe disc, buc- 2;
- tipul strivitorului - cu două valțuri;
- lățimea de lucru a strivitorului, m - 1750;
- acționare - tractor de 55…65 CP
- turația prizei de putere, min^{-1} - 540;
- viteza de lucru max., km/h - 10;
- înălțimea de tăiere, mm - 40…60;
- lățimea brazdei de material, m - 0.8…1,2
- masa, kg - 1840;

Încercările au fost efectuate la recoltat lucernă cu caracteristicele prezentate în tabelul nr. 1. Aspecte din timpul încercărilor sunt prezentate în fig. 3 şi 4.

Caracteristicele lanului de lucernă *Tabelul nr. 1*

Specificație	U.M.	Cultura recoltată
		Lucernă
Producția de masă vegetală	kg./ha.	16.560
Anul de vegetație	-	primul
Stadiul de vegetație	-	35 % înflorit
Înălțimea medie a lanului	mm	620
Înălțimea medie a plantelor	mm	740
Umiditatea plantelor la recoltare	%	71,3
Numărul de plante pe m^2.	buc.	198
Compoziția botanică:		
-lucernă	%	86
-alte plante	%	14

Încercările au fost efectuate în următoarele condiții:
- tractorul folosit…………………………….…………………U 650;
- turația motorului……………………………………………...1800 rot/min;
- turația prizei de putere…………………………………..540 rot/min;
- sarcina pe patinele vindroverului………………………..25 kg;

Fig.3 Vindroverul VTR la recoltat lucernă

Valorile medii ale indicilor calitativi de lucru la recoltat lucernă sunt prezentați în tabelul 2.

Valorile medii ale indicilor calitativi de lucru *Tabelul nr. 2*

Denumirea indicelui	UM	Valoarea determinată
Lățimea efectivă de lucru	m	2150
Înălțimea de tăiere (miriștea)	mm	60
Viteza de lucru	Km/h	3,8; 6,2
Gradul de strivire a plantelor	%	85
Caracteristicele brazdelor % - lățime - înălțime - greutate (în momentul recoltării)	 mm mm kg/m.l.	 0.9 – 1.6 - cca. 3,2
Pierderi de material	%	1,5

Fig.4 Aspectul brazdelor de lucernă recoltate cu vindroverul VTR

Înălțimea de tăiere a fost de 60 mm (conform cerințelor agrotehnice pentru recoltat lucernă) şi a fost uniformă pe toată lățimea de lucru. De menționat faptul că din reglaje se pot obține înălțimi de tăiere cuprinse între 40…80 mm în funcție de cerințele de teren şi cultură.

Viteza optimă de lucru a fost de 6,2 km/h, (corespunzătoare treptei de viteză II.R a tractorului U650 M), însă în condițiile unui teren bine nivelat se poate lucra cu viteze de până la 10 km/h în condițiile unei înălțimi corespunzătoare de tăiere

Gradul de strivire a avut valoarea 85% iar pentru determinarea lui s-a folosit relația:

$$X = \left(1 - \frac{S_1}{S_2}\right) \times 100$$ unde:

*S*1- greutatea medie a plantelor nestrivite

*S*2- greutatea medie a plantelor strivite

S-a considerat plantă strivită acea plantă a cărei tulpină a fost strangulată în cel puțin două locuri.

Încercările de exploatare s-au efectuat în aceleaşi condiții în care s-au determinat indicii calitativi de lucru, iar valorile medii sale indicilor de exploatare unt prezentate în tabelul 3

Valorile medii ale indicilor de exploatare *Tabelul nr. 3*

Denumirea indicelui	U.M.	Valoarea determinată pentru	
		Viteza a I-a R de 3,8 Km/h	Viteza a II-a R de 6,2 Km/h
Producția de masă verde	t/ha	16,4	16,4
Capacitatea efectivă de lucru (W_{ef})	ha/h	0,82	1,35
Capacitatea de lucru pe schimb (W_{sch})	ha/h	0,59	1,0
Coeficientul întoarcerii (k_{21})	-	-	0,94
Coeficientul siguranței tehnologice (k_{41})	-	0,99	0,99
Coeficientul de folosire a timpului schimbului (k_{07})	-	0,72	0,74
Consum de motorină	l/ha	6,7	4,9

Capacitatea de lucru pe schimb a fost de 0,59 ha/h, pentru viteza de lucru de 3,8 km/oră, respectiv 1,0 ha/h pentru viteza de lucru de 6,2 km/oră, rezultând un coeficient de folosire a timpului schimbului de 0,72 – 0,74;

Consumul specific de motorină a fost de 6,7 l/ha pentru capacitatea de lucru pe schimb de 0,59 ha/h, corespunzătoare vitezei de 3,8 km/h şi de 4,9 l/ha pentru viteza de lucru de 6,2 km/h când realizează 1,0 ha/h..

În cadrul încercărilor de exploatare s-a urmărit stabilirea modului de deplasare în lucru a agregatului vindrover-tractor, în vederea diminuării timpului afectat întoarcerilor la capătul parcelei şi evitării deplasării în gol. Astfel se recomandă următoarele scheme de deplasare în lucru:

a. Deplasarea de jur împrejur, de la exterior către centru parcelei, este recomandată pentru recoltarea parcelelor cu laturile mai mari de 200…250 m, pe cât posibil de formă pătrată. În această situație timpul afectat întoarcerilor este mic.

b. Deplasarea laterală, cu întoarcere pe partea dreaptă la capetele parcelelor, recomandată pentru parcele cu lungime mai mică de 200 m. În această situație este necesar ca la capeteple parcelei să existe un spațiu cu lățimea de 6-8 m necesar pentru întoarcerea agregatului, care se obține prin cosire anterioară.

Reglaje:

Pentru obținerea unui regim de lucru optim cu vindroverul, în conformitate cu cerințele agrotehnice, în funcție de caracteristicile culturilor de plante furajere recoltate şi de starea terenului, vindroverul a fost prevăzut cu următoarele posibilități de reglare a organelor de lucru:

- reglarea înălțimii teoretice de tăiere de la 40 mm până la 80 mm se realizează prin înclinarea echipamentului de lucru cu ajutorul tirantului central;
- forța de apăsare a patinelor pe sol se realizează prin reglarea arcurilor de întindere montate între cadrul echipamentului şi cadrul de rulare al vindroverului;
- reglarea lățimii brazdei de furaj între 0,8...1,2 m se realizează prin închiderea sau deschiderea deflectoarelor din spatele strivitorului.

Concluzii

În urma încercărilor efectuate cu vindroverul tractat VTR au rezultat următoarele concluzii:

- vindroverul tractat **VTR,** efectuează la o singură trecere operațiile de cosire, strivire şi aşezare pe sol în brazdă continuă şi uniformă a plantelor furajere ierboase (lucernă, trifoi, ierburi, amestecuri de ierburi cu leguminoase) în vederea uscării naturale;
- în funcție de tehnologia de lucru adoptată, plantele furajere aflate în brazdă pot fi adunate la umiditatea de 50…55% pentru însilozarea la umiditate scăzută, sau lăsate să se usuce până la umiditatea de cca 20%, urmând a fi adunate şi depozitate sub formă de fân vrac sau balotat;
- aparatul de tăiere cu discuri rotative lucrează corespunzător, fără înfundări realizând înălțimi de tăiere cuprinse între 40…90 mm în funcție de cerințele din teren;
- gradul de strivire a avut valoarea 85% la recoltat lucernă în condițiile unor pierderi sub 2%;
- capacitatea de lucru pe schimb a fost de 0,59 - 1,0 ha/h, pentru viteza de lucru de 3,8 - 6,2 km/oră;

ECHIPAMENTE TEHNOLOGICE PENTRU REALIZAREA DE MATERIALE ECOLOGICE OBŢINUTE PRIN VALORIFICAREA DEŞEURILOR TEXTILE

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REZUMAT:
Lucrarea prezintă activităţile de cercetare-proiectare-dezvoltare care s-au desfăşurat pentru realizarea de echipamente tehnologice specializate în cadrul unei Linii tehnologice pentru producerea de materiale ecologice obţinute prin valorificarea deşeurilor textile. Linia tehnologică materializează îmbinarea dintre o tehnologie clasică de obţinere a vălului cardat din fibre de bază (rezultate din deşeuri textile) şi fibre bicomponente termoadezive, o tehnologie nouă de pliere verticală a vălului şi o tehnologie de realizare a produsului finit prin termofixare.
Proiectul a fost elaborat în cadrul contractului nr. 125/2007 – Program INOVARE, de un consorţiu format din S.C.MATIRO-SA Bucureşti, S.C.ICTCM-SA Bucureşti, Universitatea Tehnică „Gh. Asachi“ Iaşi – Centrul de Cercetare şi Transfer Tehnologic POLYTECH şi Universitatea Politehnica Bucureşti – Centrul de Excelenţă Ştiinţifică şi Inginerie Mecanică şi Tribologie. Echipamentele realizate în cadrul proiectului constituie noutate pentru România şi răspund cerinţelor UE privind reciclarea deşeurilor textile şi protecţia mediului.

Cuvinte cheie: echipament tehnologic, deşeu textil, reciclare, termofixare, material ecologic

1. INTRODUCERE

Proiectul de cercetare-dezvoltare a avut ca obiectiv prioritar realizarea în ţară, în concepţie originală, de către participanţii consorţiului a echipamentelor specifice pentru obţinerea de materiale ecologice provenite din reciclarea deşeurilor textile, pe baza unei noi tehnologii „curate”, care să corespundă cerinţelor de pe piaţa internă sau externă, în perspectivele globalizării activităţii economice.

Prin realizarea proiectului de cercetare s-a urmărit: realizarea de echipamente competitive pe piaţa de profil; realizarea de noi tipuri de materiale ecologice, obţinute prin valorificarea deşeurilor textile, în vederea obţinerii de materiale neţesute cu porozitate controlată, având caracteristici de compresibilitate ciclică ridicată; realizarea materialelor ecologice pe baza unei noi tehnologii „curate” de valorificare a deşeurilor textile; eficientizarea utilizării resurselor de materie primă, respectiv utilizarea fibrelor recuperate din deşeuri textile.

Proiectul corespunde *obiectivului general* al programului: „Creşterea capacităţii de inovare, dezvoltare tehnologică şi asimilare în producţie a rezultatelor cercetării, în vederea îmbunătăţirii competitivităţii economiei naţionale şi a creşterii calităţii vieţii”.

Obiectivele măsurabile ale proiectului sunt: noi echipamente de obţinere a materialelor neţesute cu porozitate controlată, prin valorificarea deşeurilor textile; o nouă tehnologie de valorificare a deşeurilor textile; demonstrarea posibilităţilor de realizare a funcţionalităţii şi a utilităţii noii tehnologii „curate” cu echipamentele tehnologice aferente, precum şi a materialelor noi ecologice care se vor realiza; îmbunătăţirea procesului de învăţământ de profil, prin abordarea pe un plan nou a unor aspecte fenomenologice şi constructive din cadrul ingineriei mecanice.

2. DESCRIEREA NOII TEHNOLOGII DE OBȚINERE A PRODUSELOR ECOLOGICE DIN DEŞEURI TEXTILE

Pentru stabilirea tehnologiei de obținere a produselor ecologice s-a pornit de la definiția materialelor textile nețesute voluminoase, care sunt acele materiale textile poroase, ce înmagazinează o mare cantitate de aer în porii capilari ceea ce permite o bună izolare termică dar şi absorbția sunetelor (izolare fonică).

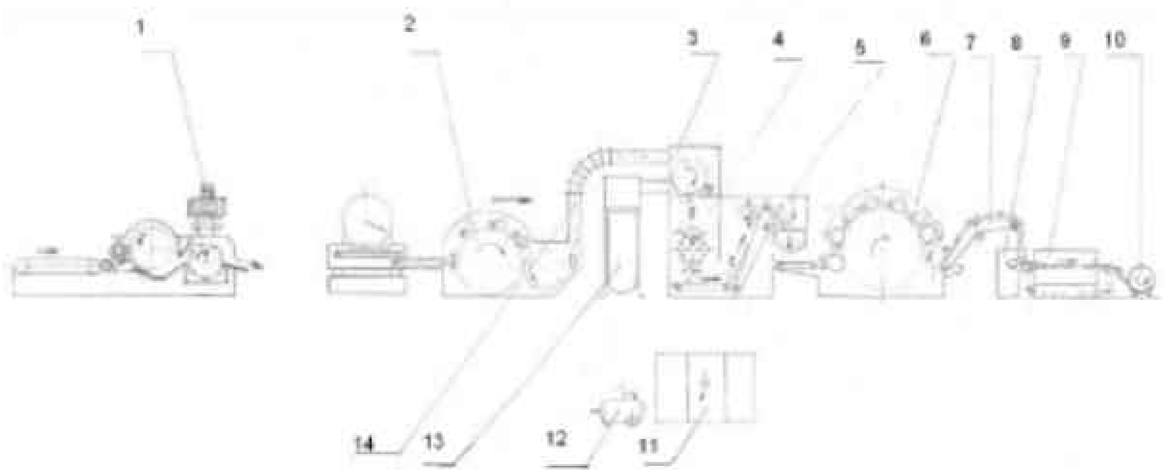
Porozitatea este caracteristica de bază a materialului nețesut voluminos care influențează capacitatea de izolare termică şi fonică.

Pornind de la caracteristica de bază, porozitatea, s-a conceput noua tehnologie de realizare a materialelor nețesute voluminoase, fluxul tehnologic fiind prezentat în organigrama de mai jos:

Noua tehnologie se bazează pe obținerea unui văl de fibre debitat de o cardă, care ulterior va fi pliat vertical.
Prin pliere verticală (element de noutate) fibrele sunt paralele şi orientate pe direcție verticală, obținându-se un produs sub formă de pătură.
După pliere urmează operația de termofixare a păturii. Ținând cont că fluxul termic se deplasează perpendicular pe planul materialului, rezultă că acesta se deplasează paralel cu fibrele care nu vor opune rezistență la trecerea fluxului termic prin material.
În stabilirea noii tehnologii s-a ținut cont de următoarele caracteristici tehnologice ale materialelor nețesute voluminoase: masa, densitatea, grosimea, influența amestecului fibros, influența gradului de consolidare determinat de procentul de fibre termoadezive.
Porozitatea controlată se va realiza prin corelarea acestor caracteristici tehnologice.
Materialele nețesute voluminoase cu porozitate controlată obținute prin noua tehnologie au următoarele proprietăți funcționale, mai bune decât cele obținute prin tehnologiile clasice: voluminozitate, rezistență la apăsare, elasticitate, izolare termică, fonică, proprietăți de umplere.
Specialiştii în domeniul prelucrării deşeurilor textile au stabilit în urma probelor efectuate că produsele nețesute se pot obține cu un preț de cost redus utilizând ca materie primă:
·Fibre recuperate obținute din defibrarea destrămăturii provenite din deşeuri textile;
·Fibre termoadezive care să asigure consolidarea termică a suportului textil.
S-au stabilit ponderile (procentele) componenților din trei variante propuse şi anume: 70% fibre recuperate şi 30% fibre termoadezive.
În funcție de domeniul de utilizare al materialului nețesut s-a propus utilizarea fibrei bicomponente CO-PES/PES, cu punctul de topire între 110-130 °C.
Deoarece s-a hotărât ca produsul nețesut să aibă grosimea de 30 mm, procesul tehnologic impune utilizarea fibrei termoadezive cu lungime de 100 mm (lungime necesară) pentru a se forma un pliu complet.
Punctul de topire al fibrei bicomponente este unul din parametrii de bază în conceperea Cuptorului de termofixare.
Tehnologa de obținere a materialele nețesute voluminoase cu porozitate controlată a determinat conceperea *Liniei tehnologice cu echipamentele specifice* pentru realizarea acestora.
Pentru echpamentele din Linia tehnologică s-au stabilit scheme tehnologice şi soluții constructive specifice.
În mod special s-au analizat şi adoptat soluțiile constructive originale pentru următoarele echipamente: Maşina de defibrat, Carda, Maşină de pliere verticală a vălului, Cuptor de termofixare.
La stabilirea soluțiilor constructive un rol important l-a avut amestecul fibros format din fibre recuperate scurte şi fibre bicomponente lungi. Amestecul fibros va influența dimensiunile organelor de lucru (diametre, ecartamente, viteze de lucru şi tipul de garnituri de pe organele de lucru).

3. LINIA TEHNOLOGICĂ PENTRU REALIZAREA DE MATERIALE NEȚESUTE VOLUMINOASECU POROZITATE CONTROLATĂ

Pentru realizarea de materiale nețesute voluminose cu porozitate controlată conform tehnologiei prezentate partenerii din consorțiu au proiectat şi realizat o linie tehnologică formată din următoarele echipamente (a se vedea figura 1):



LEGENDĂ

1. MAŞINA DE DEFIBRAT
2. AMESTECĂTOR
3. CONDENSOR
4. BUNCĂR DE ALIMENTARE
5. MAŞINĂ ALIMENTATOARE
6. CARDĂ
7. TRANSPORTOR DE VĂL
8. MAŞINĂ DE PLIERE VERTICALĂ A VĂLULUI
9. CUPTOR DE TERMOFIXARE
10. ROLATOR
11. INSTALAȚIE DE AUTOMATIZARE
12. SURSĂ DE AER COMPRIMAT
13. FILTRU
14. INSTALAȚIE DE TRANSPORT PNEUMATIC

Fig. 1 – Schema tehnologică a Liniei tehnologice pentru realizarea materialelor nețesute voluminoase cu porozitate controlată

Maşina de defibrat este echipamentul care are rolul de a transforma efiloseul (rezultat în urma destrămării deşeurilor) în material fibros (a se vedea figura 2).

Se compune din: bandă transportoare, batiu, mecanism alimentare, tambur destrămător, tambur sită, mecanism blocare, instalație de exhaustare, transmisie, instalațue electrică.

Fig. 2 – Maşina de defibrat

Fig. 3 - Amestecător

Amestecătorul este un grup format dintr-un Dozator alimentator şi un Lup destrămător – amestecător (a se vedea figura 3).

Dozatorul alimentator este un cântar cu platan mobil, prevăzut cu dispozitiv de eliberare de tară.

Lupul destrămător este format dintr-un batiu pe care se montează un tambur principal, trei grupuri de valțuri lucrătoare-întorcătoare, un grup de alimentare format din două valțuri alimentatoare şi un tambur debitor. De batiu se prind diametral opus o masă de alimentare şi o gură de debitare.

Materialul fibros alimentat pe dozator este cântărit în porții şi destrămat şi amestecat în lup, de unde este evacuat pneumatic.

Agregatul de alimentare este compus din: Condensor, Buncărul de alimentare, Maşina alimentatoare cu cântar automat.

Condensorul este format dintr-un batiu care conține un ventilator radial dublu aspirant cu palete drepte, un tambur sită şi un valț debitor.

Materialul fibros este transportat de masa de aer absorbită de ventilator prin tamburul sită şi depus pe periferia acestuia. Pătura este desprinsă de valțul debitor cu palete, materialul fibros căzând în buncărul de alimentare. Desprinderea de pe tamburul sită este facilitată şi de construcția internă a acestuia.

Buncărul de alimentare se compune din două tronsoane şi instalație electrică. Tronsonul inferior conține organele de lucru, respectiv valțurile alimentatoare şi valțul debitor precum şi antrenarea acestora.

Tronsonul superior este o incintă tampon pentru materialul fibros, prevăzută cu uşi de vizitare şi relee foto de nivel minim şi maxim.

Materialul din tampon este preluat de valțurile de alimentare şi depus de valțul debitor pe masa orizontală a Maşinii alimentatoare cu cântar automat.

Maşina alimentatoare cu cântar automat se compune din batiu, masă orizontală, masă înclinată, valț egalizator, valț debitor, cântar automat, instalație electrică şi pneumatică, valțuri de susținere. Alimentarea cu material fibros se face automat (sau manual) pe masa orizontală. Masa înclinată prevăzută cu şipci cu cuie preia materialul şi îl aduce în zona de destrămare - debitare. Stratul de material transportat este egalizat cu valțul egalizator.

Valțul debitor descarcă materialul de pe masa înclinată în cuva cântarului automat. Acesta debitează porția cântărită conform secvenței de alimentare programată.

Carda (a se vedea figura 4) se compune din batiu, masă de alimentare cu valț presător, grup rupător, tambur principal, grupuri de cardare (lucrători - întorcători), valț fugător, valț curățitor pentru fugător, tambur perietor, pieptene detaşor şi transmisie pentru antrenarea transportorului de văl. Materialul fibros alimentat în porții succesive pe masa de alimentare este preluat de grupul rupător şi prezentat de acesta tamburului principal.

Cardarea se produce între acesta şi grupurile de lucrători.

Descărcarea tamburului principal se face de valțul fugător, materialul fibros fiind depus pe perietor. Vălul fibros este desprins de pe tamburul perietor de pieptenele detaşor şi preluat de transportorul de văl.

Fig. 4 – Cardă

Fig. 5 – Transportor de văl şi Maşina de pliere verticală a vălului

Transportorul de văl (a se vedea figura 5): este format dintr-o bandă cu şipci aşezată pe valţuri de susţinere, montate pe un batiu. Geometria benzii permite preluarea vălului de la Cardă sub un unghi optim şi conducerea acestuia către maşina de pliat văl vertical. Vălul intră în această maşină în poziţie verticală.

Maşina de pliere verticală a vălului (a se vedea figura 5) se compune din:

- Batiu
- Antrenare
- Pieptene oscilant
- Piston
- Valţ striat

Materialul fibros (vălul de cardă) debitat vertical de pe transportorul cardei intră în batiu, între pereţii interiori ai acestuia, în zona de lucru. Pieptenele oscilant împinge valul către banda transportoare a cuptorului de termofixare. Pliurile sunt formate din vălul cardat şi împinse în zona de formare a materialului neţesut de pistonul prevăzut cu ace. Materialul neţesut este antrenat de valţul striat care îl împinge între banda transportoare şi grătarul cuptorului, în vederea termofixării lui.

Cuptorul de termofixare (a se vedea figura 6): La conceperea cuptorului s-au avut în vedere mai mulţi parametri determinanţi pentru obţinerea rezultatelor propuse prin tema de proiectare, printre care: producţia cardei, temperatura de termofixare şi timpul cât materialul se găseşte în cuptor. Prin corelarea acestor parametri a rezultat lungimea cuptorului.

Cuptorul de termofixare se compune din: transportor, cuptor, grătar, ventilator de recirculare aer cald, instalaţie de automatizare.

Transportorul (a se vedea figura 6) este un subansamblu complex prin intermediul căruia se realizează transportul materialului neţesut obţinut prin plierea verticală a vălului cardat. Acesta se compune în principal din: batiu, bandă transportoare, antrenare, suporţi de susţinere, arbori de antrenare – susţinere.

Consolidarea produsului se realizează în curent de aer cald la o temperatură de 110^0-130^0C.

Temperatura necesară termofixării se asigură prin intermediul rezistenţelor electrice grupate în baterii de rezistenţe prevăzute a fi cuplate şi respectiv decuplate separat.

Rolatorul (a se vedea figura 6): este format dintr-un batiu pe care se găsesc valţurile de rolare, antrenate de la masa transportoare a Cuptorului de termofixare printr-o transmisie cu lanţ şi un dispozitiv de tăiere transversală a formatului rolat.

Instalaţie de filtrare: este formată dintr-o cameră de destindere susţinută pe un schelet autoportant, cameră care este echipată cu doi saci filtraţi din pânză specială.

Instalaţie de transport pneumatic: este alcătuită din elemente de tubulatură (tronsoane drepte cu sau fără şibăre, coturi, reducţii). Prin asamblarea lor între Grupul de alimentare, descărcare, amestecare şi Condensor pe de o parte şi între Condensor şi Instalaţia de filtrare pe de altă parte se materializează circulaţia pneumatică dorită în cadrul amplasamentului ales pentru Linie.

Sursa de aer comprimat poate fi un electrocompresor tip ECR 350 sau reţeaua proprie de aer comprimat (în situaţia când ea există).

Instalaţia de automatizare cuprinde toate elementele de intercondiţionare între utilaje, precum şi echipamentele de realizare a alimentării şi comenzii motoarelor electrice şi componentelor electrice, electromecanice, electropneumatice şi electronice ale utilajelor Liniei.

Fig. 6 – Cuptorul de termofixare, Transportorul şi Rolatorul

PARAMETRI TEHNICO-FUNCȚIONALI PRINCIPALI

Pe baza datelor şi rezultatelor obținute în etapele de experimentări partenerii implicați în realizarea proiectului au stabilit valorile principalilor parametri tehnico–funcționali ai Liniei tehnologice pentru producerea de materiale ecologice obținute prin valorificarea deşeurilor textile, prezentate în tabelul 1:

Tabelul 1

·lățimea de lucru 1000(mm)
·numărul de cicluri de pliere 250-400 (cicluri/min)
·viteza de debitare a cardei 17(m/min)
·temperatura de consolidare 110 - 130°C
·viteza de termocondensare 0,5 – 1(m/min)
·înălțimea produsului realizat max. 30(mm);
·masa pe unitatea de suprafață 400 - 800 (g/m^2)

3. CONCLUZII

3.1 Proiectul contribuie la reducerea impactului negativ generat de activitățile economice asupra mediului, prin implementarea unei tehnologii „curate“ în politica de management a mediului introducând în circuitul economic deşeurile textile rezultate în industria confecțiilor. Totodată proiectul se încadrează în cadrul strategiei Guvernului României conținută în „Capitolul 18 – Politica privind protecția mediului înconjurător“ prin promovarea ecoeficienței şi provocarea spre inovare.

3.2 Prelucrarea deşeurilor textile prin noua tehnologie realizată în lucrare şi reintroducerea acestora în circuitul industrial sub forma de materiale nețesute cu porozitate controlată va contribui la diversificarea bazei de materii prime, va avea un impact pozitiv asupra pieței şi va îmbunătăți calitatea mediului înconjurător.

3.3 Utilizarea materialelor nețesute cu porozitate controlată având rezistență mare la încărcare mecanică ciclică va avea un efect preconizat pozitiv, întrucât va contribui la:

- reducerea costurilor de producție cu circa 30% (comparativ cu produsele similare existente);
- reducerea consumului energetic specific cu circa 20% (comparativ cu produsele similare existente);
- reducerea impactului asupra mediului prin utilizarea noilor produse ecologice.

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VOLUMIC PUMPS EXPLOITATION FOR THE SAFETY SYSTEMS OF THE WATER DAMS CASE STUDY: MOTRU WATER DAM

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Abstract:

In order to operate for a long period of time, exploitation of the equipment must be done as efficient as possible. Many times , the causes for important faults in equipment exploitation are caused by details considered as minor. The article presents the essential aspects in volumic pump exploitation in order to avoid such situations. The volumic pumps of Motru Dam are situated in the bottom discharge control system. Several situations were analysed: replacement of the 30 years old pumps, matching of the new pumps to the already existing hydraulic system, settings made for commissionig and exploitation.

Key words: axial piston pump, exploitation, lifetime, bottom discharge, flow curve characteristics, head

1. GENERALITĂŢI

Pompa este o maşină care transformă energia mecanică, primită de la o sursă de antrenare, în energie hidraulică. Pompele volumice realizează transportarea lichidului dintr-o cavitate în alta prin echivalarea de volume şi nu prin intermediul forţelor centrifuge ca la pompele centrifuge.

Pompele volumice ce dotează instalaţia golirii de fund pentru barajul Motru sunt de tipul pompă volumică cu pistonaşe de tip axial.

2. CARACTERISTICI TEHNICE PRINCIPALE

Caracteristicile tehnice principale ale instalaţiei de pompe ce echipează vanele de golire de fund baraj Motru sunt:

-Forţa maximă de lucru la ridicare - 28 tf;
-Forţa maximă de lucru la coborâre - 12 tf
-Forţa maximă la aşezare pe prag - 14 tf
-Timp vană revizie-ridicare 4,45 min
-Timp vană revizie-coborare 5,1 min
-Timp vană lucru - ridicare - 3,6 min
-Timp vană lucru - coborâre - 4,2 min
-Viteza uleiului în conducte - 2,5 m^3/s
-Efortul în conducte - 255 kgf/cm^2
-Volum total rezervor - 320 l
-Volum util rezervor - 115 l
-Unghi instalat la pompa volumică - 25 grd.
-Debit pompă volumică - 17 l/min
-Tip pompă axială - 712-Bz1000-V1100
-Greutate pompă - 26 kg
-Turaţie nominală - 1430 rot/min;
-Tip motor electric - ASI-112M;
-Putere nominală - 4kW;

3. CONSIDERENTE PRIVIND SCHIMBAREA POMPELOR VECHI

În timpul funcţionării şi la efectuarea probelor profilactice s-a observat o mărire inadmisibilă a timpului de ridicare-coborâre a vanelor golirii de fund baraj Motru. Iniţial s-a considerat a fi o problemă de gripaj în ghidaje. S-a recurs la mărirea numărului de ungeri regulate prin intermediul conductelor de gresare in diferite puncte ale ghidajului, la finalul perioadei timpul de actionare nefiind influentat. Dupa verificarea amănunţită a circuitului hidraulic a sistemului GUP, echipa de reparaţii a demontat în vederea reviziei una din cele două pompe volumice cu pistoane axiale.

La demontare s-au constatat următoarele probleme:

- joc foarte mare al pistoanelor în cilindrii (aproximativ 0,1 , mult mai mare decât valoarea maximă admisă de 0,005-0,008 mm);
-ovalitatea accentuată a pistoanelor (mai mare decat 0,003 mm, valoarea maximă admisă);
-ovalitatea accentuata la corpul cilindrilor (mai mare decat 0,01mm, valoarea maximă admisă);
- gripaj la doua pistoane în zona cuplelor sferice;
- urme de frecare accentuată în zona cuplelor sferice la toate cele 7 pistonaşe;
- uzură accentuată a suprafeței discului de distribuție.

Fig.1.
Discul de distribuție al pompei cu pistonaşe axiale demontat

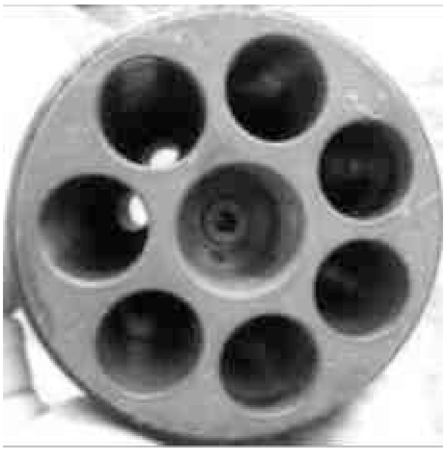

Fig.2.Cilindrii pistonaşelor (n=7)

Fig.3.Detaliu capete pistonaşe ovalizate

La demontarea celei de-a doua pompe s-au observat aceleaşi probleme.

Cum valoarea de reparare era aproximativ egală cu cea de înlocuire singura soluție viabilă a rămas înlocuirea pompelor volumice.

4. ALEGEREA NOILOR POMPE

La pompele vechi, puse în funcțiune în 1979, legăturile între pistoane şi discul oblic era făcută prin articulații sferice. Aceste legături care erau des utilizate în industria pompelor volumice prezintă dezavantajul că sunt complicate şi se defectează uşor.

Astfel, la demontare, s-au observat gripaje în zonele cuplelor sferice, pătrunderi de mizerie şi impurități din ulei, cât şi zone cu frecări şi „scrijeliri” adânci în cămaşa cilindrilor.

Aceste frecări au dus la scăderea randamentului mecanic al pompei, astfel fiind diminuat randamentul global al instalației.
Influența s-a extins astfel asupra timpului de inchidere-deschidere vane acesta ajungând până la aproximativ 9 min. În cazul acestor instalații de siguranță depăşirea timpilor nu este admisă, impunandu-se luarea de măsuri urgente.

Fig.4. Pistonaşe cu cuplaj sferic (aspect la demontare)

Pentru a evita apariția unor astfel de probleme s-au achizitionat pompe la care această legatură se face prin intermediul unor arcuri. Discul fulant a fost înlocuit cu un rulment axial pe care se sprijină pistoanele. Astfel pistoanele sunt în contact permanent cu rulmentul, datorită arcurilor introduse în cilindru.

Mai jos prezentăm schema forțelor descompusă pentru unul din cele 7 pistonaşe axiale[1]:

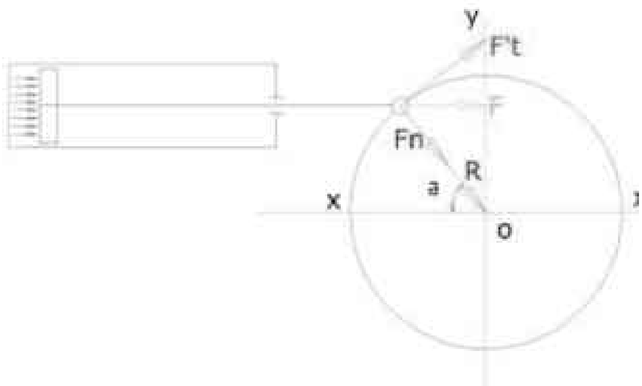

Fig.5. Schema forțelor

În fig.5. se prezintă modul cum acționează forțele în pompele cu pistonaşe axiale. Rezistența creată în interiorul subansamblelor pompei volumice provine din presiunea pe care o exercită lichidul vehiculat (uleiul hidraulic) asupra pistoanelor pompei.

Forța dată de presiunea fluidului de lucru este:

$$F = p\frac{\pi d^2}{4}[kgf] \tag{1}$$

unde

p – presiunea lichidului asupra pistonului [kgf/cm^2];

d – diametrul pistonului [cm];

Forta F se poate descompune în două forțe componente: o forța tangențială, Ft, şi o forță radială, Fn:

$$F_t = F\sin\alpha \tag{2}$$

unde α este unghiul de rotație al manivelei;
Momentul rezistent este:

$$M = FR\sin\alpha \tag{3}$$

Relațiile (3) şi (4) sunt valabile doar pentru sistemul bielă-manivelă plan. În cazul în care sistemul devine spațial, forța tangențială devine:

$$F\tan = Ft\cos\beta = F\sin\alpha\sin\gamma \tag{6}$$

Momentul rezistent rezultant

$$M_{rez} = FR\sin\gamma\sum_{1}^{n}\sin\alpha_n \tag{7}$$

Formulele stabilite permit să se determine puterea necesară pentru antrenarea pompei şi să se dimensioneze organele pompei.

Odată stabilit modelul de pompă, conform caracteristicilor hidraulice s-a ales varianta cu numar impar de cilindrii deoarece fluctuația totală a debitului este mai mica.

De exemplu:

· Pentru pompa cu şase cilindrii [1]:
-debit maxim 106,1%;
-debit minim 83,8%;
-fluctuația totală a debitului 22,3%.

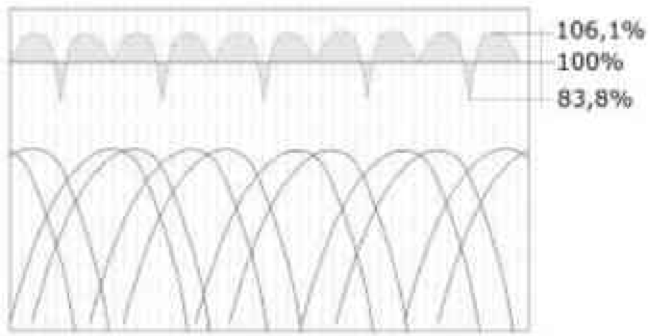

Fig.6. Variația debitului unei pompe cu şase cilindri

·Pentru pompa cu şapte cilindri [1]:
-debit maxim 101,2%;
-debit minim 97,2%;
-fluctuația totală a debitului 4%.

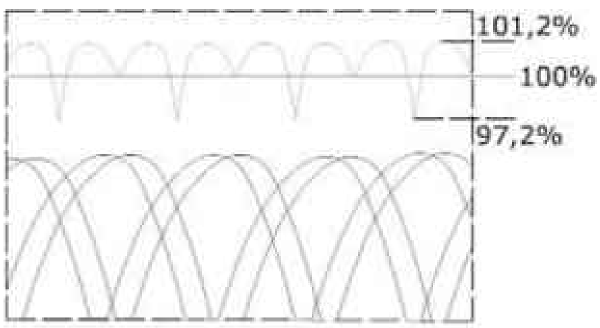

Fig.7. Variația debitului unei pompe cu şapte cilindri

Fluctuațiile debitului furnizat de pompele volumice cu pistonaşe axiale sunt mai mici la pompele cu număr impar de cilindri față de cele cu număr par, deoarece, la pompele cu număr par de cilindri, în dreptul fiecărui cilindru se găseşte cilindrul diametral opus şi din această cauză începutul refulării unuia corespunde cu sfârşitul refulării cilindrului opus.

Astfel diferența dintre debitele instantanee maxime şi minime este mai mare decât la pompa cu număr impar de cilindrii, la care începutul refulării fiecarui piston nu corespunde cu sfârşitul refulării unui alt piston.

In cazul instalației de G.F. a barajului Motru pompa poate avea o fluctuație de debit de:

1. pentru pompa cu 6 cilindrii: Qn=17 l/min,

$$Q\max = 17\frac{106{,}1}{100} = 18{,}037$$ [l/min], iar

$$Q\min = 17\frac{83{,}8}{100} = 14{,}246$$ [l/min]

$$\Delta Q = Q\max - Q\min = 18{,}037 - 14{,}246$$

=3,791 [l/min]

2. pentru pompa cu 7 cilindrii: Qn=17 l/min,

$$Q\max = 17\frac{101{,}2}{100} = 17{,}204$$ [l/min], iar

$$Q\min = 17\frac{97{,}2}{100} = 16{,}524$$ [l/min]

$$\Delta Q = Q\max - Q\min = 17{,}204 - 16{,}524$$

=0,68= **[l/min]**

Din acest calcul observăm că diferența fluctuațiilor de debit (de aproximativ 3 l/min) ne obligă să alegem pompa cu 7 pistoane, având şi un randament mai bun.

Totodată ne asigurăm astfel şi de limitarea suprapresiunilor pe circuitul hidraulic la o valoare mai mică. Fluctuația debitului într-un circuit hidraulic poate provoca o creştere considerabilă a presiunii, mai ales la turații mari[4].

Deasemenea aceste fluctuații repetate pot provoca un fenomen de rezonantă, fenomen ce produce inevitabil avarii în sistemul hidraulic (conducte, supape, distribuitoare...).

5. RELAȚIA CU FURNIZORUL, ACHIZITIONAREA POMPEI

Începând de la domeniul casnic şi pâna la cel industrial pompele îşi îndeplinesc rolul, uneori mai important, uneori mai modest satisfăcând cerințele beneficiarului.

În cadrul instalațiilor ce echipează vanele de siguranță ale barajelor de apă, rolul pompei este de o importantă majoră. În exploatarea acumulărilor de apă sunt deseori cazuri de ape mari, deversări date de vârfuri ale hidrografelor de viitură. În acel moment o nefuncționare corespunzătoare a instalației de vane de siguranță poate avea consecințe catastrofale. Astfel că pompele din dotarea acestor instalații trebuie să fie simple, robuste, eficiente si garantate pentru o perioadă de viață cât mai mare.

Avand in vedere aceste aspecte, între beneficiar şi furnizor trebuie să existe o relație strânsă de la comanda fermă şi până la furnizarea ulterioară de piese de rezervă.

În practică la verificarea pompei pe ştandul de probă, sunt foarte rare cazurile când punctul contractat se găseşte pe curba caracteristică, având în majoritatea cazurilor abateri în anumite limite. Trebuie solicitat furnizorului garanții pentru zona de debit şi cădere necesară instalației, şi valorile punctului nominal pentru care pompa poate fi corespunzatoare.

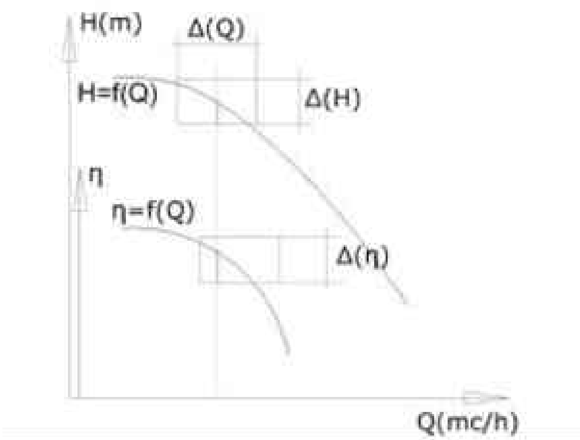

Fig.8. Domeniul garantat pentru parametrii nominali ai unei pompe

Conform figurii, domeniul garantat de furnizor pentru curba H=f(Q) este dreptunghiul având laturile ΔQ si ΔH, iar pentru curba η=f(Q), limitele garantate sunt date de segmentul Δη.

În această situație, pompa este considerată corespunzătoare, dacă curbele respective intersectează sau sunt tangente la treptunghiul ΔQ-ΔH, respectiv la segmentul Δη [2].

În ceea ce priveşte aceste pompe volumice trebuie ştiut că nu există reglementari internaționale, care să stabilească limitele de garanție a parametrilor, deoarece randamentul volumic al acestora este net superior fața de randamentul celorlalte tipuri de pompe. Neconvențional se admit abateri de ±5%[4].

6. MONTAREA, PUNEREA ÎN FUNCȚIUNE ŞI EXPLOATAREA POMPEI VOLUMICE

Odată achiziționată pompa, aceasta se montează conform documentației tehnice, respectând prescripțiile proiectantului.

Există reguli care nu sunt precizate în documentația tehnică considerându-se cunoscute[2].

Reguli generale înainte de montare:

- se verifică documentația pompei;
- se verifică existența certificatului de calitate şi conformitate al produsului;
- se îndepartează capacele de plastic de pe orificiile pompei;
- se va verifica aspectul general al pieselor pompei;
- nu se va îndeparta, pe cât posibil, unsoarea de protecție;
- după o depozitare mai lungă trebuie verificată unsoarea rulmenților înainte de montare;

se face o verificare a dispozitivului de reglaj a unghiului corpului mobil, se urmareşte corespondența acului indicator cu poziția reglată;

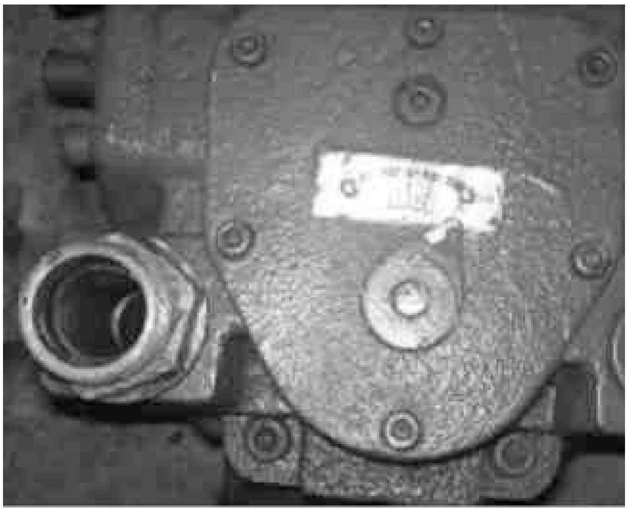

Fig.9. Acul indicator trebuie să copieze poziția dispozitivului de reglare unghi

Reguli generale pentru montare:

- se verifică şi stabileşte corespondența găurilor de montaj cu cele ale pompei;
- strângerea buloanelor se face în cruce;
- se centrează pompa, asigurându-se coaxialitatea arborilor;
- se bransează conductele prin flanşe strânse cu şuruburi sau prin îmbinări filetate (ca în fig.9);
- axele flanşelor conductelor trebuie să coincidă cu cele ale flanşelor la care se racordează, iar flanşele trebuie să fie paralele între ele;
- racordarea trebuie facută fără a da naştere la tensiuni sau solicitări în corpul pompei;
- se evită montajele care pot genera pungi de aer;
- înainte de montarea conductelor acestea se vor „sufla” cu aer, se vor spăla si curăți, eliminându-se astfel impuritățile rămase î timpul sudării.
- diametrul conductei de refulare trebuie să fie cel puțin egal cu cel al orificiului de refulare al pompei;
- îmbinarile conductelor de admisie şi refulare trebuie să se facă cu garnituri plate, moi, cu grad de etanşare superioară;

Reguli generale pentru punerea în funcțiune:
- se verifică rotirea liberă;
- se verifică sensul de rotație;
- se verifică sistemul de etanşare;
- se verifică circuitele de etanşare;
- se amorsează (pompele volumice sunt considerate autoamorsante, dar unele tipuri vin însoțite de racorduri pentru amorsare).
- toate pompele volumice se pornesc cu vana de pe refulare deschisă;

Reguli generale pentru exploatare :
- se urmareşte funcționarea liniştită şi fără zgomote şi vibrații a utilajului;
- temperatura uleiului în lagăre nu trebuie să depăşească cu mai mult de 50°C, temperatura mediului ambiant;
- se urmareşte periodic apariția eventualelor pierderi de ulei;
- se verifică periodic temperatura de funcționare a rulmenților (de obicei prin atingerea cu mâna);
- aparatele de măsura şi control trebuie observate în permanență;
- dacă regimul de pompare prezintă pulsații se caută şi se înlatură defectul;

5. CONCLUZII ŞI PROPUNERI

Concluzii:

· observarea atentă a instalațiilor şi caracterul preventiv al personalului de exploatare poate preveni apariția unor defecte majore sau chiar avarii;

· înlocuirea în termen a echipamentului la sfârşitul perioadei de viața conferă păstrarea gradului de siguranță ridicat al instalației;

· instalațiile trebuie modificate odată cu trecerea timpului şi aduse în pas cu avansul tehnologic.

Recomandări:

· Analizarea şi urmărirea atentă a parametrilor de funcționare ai pompelor cu scopul creşterii fiabilității şi siguranței în exploatare.

· Utilizarea pe parcursul măsuratorilor profilactice a unei aparaturi moderne cu care să se diagnosticheze cât mai precis valorile parametrilor de funcționare ai pompelor.

Antrenarea personalului de exploatare astfel încât să rezulte o mărire a fiabilității exploatării şi a gradului de siguranță.

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THE MECHANICAL-HYDRAULICALLY COMBINED DRIVING GEAR BOX

Constantin Chiriță, Adrian Constantin Hanganu, Laurențiu Damian,
Daniel Calfa

Abstract: *The Gear Box drive is mounted between the original propulsion gearbox-engine and the differential distribution gearbox and is set up to allow the two functional modes of operation:*

a) with Mechanical transmission 1:1 to move between locations;

b) with Hydrostatic transmission technology, for technological move, continuously and adjustable.

Keywords*: combined driving gear box, hydrostatic transmission, mechanical transmission, mobile equipment*

1. Introduction

The Gear Box drive is mounted between the original propulsion gearbox-engine and the differential distribution gearbox and is set up to allow the two functional modes of operation (fig. 1):

a) with Mechanical transmission 1:1 to move between locations;

b) with Hydrostatic transmission technology, for technological move, continuously and adjustable.

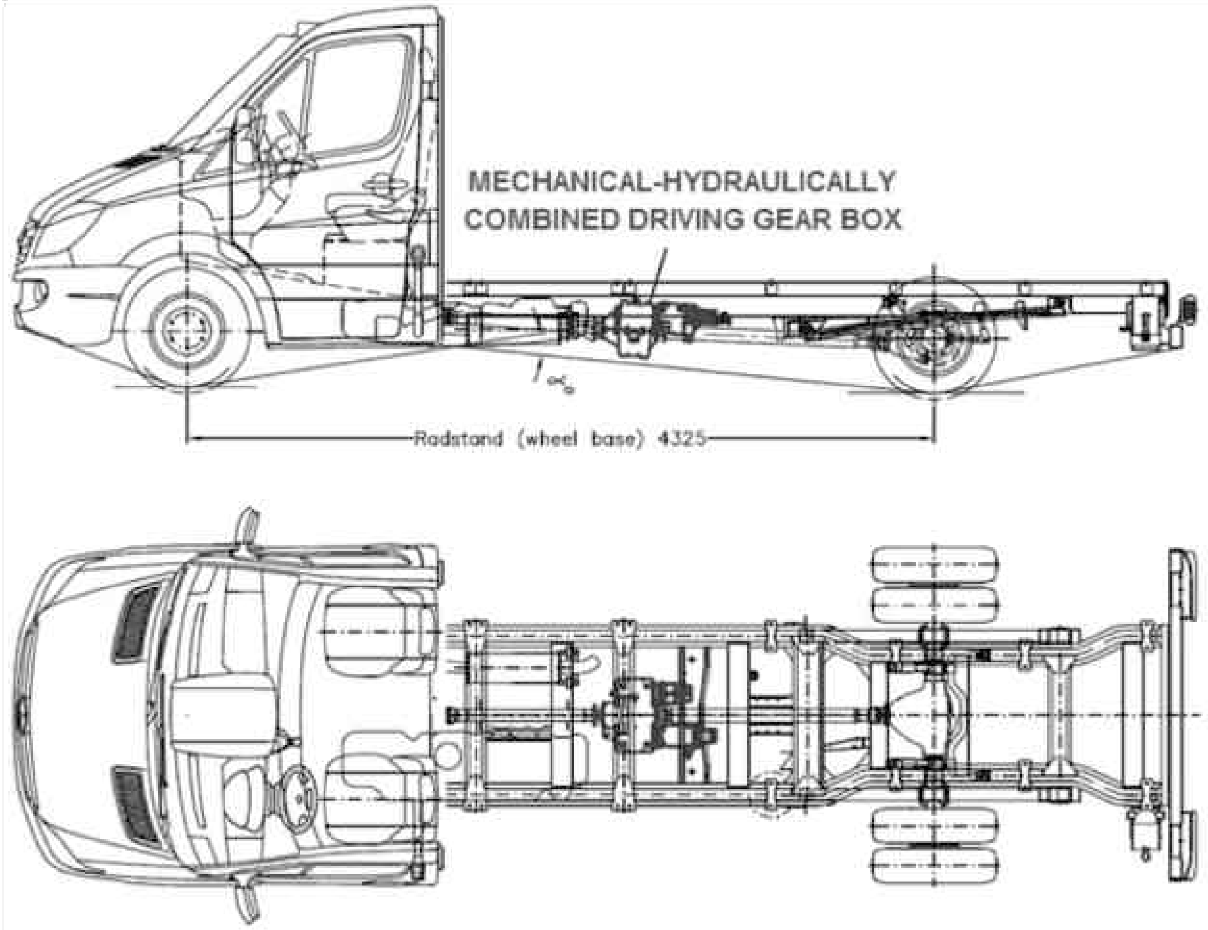

Fig. 1 - Mechanical-hydraulically combined driving gear box. The requirement for Mercedes Sprinter

2. ***Mobile equipment***
Initially the car was equipped type Mercedes Sprinter (Fig. 1 and 2), but had to equip vehicles with nominal load of 5 t: Renault, Iveco, Ford, etc.

Technical data			
Model	**509 CDI**	**511 CDI**	**510 CDI Chassis 4x2**
Engine			
Model series	OM646 DE22LA EURO4		
No. of cylinders/arrangement/valves	4/in-line/4		
Bore/stroke/swept volume	88 mm/88.3 mm/2148 cc		
Rated output	65 kW (88 hp) at 3800 rpm	80 kW (109 hp) at 3800 rpm	70 kW (95 hp) at 3800 rpm
Rated torque	220 Nm at 1400-2600 rpm	280 Nm at 1600-2500 rpm	250 Nm at 1400-2400 rpm
Fuel preparation	Electronically controlled diesel direct injection with common rail, turbocharger, charge-air cooling		
Tank/battery			
Tank capacity, fuel type	Approx. 75 L diesel		
Battery	12 V/74 Ah		
Performance data			
Top speed	Limited to 90 km/h		
Powertrain			
Drive	Rear-wheel drive		
Clutch	Single-disc clutch (SAC2 240) with dual-mass flywheel		
Transmission	Manual 6-speed (NSG 370-6)	Manual 6-speed (NSG 400-6)	Manual 6-speed (NSG 400-6)
Gear ratio	5.014; 2.831; 1.789; 1.256; 1.0; 0.797 Reverse 4.569	5.453; 2.974; 1.873; 1.332; 1.0; 0.777 Reverse 4.946	5,076; 2,610; 1,518; 1,000; 0,791; 0,675 Reverse 4,727
Final-drive ratio	5.100	4.727	4.727

Fig. 2 – Technical data for Mercedes Sprinter

3. 3D Design Prototype
In Fig. 3 is the 3D Design Prototype

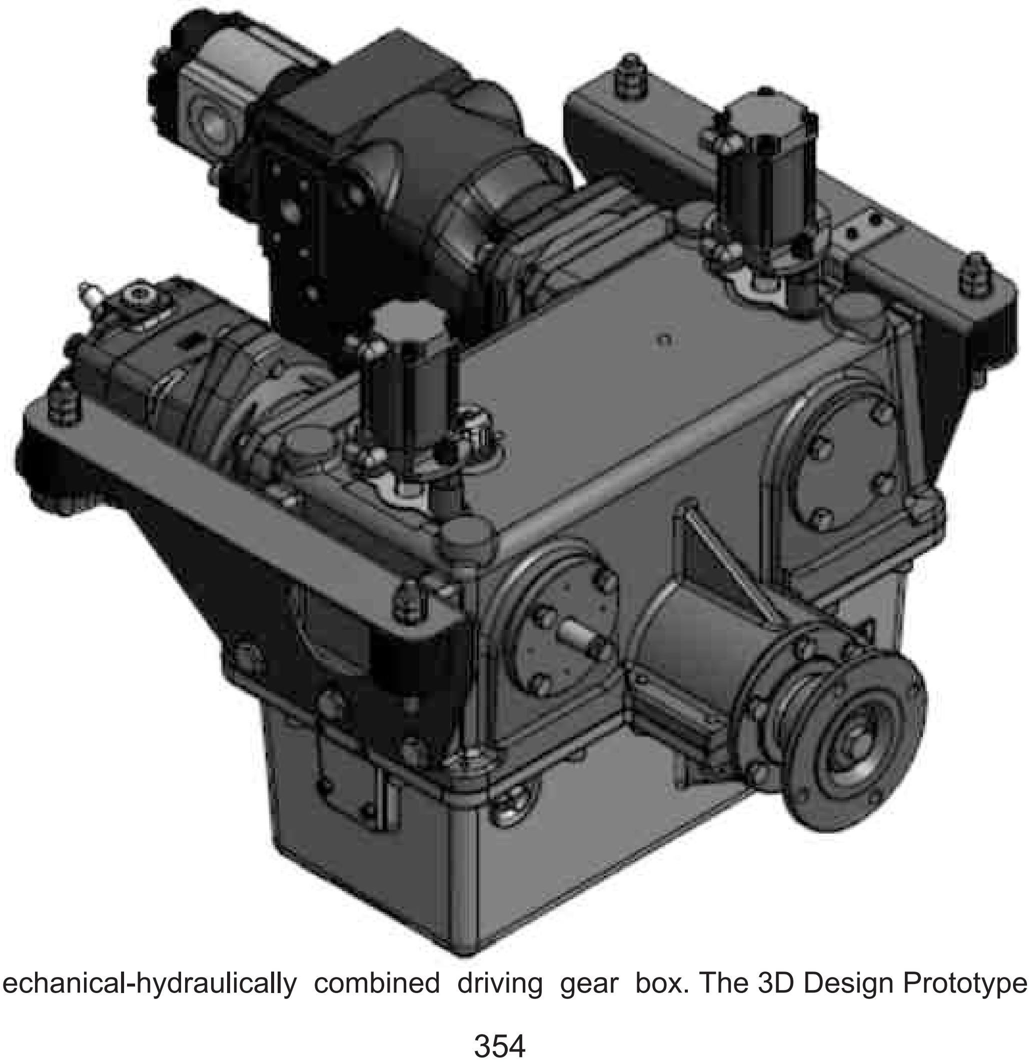

Fig. 3 – Mechanical-hydraulically combined driving gear box. The 3D Design Prototype

4. Technical Parameters

Table 1 presents the designed parameters for the mechanical-hydraulically combined driving gear box.

Tab. 1 Technical Parameters

No.	Parameters	Values
A	**MECHANICAL DRIVE 1:1**	
1.	Maximum intermittent torque	3.000 [Nm]
2.	Maximum continuous torque	1.500 [Nm]
3.	Maximum Speed	5.000 ÷ 6.000 [min^{-1}]
B	**HIDROSTATIC DRIVE**	
B1	HYDRAULIC PUMP SHAFT	
4.	Maximum Speed	575 [min^{-1}]
5.	Direction of rotation	right
6.	Avaible ratios	1/ 2,0625
B2	OUTPUT SHAFT	
7.	Maximum intermittent torque	525 [Nm]
8.	Maximum continuous torque	750 [Nm]
9.	Maximum Speed	285 [min^{-1}]
10.	Direction of rotation	right
11.	Avaible ratios	5,86/1
C	Weight	146 [kg]

5. Test bench

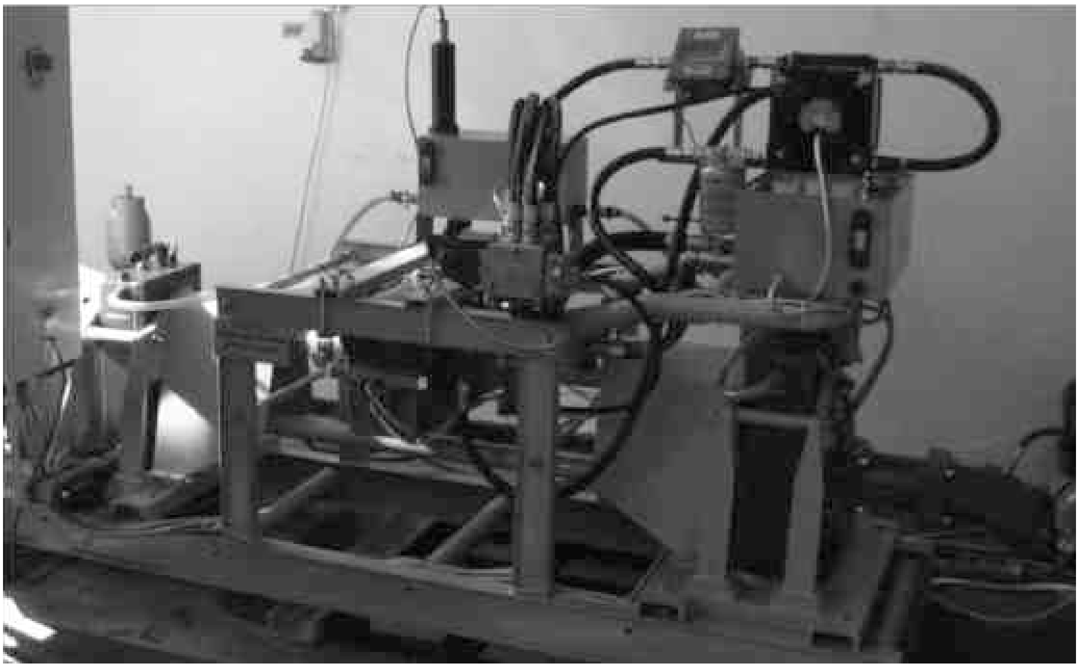

Fig. 4 – Test bench.

The test bench is shown in fig. 4. The kinematic transmission schemes for testing mechanical and hydrostatic transmission are presented in fig. 5 and fig. 6.

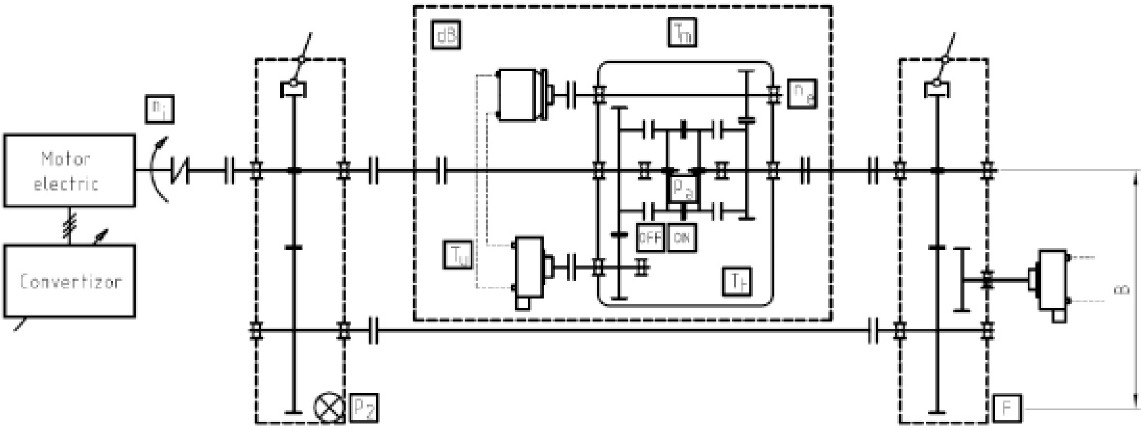

Fig. 5. – The kinematic transmission schemes for testing mechanical transmission.

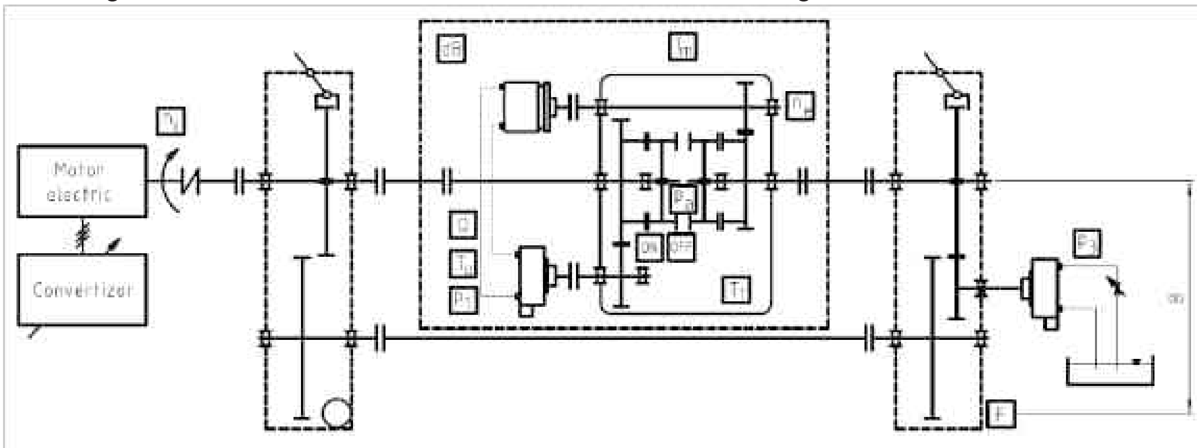

Fig. 6. – The kinematic transmission schemes for testing hydrostatic transmission.

6. Data acquisition

The virtual instrument data acquisition is presented in fig. 7, 8 and. 9.

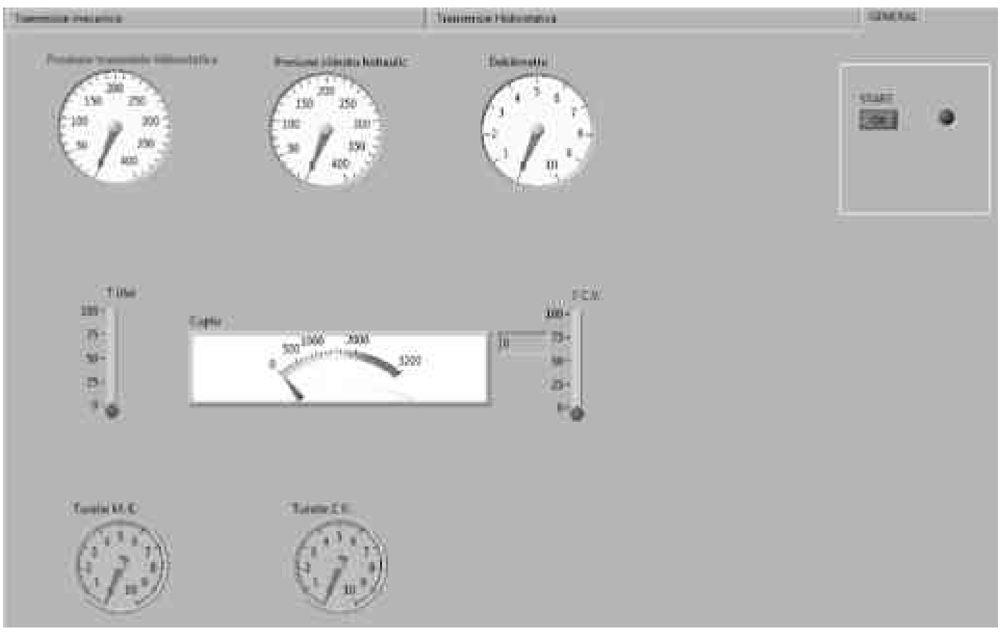

Fig. 7. – The virtual instrument data acquisition. Screen 1.

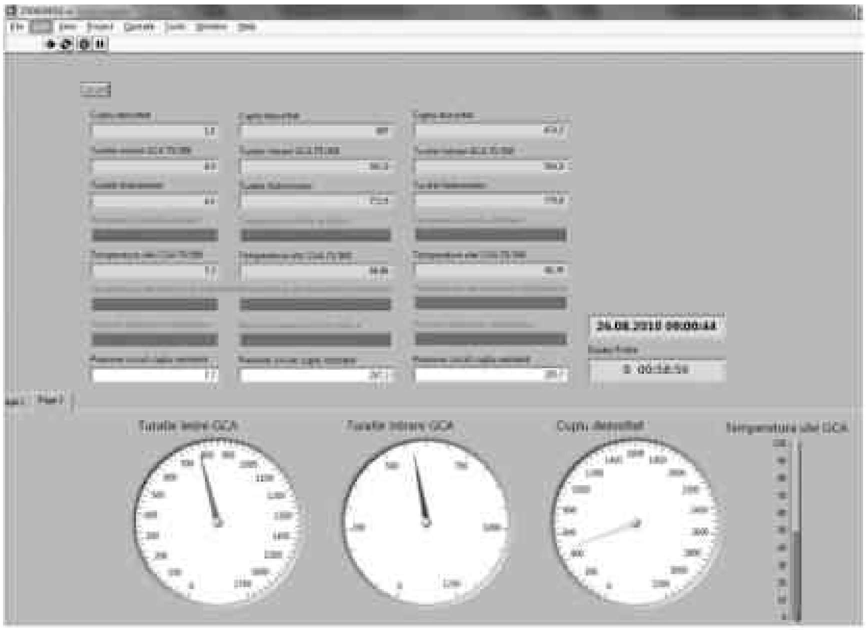

Fig. 8. – The virtual instrument data acquisition. Screen 1.

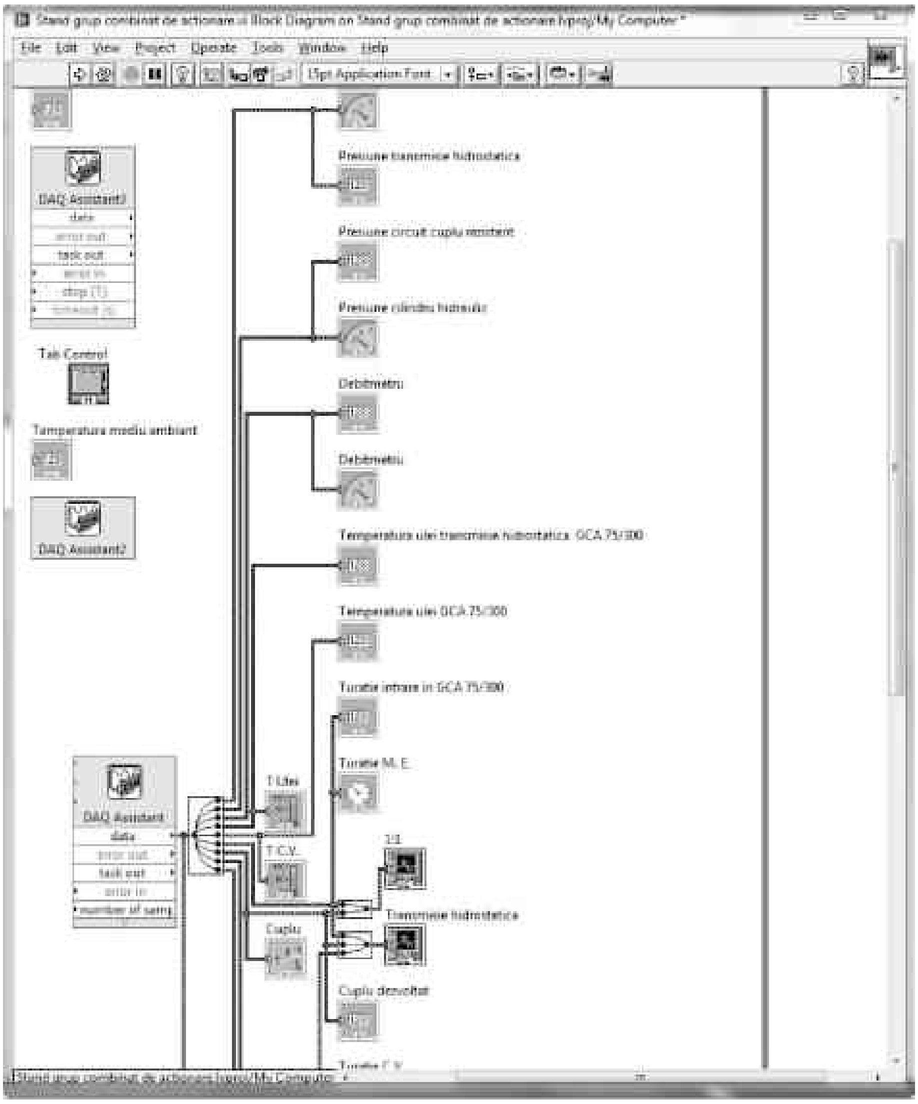

Fig. 9. – The virtual instrument data acquisition. Screen 3.

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JOINT MOTION AREA RELATED TO PROSTHESIS COMPONENT POSITION IN TOTAL HIP ARTHROPLASTY

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Abstract- *The total hip arthroplasty is the most common procedure for hip reconstruction, but even if it has a great success rate it also has some limitations regarding compromises that must be made, which can lead to post operative complications and could affect patient's life quality and implant's lifetime. Utilization of a personalized implant permits restoration of the original anatomy with maximization of the contact surface between bone and prostheses, which leads to the optimization of load distribution. The authors realized a 3D proximal femur modelling, designed an adequate personalized prostheses and realized computational simulation of the assembly, in order to anticipate the joint motion area related to acetabular cup position. We must outline that because the reconstruction was made keeping the natural rotation centre of the femoral head, the influence of the anteversion of the stem was not analysed.*

Keywords - personalized prostheses, motion area simulation.

1. Introduction

The idea of a personalized hip implant is not so new on the international scale and there are some preoccupations regarding personalized implant manufacturing, using classic and non-conventional technologies. The new laser sintering machines have brought an unexpected excitement among researchers in this domain. In the history of total hip arthroplasty (THP) many different positions for the acetabular cup and the femoral stem component have been recommended. For the acetabular component, in different studies an abduction of 30° to 50° and an anteversion of 0° to 30° were suggested. Charnley, the pioneer in arthroplasty advocated a 45° of acetabular abduction, a 0° anteversion and a maximum 5° femoral anteversion for the stem [1,2]. Muller proposed that the combined anteversion of the cup and stem should not exceed 25° to 30°, while Ranawat opined for 20° to 30° for this combined anteversion in males and up to 45° in females [3].

Different positions of the prosthesis components lead to different results regarding joint motion area and have impact upon implant's durability and stability. The data obtained in the course of this study help doctors to predict the prosthetic joint motion resulting from acetabular cup position.

2. Method description

For motion area evaluation, the 3D models of the proximal femur, hemipelvis, the spherical joint, the plastic liner and the acetabular cup were computed. The authors have used the CT scan data of the patient A.M., whose 3D model of the proximal femur was obtained using the commercial soft 3D DOCTOR, and importing the obtained surfaces in SolidWorks 2009, in order to compute the solid model. The assembly for joint area evaluation was obtained by fixation of the hemipelvis, on which the acetabular cup and the liner were inserted using concentricity mates between cup and the acetabular fossa and parallelism between their plan faces. The subassembly formed by the proximal femur, personalized stem and spherical joint was then inserted using only a concentricity mate between the joint and the liner. This single constraint allowed free rotation of the femur-prosthesis subassembly in order to determine the maximum angles of motion without interferences. Next, the reference planes used for characterization of the position of the different body parts were materialized: sagittal, frontal and transverse planes (see **fig.1**)

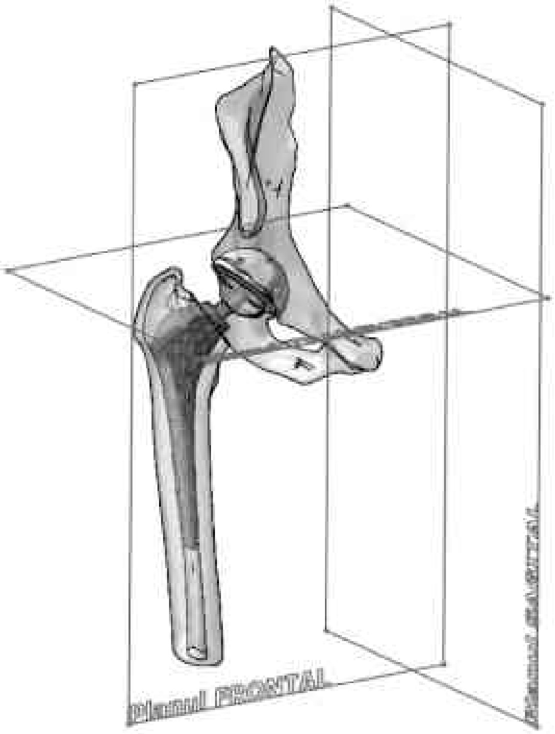
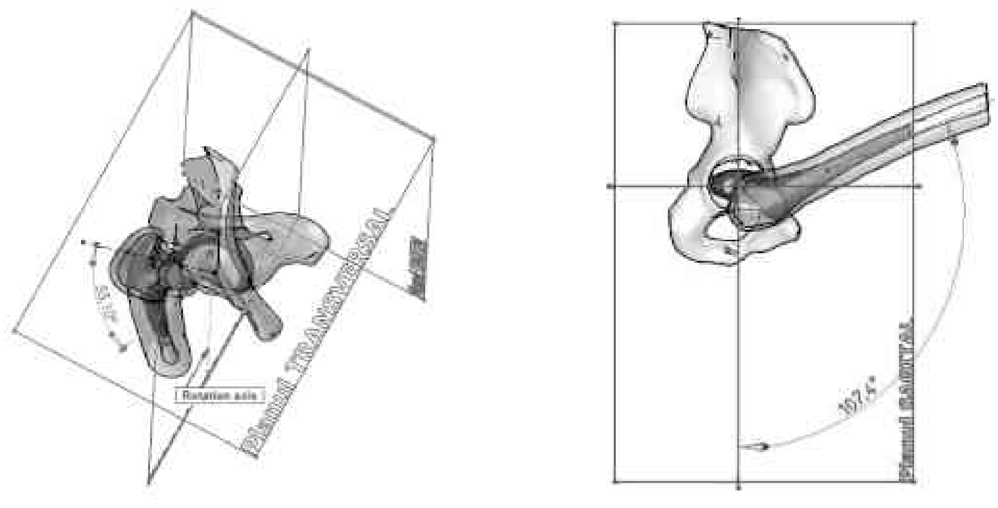


Fig. 1: *Materialization of the reference planes*

The sagittal plane was placed at half of the distance between femoral heads (the distance was measured on the radiographic image of patient's A.M. hip). The other two planes were constructed perpendicular to the first one and passing through the femoral head centre.
Taking in account the controversies regarding the position of the acetabular cup, in order to study the influence, we orientated it in 30°, 40°, 45°, 50° abduction and 0°,10°,20°, 30° anteversion.

All the 16 resulted combinations were then examined for maximum joint motions in five directions (associated with hip dislocation), as follows [6]:
Study I: Maximum external rotation in 0° flexion and 0° abduction;
Study II: Maximum flexion in 0° rotation and 0° abduction;
Study III: Maximum flexion in 10° adduction and 10° internal rotation;
Study IV: Maximum internal rotation in 90° flexion and 0° abduction;
Study V: Maximum internal rotation in 90° flexion and 10° abduction.
For exemplification, the study of maximum flexion in 10° adduction and 10° internal rotation was used to simulate the function of getting up from a low chair without keeping the knees apart [4,5]. The assembly was displaced/rotated until the impingement between prosthetic elements (acetabular cup - stem neck or acetabular cup - stem neck) or bones (femur - hemipelvis) occurred. The contact type was recorded in the results table, the bone impingement was noted with “A” and prosthetic impingement with “B”.
In order to orientate the acetabular cup to the desired angles, 16 dedicated planes were created. Also, in order to force the displacement of the stem-femur subassembly in the desired directions other auxiliary plans and rotational axes were created, temporary mates being assigned to the subassembly.



a. Maximum external rotation

b. Maximum flexion

Fig. 2: *Measurement of the maximum angle*

3. Results and discussions

Appreciation of the maximum joint motion angle was made by measuring the difference between the initial position (stand up) and the final one when impingement occurred (see **fig. 2**). The interferences between the elements of the assembly were evidenced using the "Interference detection" command, available in SolidWorks 2009.

The launch of the "Interference detection" command, opens a dialog window were the interferences are listed and the zone is highlighted in red for an easy and rapid location. The programme also calculates the volume of the superimposed elements (see **fig. 3**).
In **table 1**, the computed maximum joint motion angles are presented for patient A.M. hip with personalised femoral stem. The motion areas are presented for all five studies defined in the first paragraph, for all the possible combinations of the acetabular cup positions (16 positions). In order to outline the correspondence between the results in table 1 and the variation diagrams (see fig. 4), the table lines were shaded in the colours of corresponding curves.

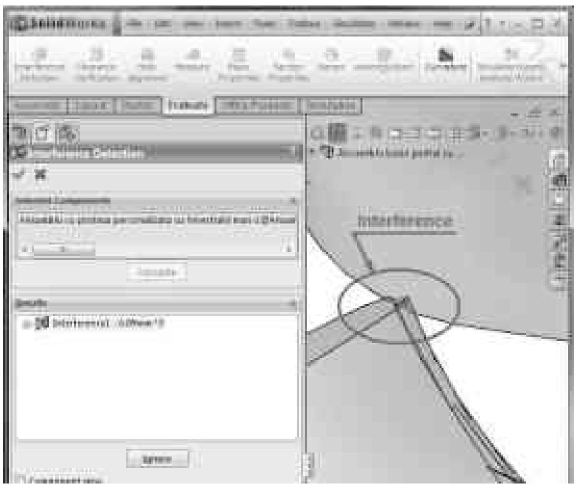


Fig. 3: *Interference detection*

Using the 3D model the authors demonstrated that external rotation in neutral position of the femur decreases as acetabular cup anteversion and abduction increases. For anteversion of 0° and 10°, the maximum external rotation is the same for all positions of the acetabular cup, respectively 55.1° the impingement in this case taking place between the femur and the pelvis. The decrease of the motion area depending on acetabular orientation is not so significant, the biggest difference being of 9°. One can see on the diagram that the global influence obtained by anteversion modification is more significant. Acetabular abduction had little effect upon maximum external rotation.
The joint flexion in 0° rotation and 0°femoral abduction increased as acetabular abduction and anteversion increased. When the acetabular cup was placed in 30° abduction and 0° anteversion, the model allowed the smallest flexion angle (107.4°), and the maximum value was obtained for 50° abduction, when a bone impingement was obtained.
The same relationship between the acetabular anteversion/abduction and the maximum flexion angle was observed when the femur was positioned in 10°adduction and internally rotated 10°, in order to simulate the function of getting up from a lower seat [4,5]. In this case, the maximum flexion angle increases with more than 15° keeping the shape of the curves. One can observe that the maximum flexion increases from 133.1° (bone impingement), to 148.5° (prosthetic impingement).
The increase of abduction and adduction of the acetabular cup, also leaded to an increase of the internal rotation angle, the maximum values (with bone impingement) being obtained for abduction greater then 40° and anteversion of 30°. Placing the femur in 10° adduction leads to a decrease of the previous obtained values for internal rotation, the maximum decrease being 4.8°. We can also observe the modification of impingement type from bone to prosthetic for the abduction of 40° and anteversion of 30°.

Table 1: Joint motion area depending on acetabular cup position

Acetabular abduction	Acetabular anteversion	Study I Motion area	Study I Contact type	Study II Motion area	Study II Contact type	Study III Motion area	Study III Contact type	Study IV Motion area	Study IV Contact type	Study V Motion area	Study V Contact type
30°	0°	55,1°	A	107,4°	B	113,7°	B	16,6°	B	13,1°	B
	10°	55,1°	A	119,4°	B	128,9°	B	22,9°	B	18,6°	B
	20°	48,9°	B	128,5°	B	138,8°	B	27,3°	B	22,6°	B
	30°	35,8°	B	133,1°	A	144,3°	B	30,1°	B	24,7°	B
40°	0°	55,1°	A	118,9°	B	129,1°	B	24,2°	B	22,3°	B
	10°	55,1°	A	127,1°	B	138,4°	B	30,3°	B	26,9°	B
	20°	46,9	B	130,5°	B	143,5°	B	34,5°	B	30,2°	B
	30°	33,1	B	133,1°	A	146,2°	B	36,7°	A	30,9°	B
45°	0°	55,1	A	128,5°	B	144,9°	B	31,5°	B	27,4°	B
	10°	55,1	A	131,5°	b	148,5°	A	35,1°	B	30,1°	B
	20°	44,5	B	133,1°	A	148,5°	A	36,7°	A	31,9°	A
	30°	30,6	B	133,1°	A	148,5°	A	36,7°	A	31,9°	A
50°	0°	55,1	A	133,1°	A	148,5°	A	35,7°	B	31,3°	B
	10°	55,1	A	133,1°	A	148,5°	A	36,7°	A	31,9°	A
	20°	41,9	B	133,1°	A	148,5°	A	36,7°	A	31,9°	A
	30°	26,8	B	133,1°	A	148,5°	A	36,7°	A	31,9°	A

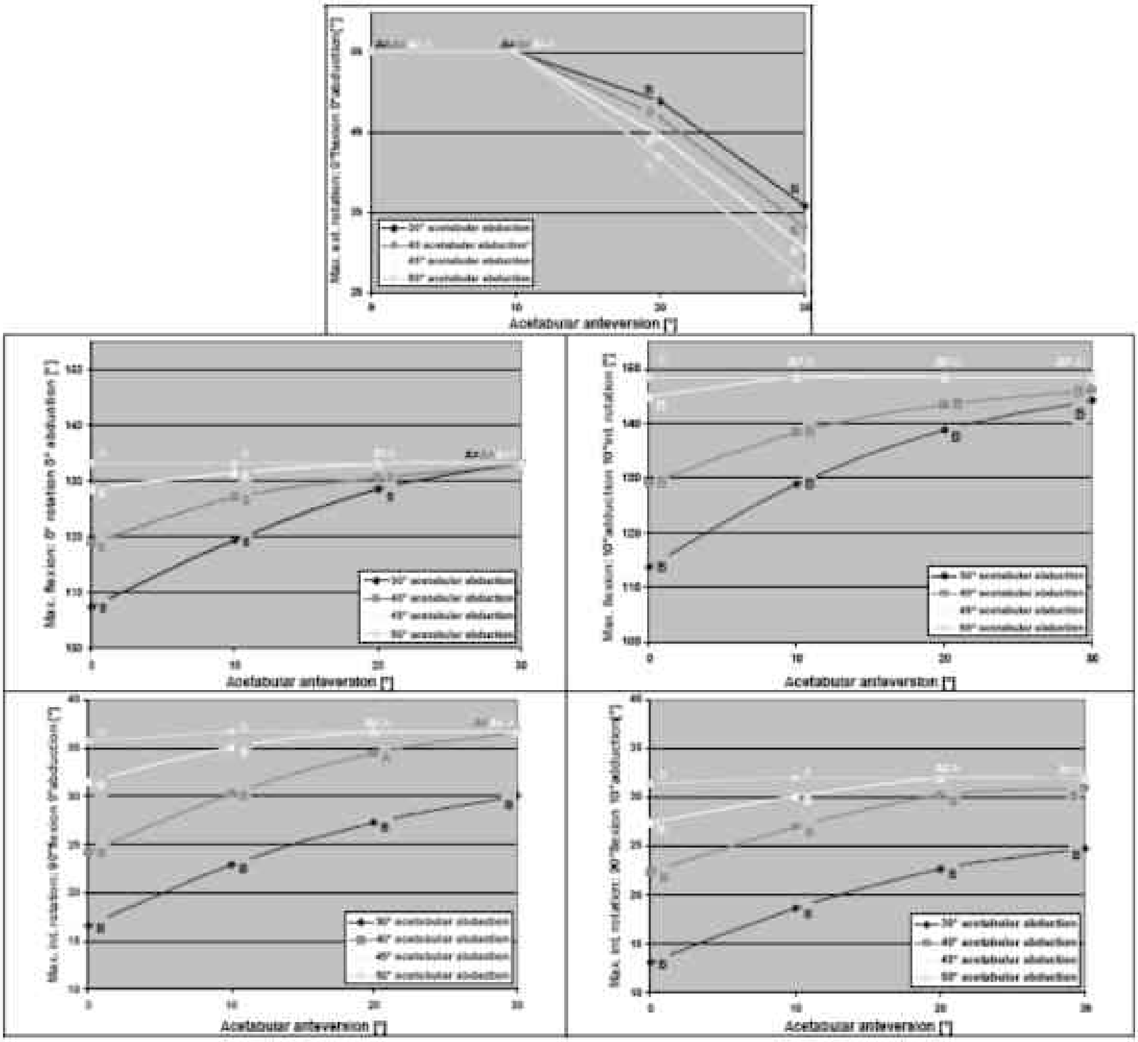


Fig. 4: *Diagrams of the joint motion area variation*

4. Conclusions

The 3D model of the right hip joint obtained from a CT scan of patient A.M., was utilized to study the relationship between the position of the acetabular cup and the femur motion area determined by the impingement between the elements of the assembly (bone and prosthetic elements). The models were obtained using the 3D DOCTOR commercial soft and then the contours exported in SolidWorks 2009, were the joint area simulation took place. For the simulation, a Fujitsu Siemens computer with Intel Core Duo 2,4GHz processor, 4GB RAM and NVIDIA QuadroFX570 video card was used.

The research was made for 16 possible positions of the acetabular cup and five directions associated with hip dislocation, as mentioned in the method description paragraph [6].

Specific implant designs can be studied using this method, and an unlimited number of implant positions and joint motions can be examined using this method.

The realised study has some imperfections regarding following matters:

- The simulation didn't take in account the soft tissues from the hip joint which could influence the range of motion or the moment of impingement;
- The study does not consider the reaction forces from the hip joint;
- The obtained results can be modified depending on the osteotomy technique which is associated to the patient specific anatomy
- The 3D model was obtained from a CT scan of a female patient and the modification of the gender or of the geographic area may modify the results.

Data collected in this study showed that femoral joint range of motion in directions usually associated with implant dislocation varies considerably depending on the position of the acetabular cup. In general, flexion and internal rotation of the joint is increased when acetabular cup abduction and anteversion increased, the extreme limits of abduction and anteversion allowing the largest movements. An inverse relationship was detected for the internal rotation, which decreases especially when the acetabular anteversion increases, abduction modifications leading negligible changes.

Information obtained by the simulation can be useful to the surgeon whom is useful to know the maximum motion area that can be obtained for a given patient and to select the position of prosthetic components leading to that area.

The surgeon's goal is to maximize the motion area of in an impulsive or forgetful patient with memory deficiencies who can forget to limit the amplitude of movements to avoid a possible dislocation. Also, in a revision operation, when only the femoral stem is needed to be replaced, the surgeon may decide to replace also the acetabular cup (even if it is firmly set) if he finds that the range of motion is not satisfactory.

Following research carried out, the authors opines for the use of 45°-50° of adduction accompanied by 10°-20° of anteversion, the position providing a bigger range of motion and at the same time a good fill of the acetabular cavity, because for small abduction and large anteversion one can observe the protrusion of acetabular cup beyond the original enclosure (see fig. 5).

a. 30º abduction 0º anteversion b. 30º abduction 30º anteversion c. 45º abduction 10º anteversion

Fig. 5: *Protrusion of the acetabular cup for different acetabular positions*

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PROGNOSIS AND DEVELOPMENT TENDENCIES OF HYDRAULICS AND PNEUMATICS IN THE BEGINNING DECADE OF THE 21ST CENTURY

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Summary

The stages of the technical parameters development of the product have been presented. The following branches have been considered as the major motive power in hydraulic fluid power (HFP): electronics, information technology and control, which, as a result of the synthesis with mechanisms, lead to the creation of mechatronics. The application of modern tools in HFP has been presented: expert systems, neuron networks, artificial intelligence, internet, acoustic holography, rapid prototyping. Major problems to fix as well as HFP application areas have been identified. The opinions of renown industrial corporations on hydraulic fluid power systems in the 1st decade of the 21st Century have been exposed.

1. Introduction

The experience from the last several dozens or so years have revealed that discoveries made by the science of new phenomena or mechanisms that control the processes, which are known for a long time and are used only sometimes, allow us to foresee which technologies and machines (artefacts) can be developed on this basis. If we succeed in mastering a given technology under laboratory conditions then we may foresee, with a high probability, its development cycle from the moment of making an invention to the moment it reaches its physical development limits [22,23]. According to the characteristics presenting the logicistic curve (Fig.1) in the product development within a given generation, one may discriminate three stages [22]. **Stage one** starts at the moment of birth of the concept of a new product or basing its design on new rules and lasts until the time when, owing to the development and implementation research, the rise in expenditures starts producing linear effects in the increment of technical parameters.

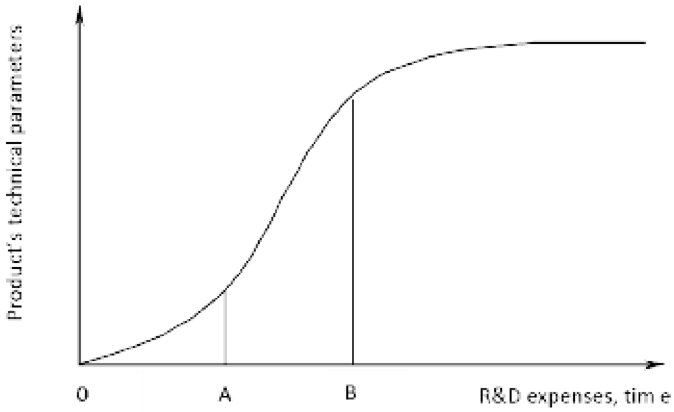

Fig. 1 Development of products' technical parameters within one technology generation [22]

Stage two features an already mentioned linear relationship between the expenses spent on R&D work and the technical parameters (section A-B).

Stage three – the development curve turns into the state of saturation, approaches asymptotically product's physical development limits when the expenses on R&D work yield minimum effects.

The considerable majority of products remain on the market over several technology generations. Examples of such products may be a PC (vacuum systems, transistor systems, highly integrated systems) or an aircraft (IC engines, jet engines, rocket engines). In approximation, this growth may be presented as successive logistic curves which base on the parameters of the previous generation. Here the substantial issue comprises decisions whether:

§ to abandon the work on the generation that exhausts its capacities and to start the R&D work on a new generation,

§ to implement products of the new generation into manufacture.

The study of the course of existing products in manufacture and the forecasting of products of a new, next generation is strictly related to company's (branch's) expenses and innovative policy. This may be expressed using a series of indexes that constitute the technical strategy measure [22]:

§ R&D intensiveness, R&D expenses/company's revenue (Tab.1)

§ R&D index/production investments,

§ index of sales for new products (SNP),

patents per 100 employees within the R&D area

Table 1. R&D intensity index (RDI) for selected branches of the U.S. industry in 1998 [22]

Branch of industry	R&D intensity index (RDI)
Software	18.4%
Computer communications systems	18.0%
Pharmaceutical products	12.0%
Semi-conductors and related products	10.6%
Computers	5.5%
Vehicles	4.3%
Oil refining	0.5%

At present, the technological progress results, in the statistical sense, from the number and importance of scientific discoveries made, inventions worked out and their implementation, that is innovation. In its fundamental stream, it is distinctly correlated with the values of the above-mentioned indexes.

Here, it is worth taking a look at the economic potential and capacities in the area of R&D in the 17 countries associated in CETOP (Table 2). In 2007, ca. 550 million people in total were living in those countries, and the average GDP per inhabitant (in current pricing) was almost 3 times higher than in Poland.

Table 2. Selected macroeconomic data of the CETOP countries in 2007 by *Statistical Yearbook of the Republic of Poland 2009*.

Country	Population (million)	GDP per inhabitant (in current pricing, thousands of USD)	Expenses in the R&D area related to GDP, %*	R&D employees per 1,000 employed *	Expenses per R&D (in thousands of USD)*
Belgium	10,697	47,468	1.9	7.9	121,414
Czech Republic	10,408	20,815	1.5	5.2	79,664
Finland	5,310	50,931	3.5	16.5	108,497
France	61,028	44,550	2.1	8.2**	122,639
Spain	45,661	35,185	1.2	5.8	82,526
Holland	16,433	53,094	1.7	5.5	115,192
Germany	82,143	44,519	2.5	7.2	141,746
Norway	4,762	94,763	1.5	9.2**	126,480
Poland	38,116	13,861	0.6**	4.5	42,282
Romania	21,508	9,518	0.5	2.2	44,981
Slovakia	5,401	17,566	0,5	5.5	33,358
Slovenia	2,029	26,905	1.6	6.1	85,120
Switzerland	7,617	64,885	2,9	6,1	143,142
Sweden	9,214	51,954	3.7	12.6	156,989
Turkey	71,002	8,894	0.8	1.9	89,701
UK	61,446	43,237	1.8	5.8	106,341
Italy	59,760	38,455	1.1**	3.4	110,608
Russia	141,841	9,518	1.1	6.7	27,408

*- data from 2006, **- related to 2005

The basic motive power of the progress in process technologies of the 21st Century is the growth and applications in three broadly understood areas for which huge human and capital resources are dedicated:

- § science of materials and materials engineering,
- § electronics and information technology as well as control systems and telecommunications,
- § bioengineering and environmental engineering.

The results of those avalanche-like expanding areas influence significantly the technology and production processes, also in all other areas of life. At this moment, the competitiveness of products and services offered on the market is the decisive factor over the economic development. Its innovativeness and productivity are constituents deciding about the international competitiveness of economy.

1. Development tendencies in fluid power

The area of technology that uses fluids: liquids and gases in different types of machinery and facilities is very secular and respectable. We have been constructing machinery and facilities that use the water and wind power since antiquity. The scientific and physical essentials were founded as late as in the 17th and 18th Centuries, and the laws and relationships revealed by B. Pascal, D. Bernoulli, L. Euler belong to the canon of hydraulics and pneumatics.

Conventional fluid power has been dominated by electronically processed signals, this occurring in all aspects: theory, designing and constructing, production, action, operation and marketing as well.

One may say, half-jokingly, that they have cast in their lot with the works by J. S. Bach, J. F. Haendel and A. Vivaldi – contemporaries of Bernoulli and Euler.

The omnipresence of electronics and information technology, their ease and friendliness result in moving from mechanical, pneumatic, electrical and hydraulic systems to those of mechatronics (Fig. 2) [35].

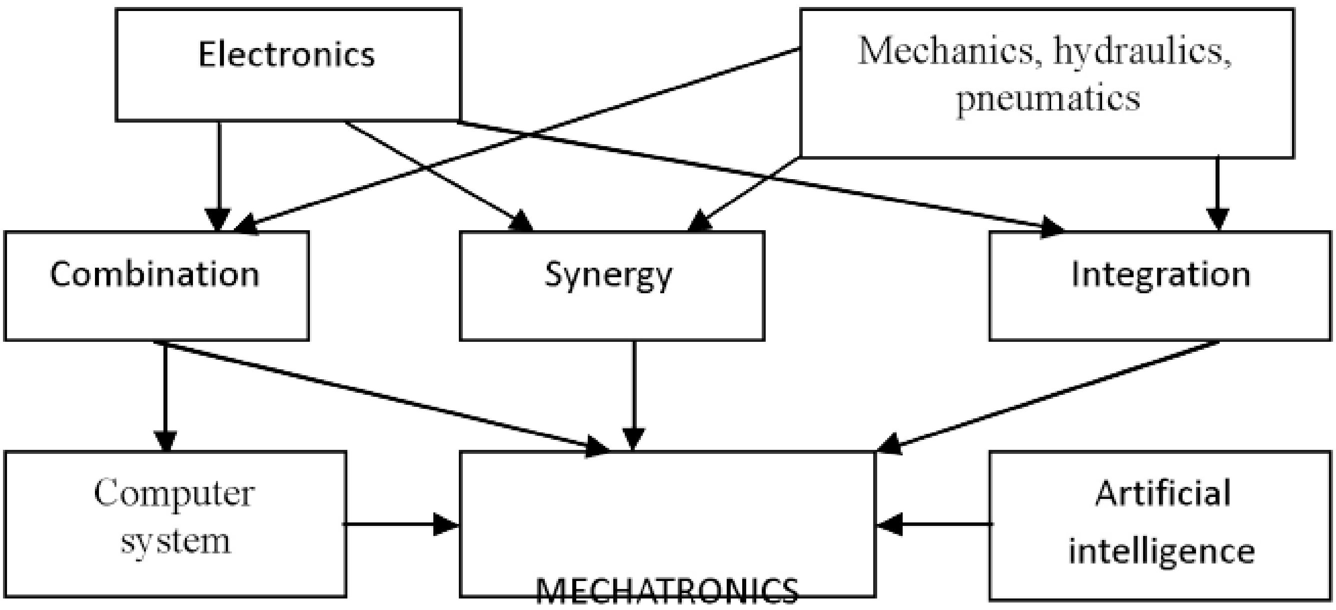

Fig. 1Definition of mechatronics [35]

To solve various types of issues related to hydraulic fluid power elements and systems the following systems are used, to a higher and higher degree, as tools:

§ Expert system in designing and diagnostic [8,19]. They use the knowledge of many specialists, comprise the basis of knowledge and interpreter. The example of results of an expert system operation that assists the generation of structure variants and the choice of elements out of definite catalogues is shown in Fig. 3.

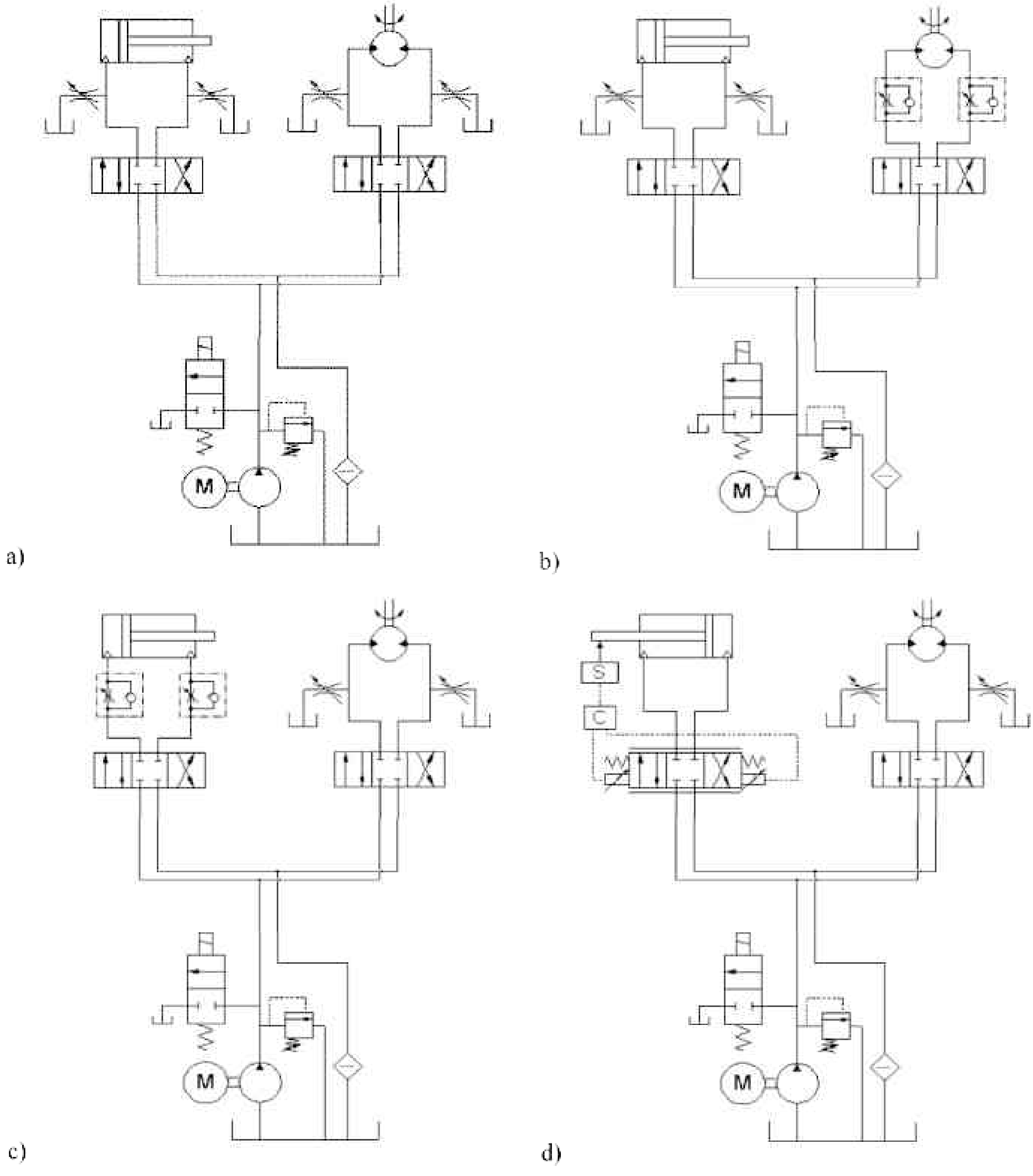

Fig. 1 Alternative concepts of hydraulic power systems generated by expert systems [19]

Artificial intelligence methods and techniques such as artificial neuron networks, fuzzy logic and genetic and evolutional algorithms in control systems and diagnostic [8,17,30], (Fig. 4, 5).

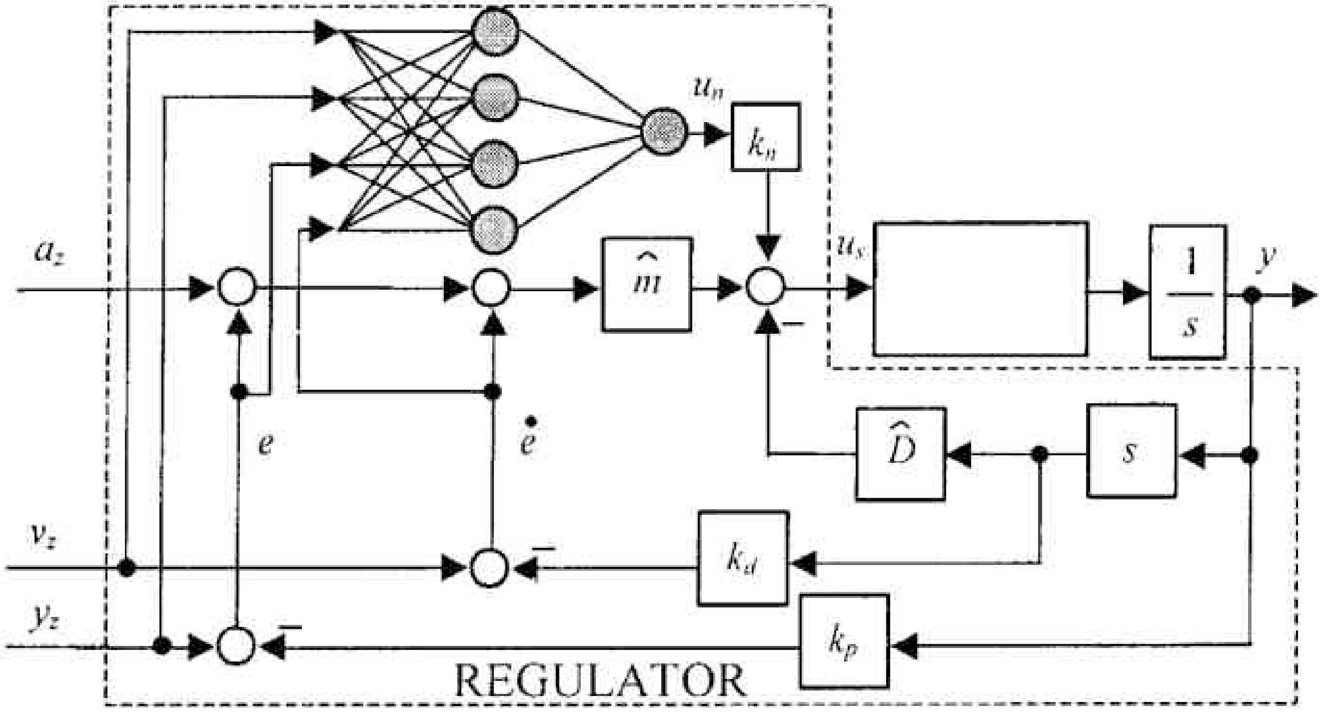

Fig. 1Block- schema of controller which computing torque with neural estimation errors corrector [30]

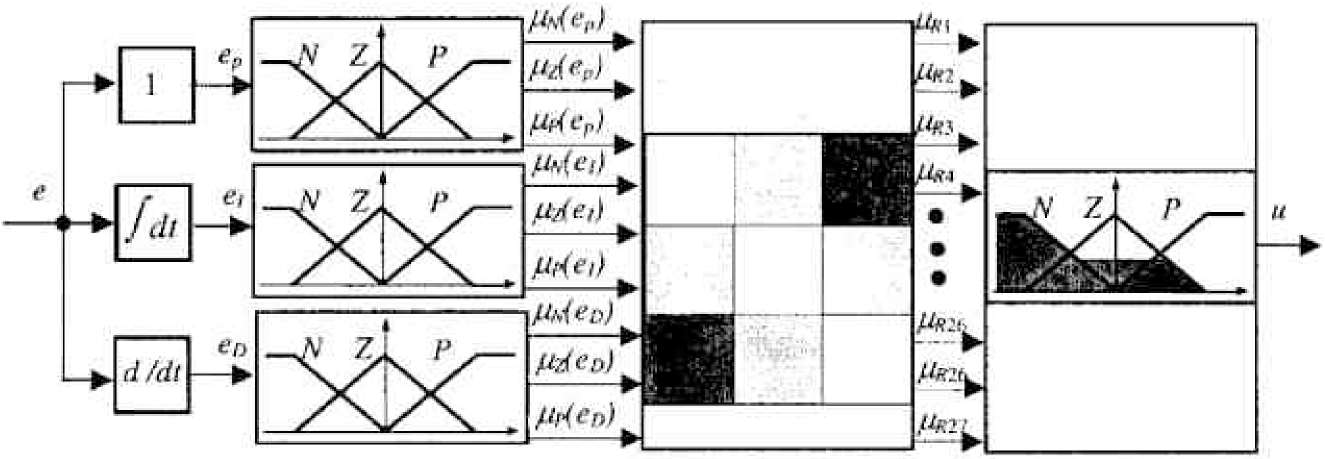

Fig. 1Block- schema of fuzzy logic PID regulator [30]

- **Internet** in searching for and acquiring information, marketing, designing of elements and systems, also in monitoring and diagnostic of brake systems [1,8]. All important manufacturing and servicing companies as well as institutions have their own www sites (Fig.6). Beside the data on the company, the user may have access to product catalogues and he/she may obtain a technical offer and price quotation . The majority of manufacturers make it possible to make deals by this way, e.g. in case of PARKER HANNIFIN more than one half of deals. Obviously, R&D associations and units have their www sites, e.g. the active Fluid Power Net.

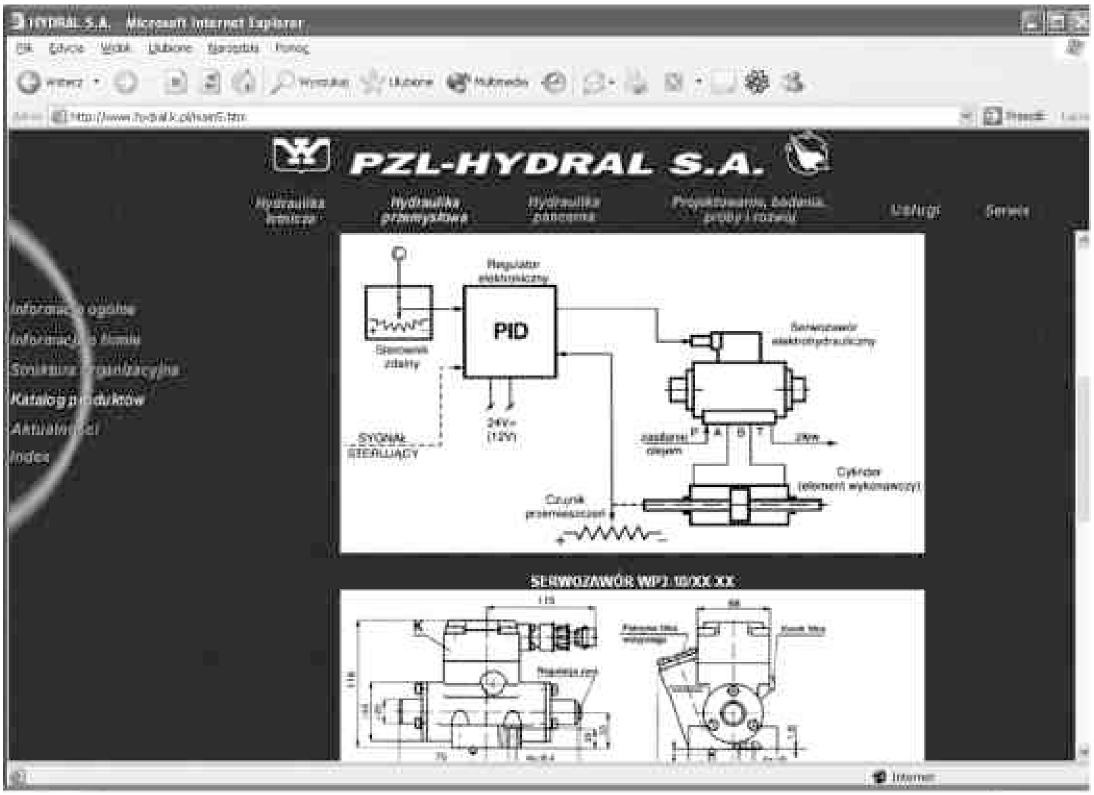

Fig. 1An example of servovalve drawing on the PZL- HYDRAL web site (www.hydral.k.pl) [1]

- Rapid Prototyping – in the process of designing and making the prototypes of elements and assemblies [9].
- Control Rapid Prototyping – of control systems that allow the designing, testing and implementing of advanced real-time control systems [17,30,31,32].
- Laser Holography and Photo-elasticity – in the flow analysis and in shaping the bodies of hydraulic elements.
- Acoustic Holography and Acoustic Probe method in the vibroacoustic analysis and in the shaping of products [20,26] (Fig.7).

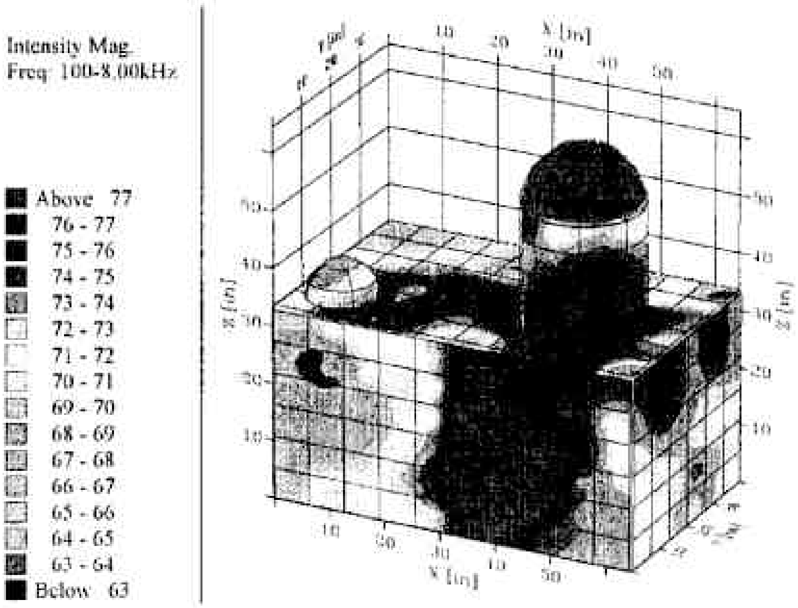

Fig. 1 Intensity of sound level on the surface of hydraulic aggregate, n=1180rpm, p=180 bar, frequency 100-8000 Hz [20]

§ **Thermovision** – allowing the identification of intensity and efficiency of power engineering transformations in hydraulic elements and assemblies.

Obviously, the above set is not complete. The multiplicity and attractiveness of offers flowing down from the businesses of electronics, information technology and telecommunications evokes confusion, sometimes a feeling of getting lost among the specialists, especially the elder, from the field of hydraulic fluid power. Among the younger generation who are passionately fond of information technology the opinion starts to appear that both electronics and information technology have already fixed, or they will do in a while, the major issues of hydraulics. The more so as new areas are being outsourced from mechatronics: **hydrotronics** and **pneumotronics** [17].

Unfortunately, this is not such good and there is no threat of unemployment for specialists in hydraulics and pneumatics by this way.

According to the classification of technology levels, as published by OECD in 1995, fluid technology products may be mostly classified among "medium-high technology" in which the share of IT and electronics means is considerable. This is confirmed by forecasts of the share of electrohydraulic elements in the global sales of hydraulics (Fig. 8). A rise from 4% in 2005 to 14% in 2010 annunciates, already shortly, the primacy of mechatronics, hydrotronics over classic solutions. This is particularly evident in the forecast of the demand for individual electrohydraulics electronic components (Fig. 9).

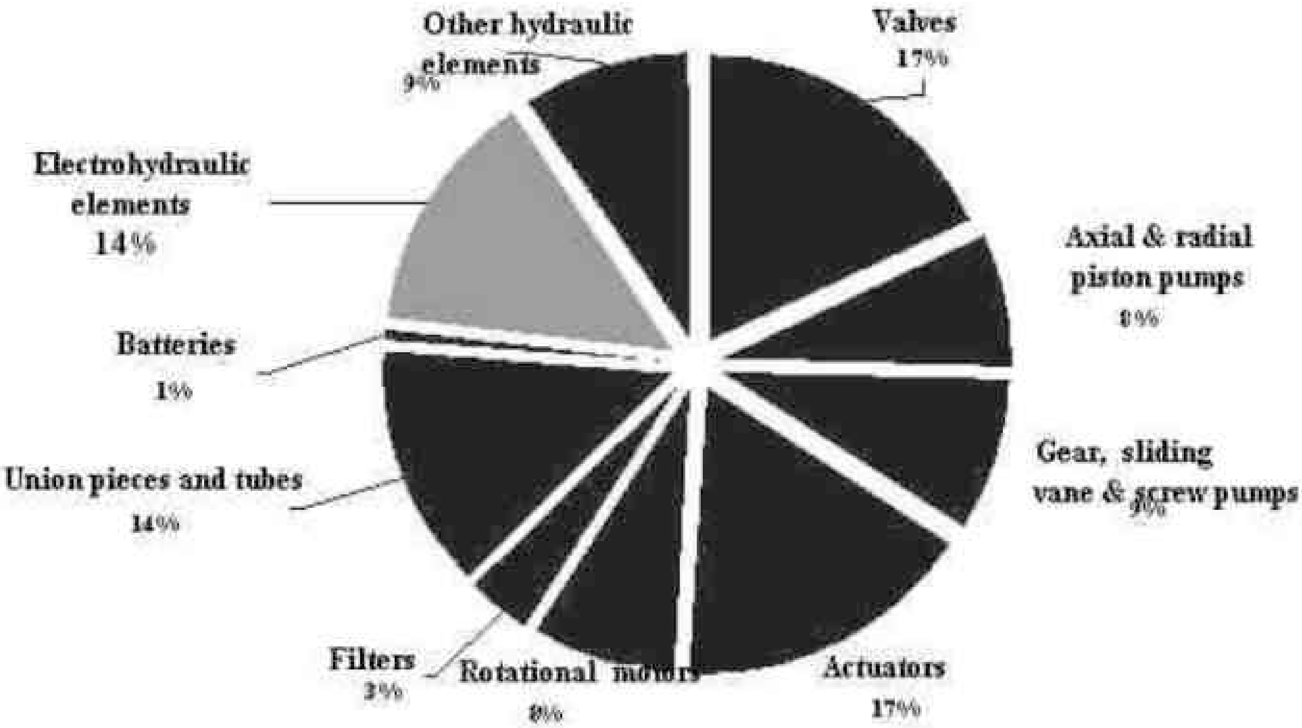

Fig. 1Anticipated shares of hydraulics components in the domestic sales in 2010 [38].

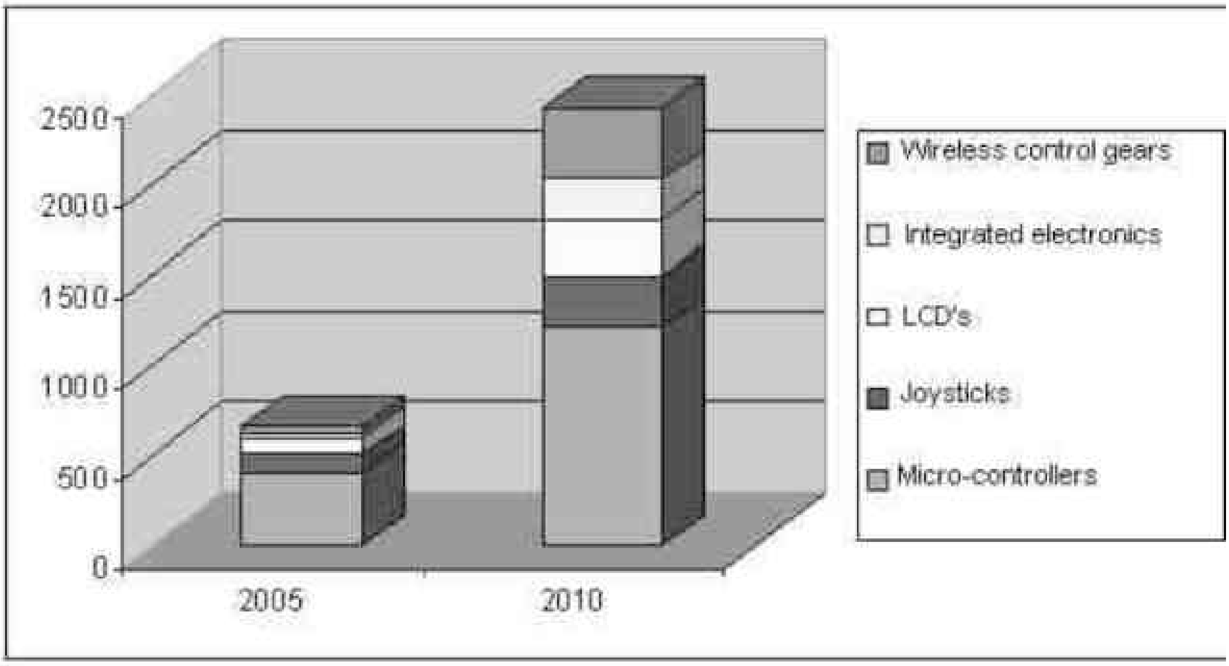

Fig. 1Anticipated demand for various electronic elements for electro hydraulics, millions of USD [38].

Various authors from many domestic and foreign R&D centres put forth their visions and growth tendencies. The ideas of "the European guru" in hydraulics and pneumatics, Prof. W.Backe [3], are to be deemed the most complex and having a realistic foundation:

1.The rise in the use of the stiff finite element method and the rheological characteristics of metallic and non-metallic materials to optimise the flow through elements, also to minimize the level of emitted noise [27,29] (Fig. 10).

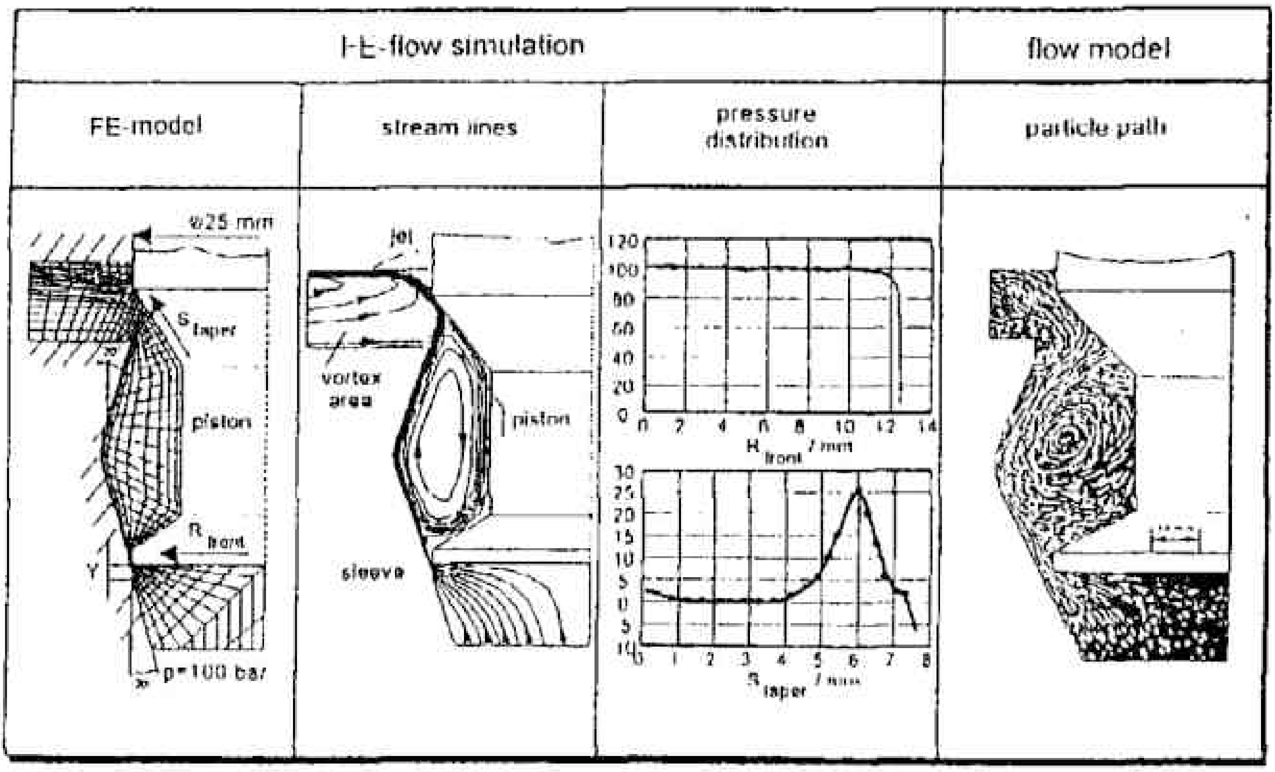

Fig. 1Finite element flow simulation and modelling technique [3]

2. Rise in the use of simulation systems to reduce the time of designing, testing and evaluating the components and systems [16,18,19,34,35].
3. Use of new materials and designing aiming at the improvement of wear characteristics and tribological properties. This has to result in the construction effort and thus in the cost reduction [21,29].
4. Environment protection through:
   § use of elements and systems of higher power efficiencies, in particular those multisource systems with energy accumulation and recuperation [10,25];
   § support of the development in seals and joining technologies [21];
   § development and application of biodegradable liquids.
5. Improvement of static and dynamic characteristics of fluid power systems through :
   § use of digital electronics systems [1,17,31],
   § specially integrated electronic units in computers [31],
   § rise in the use of modern concepts for control systems [31,33].
6. Simplification of the use, storage, diagnostic and maintenance using advanced communication systems, FIELBUS network management (Fig. 11) [4,8,17,31].

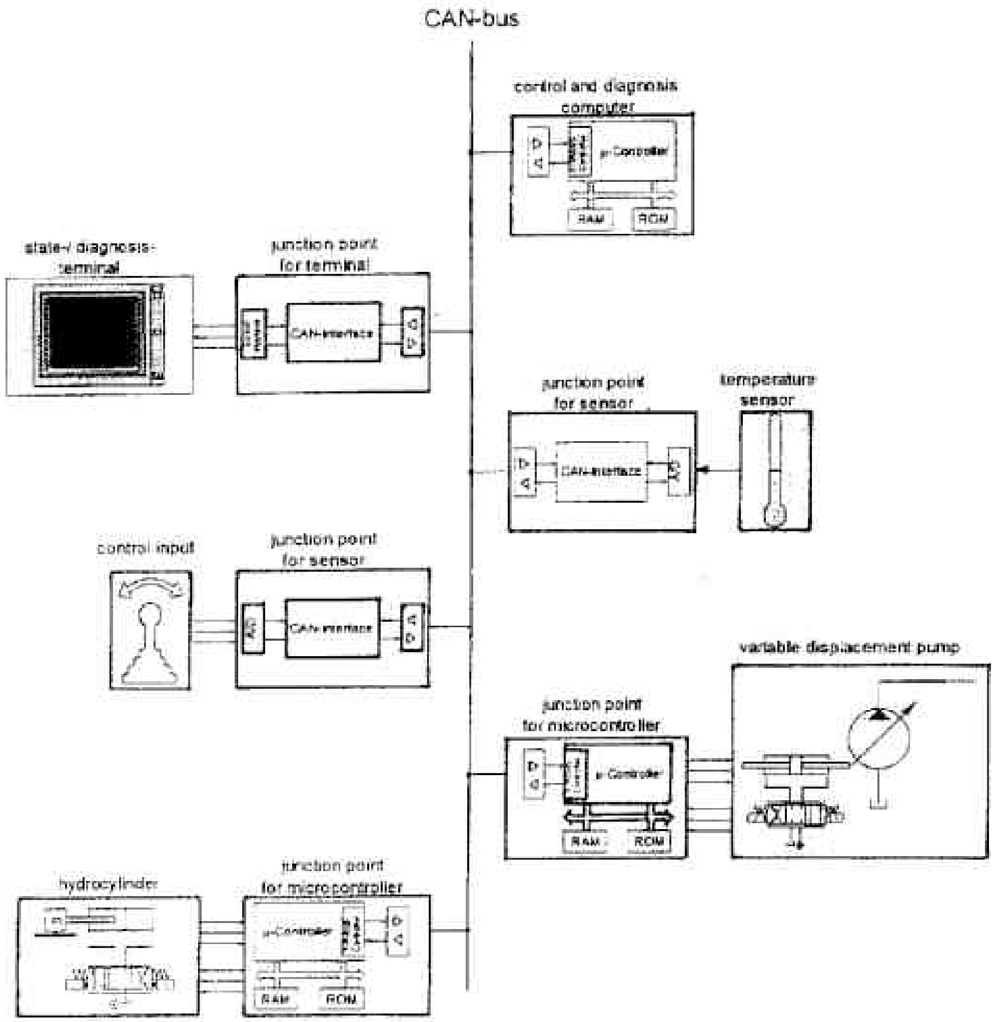

Fig. 1CAN- bus applications in mobile hydraulics [3]

It seems to us that two dynamically developing areas should be added to this list:

§ power technology for fluid microelements [15,22,34], and in some cases, nanomachinery and nanotechnologies as well;

§ fluid systems in medical engineering, also as supporting systems, and grafts as well [14].

1. **Forecasts by industrial corporations**

The representatives of U.S. companies: **Sauer-Sundstrand, Eaton Corporation, John Deere, Caterpillar** have a slightly different look at the future of hydraulics and pneumatics in the first decade of the 21st Century[37].

This is also important for the European and domestic market in the time of production and market globalisation, at least for three reasons

§ this is the forecast made by industrial corporations and not by academic scientists

§ two of the above-mentioned companies are component makers, and the other two companies represent the final manufacturers – makers of mobile construction machines;

§ the experience gathered by the North-American companies usually precede what will happen in other countries later on.

Sauer-Sundstrand

R&D efforts will concentrate mainly in three areas:

§ reduction of the production cost index,

§ reduction of dimensions of elements

§ high level and share of control systems and electronics – mechatronics.

On this list of priorities there no such goals as noise level reduction, efficiency, ecology, for the company the return of investment (ROI) rate is the most important criterion.

Eaton Corporation

R&D will prevail in three directions:

§ The reduction of noise level emitted by hydraulic systems (especially for European requirements) will be necessary taking into account the considerable noise level reduction by combustion engines. The share of hydraulic systems as a source of noise will grow.

§ Improvement of C.O.P – power density. In 1999, in USA, the power density in aircraft hydraulic systems was 10 kW/kg, and in mobile machines it was 4 kW/kg. The rise of this index will follow through:

a) a relatively small rise in operating pressures and a slightly higher rise in speeds

b) weight reduction – new materials.

§ Integration of electronic systems and reliability issues; the application of usage rules basing on the procedures of the market of vehicles is anticipated.

John Deere

It represents the point of view of the makers of agricultural and earth work machinery, and draws attention to the following elements:

§ A tendency to virtual designing, e.g. simulation and rapid prototyping.

§ A considerable rise in operating pressures, higher than in forecasts made by the makers of elements;

§ Reliability related to the complex safety of the machine. Hydraulic elements have to be provided with systems to recognize their internal status, also that the information can be implemented by advanced control systems.

§ No substantial improvement of filtration systems is foreseen in the filtration of liquids. There follows the orientation towards the designing of components with a high level of tolerance to pollution.
§ The specificity of the market for agricultural machinery results in the orientation towards the generation of low-pressure, low-cost systems. The aim of this is to improve the competitiveness within the segment of relatively poorly advanced technologies.

Caterpillar

The foreseeable tendencies of the next decade are presented in tabular form (Tables 3 and 4)

Table 3. Forecast for machinery hydraulic systems [37]

Machine parameter	1999	2004	2009
Share of machinery with electronic accessories [%]	5	60	90
Type of control system	Operator	Semi-automatic control	Integrated control
Total cost	100%	80%	50%
Reliability	x	2x	4x
Noise emission	x	x/2	x/4

Table 4. Forecast for hydraulic components [37]

Machine parameter	1999	2004	2009
Operating pressure, bar	250	350	400
Temperature of liquid, °C	100	110	120
Share of ecological liquids, [%]	<5	20	50
Operating liquid usage time, hrs	1000-2000	2000-4000	>5000
Filtration	x	2x	3x

1. Dynamics of fluid technology market

During the last decade, the market of products and services has developed and some essential changes in shares have occurred on it. The turnover of the market of hydraulics has risen almost by 35% and reached the value of EUR 22 billion (Table 5). The shares of the main participants in that market have also changed: the share of China has grown almost 7 times and the countries associated in CETOP are the leaders on that market.

The turnover of the market of pneumatics has changed over that period of time merely by 5%, however, a diametric change of the key participants has followed. The share of China in pneumatics has increased almost 15 times. The shares of USA and Japan have dropped considerably, this being mainly due to the shift to more advanced technologies and the move of the machinery and equipment to other countries.

Table 5. Development of the market of machine hydraulics and pneumatics and its main shareholders by Bolzani A. (2009) [39].

Development of the market of	Year	USA	Taiwan	Japan	China	CETOP
machine hydraulics and its main shareholders, %	1998	47,18	1,19	15,76	2,16	33,71
	2008	28,8	1,1	9,7	15,6	44,9
pneumatics and its main shareholder, %	1998	31,6	1,0	33,6	0,9	32,9
	2008	22,3	1,8	19,9	13,1	42,9

For comparison, the turnover value on the market of machine hydraulics constitutes ca. 7% of Poland's GDP and 16-18% of the sale value of the global sector of electronic elements.

The economic crisis which started in 2008, caused the collapse of the market for machinery and equipment and the obviously market for their components, and thus goods and services in fluid technique area (Fig. 12). In the case of hydraulic domestic sales (own production sold in the country plus imports) in 2009 declined by 36% (Fig. 13).

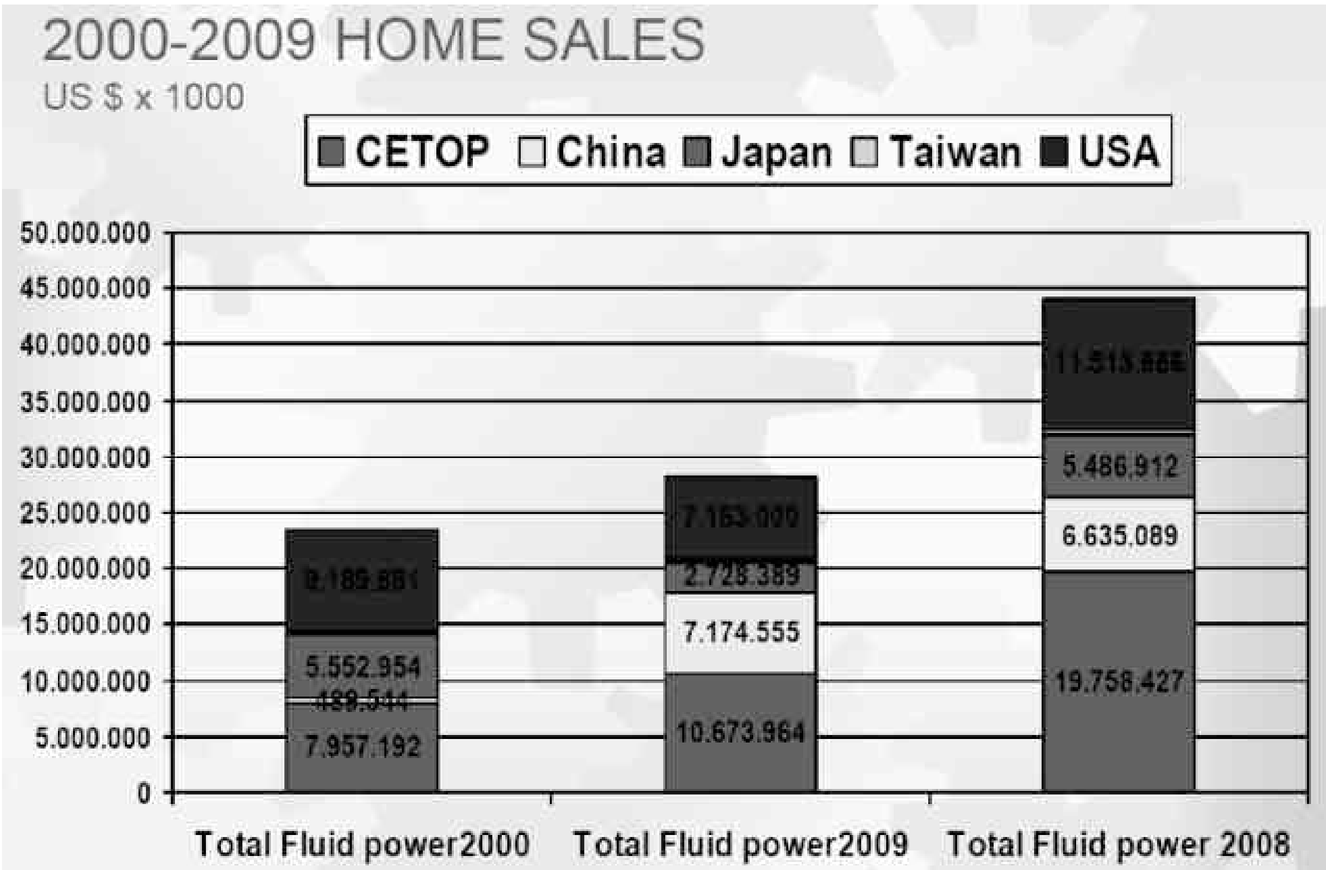

Fig. 1Home sales of fluid power products [40]

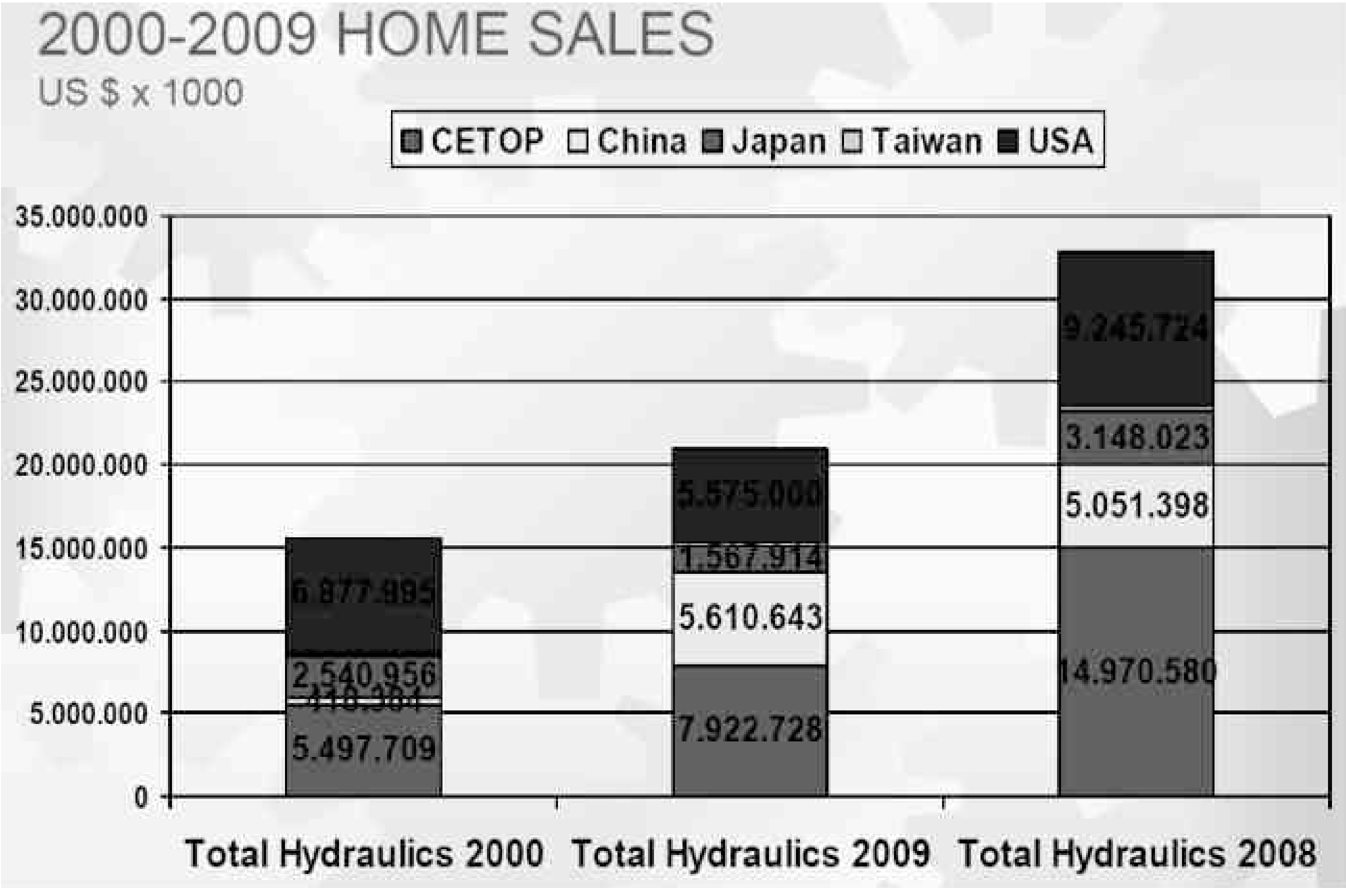

Fig. 1 Home sales of hydraulic products [40].

The demand for hydraulic and pneumatic elements is closely related to the development of individual business branches of the machinery and equipments. It is worth comparing Table 6 each other in which the relations of orders in 2008 versus 2009 most important sectors of the machine building industry in Germany were compared.

Figures 14 to 17 present, in various forms, the turnover of the sector of hydraulics and pneumatics over the last few years in Germany, USA, Japan and China, thus the key players of that market. The study of these data clearly gives evidence about the present-day capacities and trends. At this place, a reservation should be made that the data on the very dynamic shareholder in that market is missing here – India

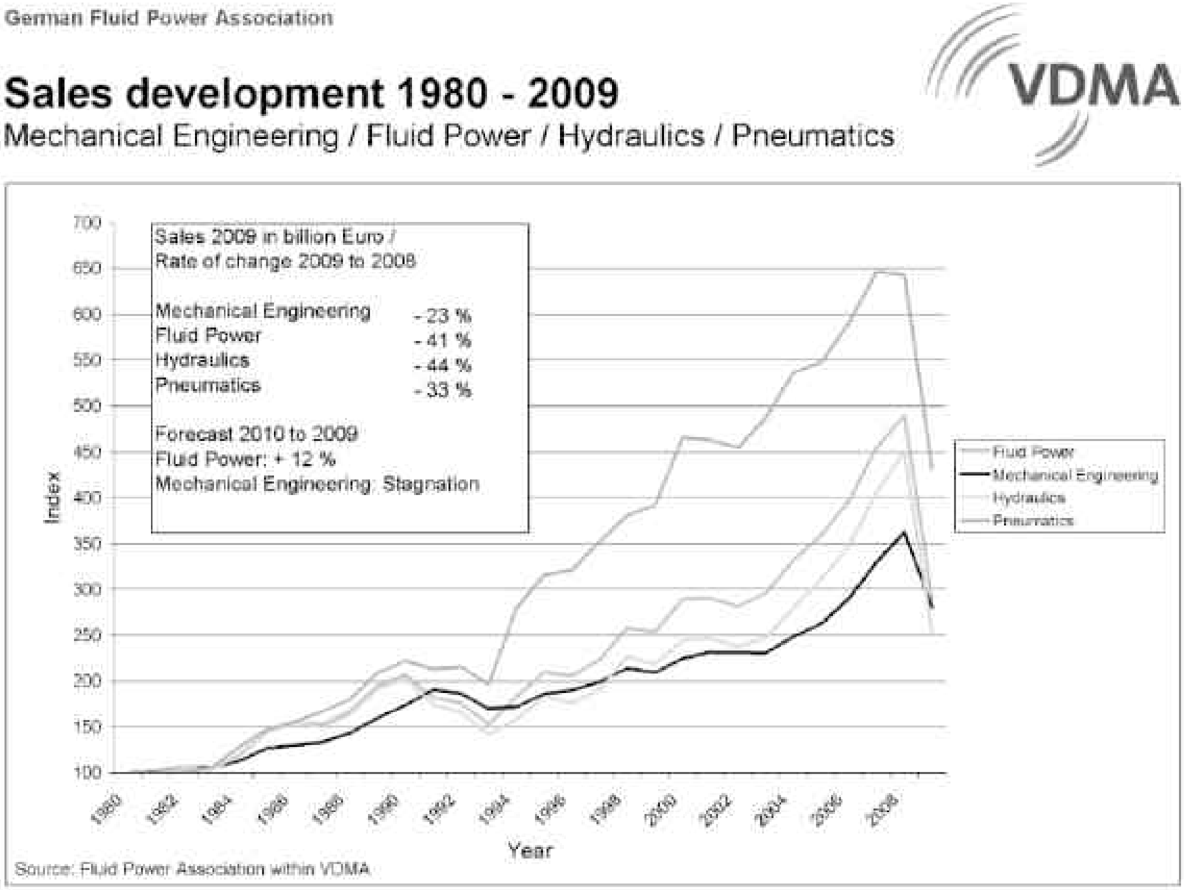

Fig. 1 Sales of mechanical engineering and fluid power products in Germany [41]

Fig. 1 US Mobile and Industrial Hydraulic Shipments Index [42].

Fig. 1 Sales of Hydraulics and Pneumatics in Japan [43].

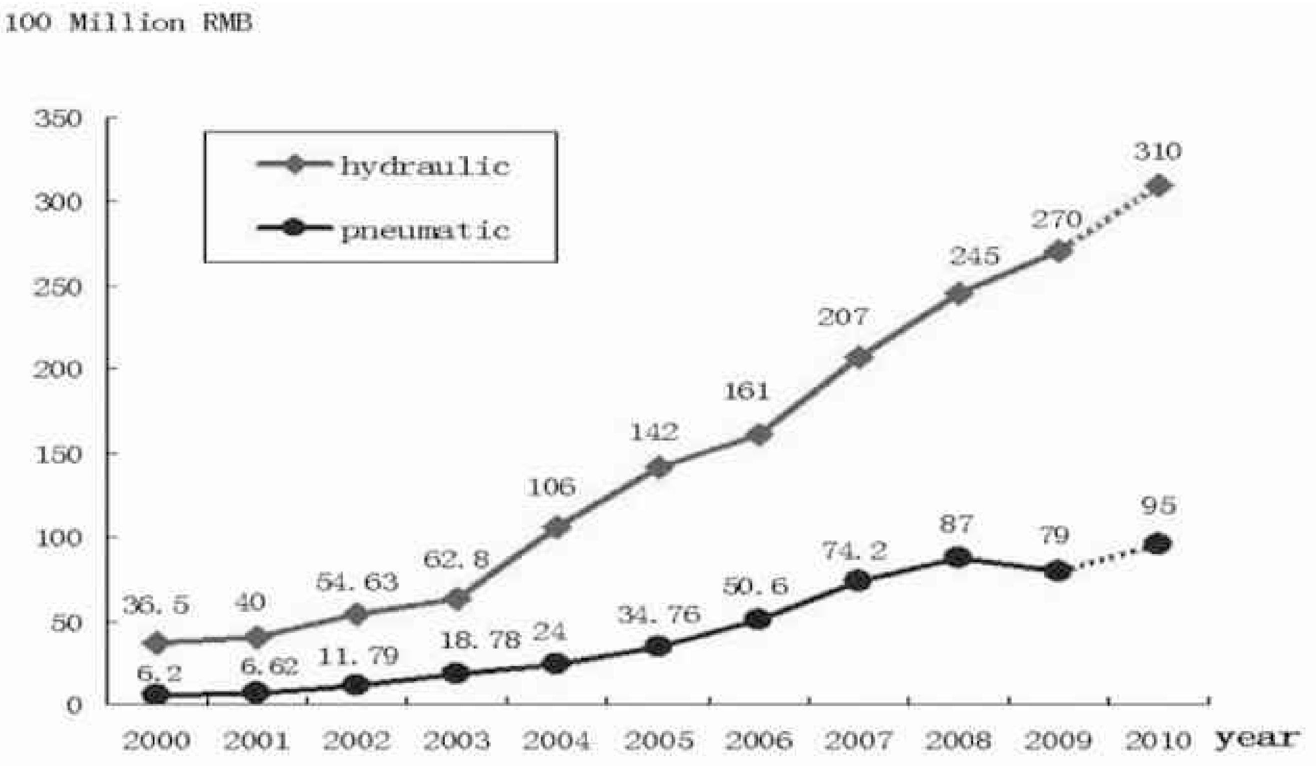

Fig. 1 Development of the fluid technology market in China [44].

Table 6. Rise in the volume orders in selected sectors industry in Germany [40]

Sector	2008 versus 2007	2009 versus 2008	2010 versus 2009
Construction equipments	-35%	-64%	+59%
Building materials machines	+3%	-52%	+43%
Mining equipments	+17%	-52%	+43%
Hydraulics	-23%	-74%	+137%
Pneumatics	-3%	-41%	+34%

1. Others important requirements in the fluid power components market

In general, hydraulic fluid power systems do not constitute a final product, but they are designed as components of various final products of machinery and facilities in which they play definite functions of a control or a drive system. The systems may differ in their structure and components – despite the realization of the same function of a drive or a control system. Elements of the same type, of the same technical parameters may originate from various makers. Thus a question springs up: why are hydraulic, pneumatic elements, etc. – in general, components made by one manufacturer, one company – under one brand name, used more often, more eagerly to the constructions of machinery and facilities systems, whereas those made by another company less often, less eagerly? This question is asked internally by many manufacturers, wholesale dealers and users acting in the area of machinery and facilities components. The answer to this question, thus an answer about the future of the manufacturers of hydraulic components, results from the interrelations between them and the final producers of machinery, vehicles and facilities. The present-day tendencies of changes in their interrelations can be determined as [11,12]:

· tendencies to limit by the final makers the number of own internal suppliers and to raise the share of sub-assemblies delivered from the outside – the make or buy issue;

· trend towards the shift to the deliveries of complete sub-assemblies instead, as to date, single parts, which means a reduction in the number of major suppliers of components and taking over by them the function of their sub-assemblies;

· taking over by the major supplier the responsibility for the quality and durability of sub-assemblies – a requirement or a recommendation to have appropriate quality certificates, e.g. QS 9000;

· organizing tenders for the supplies of components via www sites;

· anticipating in long-term contracts the yearly price drop (reduction), e.g. min. 2%, availing of the company's cash-flow, Lean Manufacturing process [24];

· spreading the „just in time” delivery system as a factor to cut down the cost and to streamline the production process. Rise of the distance factor when selecting suppliers;

· unification of products and parts conducted by final makers in order to reduce the cost;

· transfer of selected cost constituents onto the makers of components, e.g. those related with the environment protection.

According to the research made by the Wondley company, the following factores decide about the contacts with the supplier of components: quality at 39%, price at 33%, credibility of deliveries at 28%. This should be kept in mind when thinking about the company's future.

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WATER HYDRAULIC CONTROL – "AQUATRONICS" SYSTEM APPLICATION PERSPECTIVE

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Key words: Water hydraulics, application, control system, **aquatronics**

Abstract: Apart from supporting life, water it is widely used in many spheres of human activity. From very early times man explored the new applications of water. In early practical applications of water as a medium used for power transmission or accumulation, it was used in very simple devices utilising the force of gravity. For example, a stream of falling water was used to drive the wheel in a grain mill. The first pump was invented by Ctesibus in the 2nd century BC. A major step was the invention of the first hydraulic press by Joseph Bramah, who patented it in 1795. It marked the major breakthrough in the use of water as a pressure medium in fluid power. In 1850 the London Hydraulic Power Co was established and water hydraulics was beginning to receive a great attention. Water hydraulic systems were widely used in heavy machines, lifts and cranes. In 1906 the first synthetic oil appeared and the spread of hydraulic power and control systems was hindered. Water hydraulics was being replaced by oil hydraulic systems. Apparently there were certain reasons for this state of affairs. Oil hydraulic systems offer several advantages. Development of new technologies where the hygienic and manufacturing sterility standards are really high, combined with new environmental awareness, have prompted the researchers to seek new solutions in hydraulic systems. Again water was beginning to receive a great deal of attention as a pure and easily available medium. The pressure medium in hydrostatic drives acts as the power transmitter. Its behaviour whilst in service affects the efficiency and service life of the hydraulic system. That is why the choice of the pressure medium is of primary importance and the process conditions have to be strictly controlled.

1. Introduction to hydraulic system media

Hydraulic fluids have to satisfy the following requirements:

- small variations of viscosity with temperature
- the highest possible ignition temperature and freezing point
- low compressibility
- large elasticity modulus
- good thermal conductivity
- resistance to oxidation and corrosion
- small thermal expansion
- excellent lubricating properties
- homogenous structure and chemical stability
- chemical neutrality to metals and sealing materials

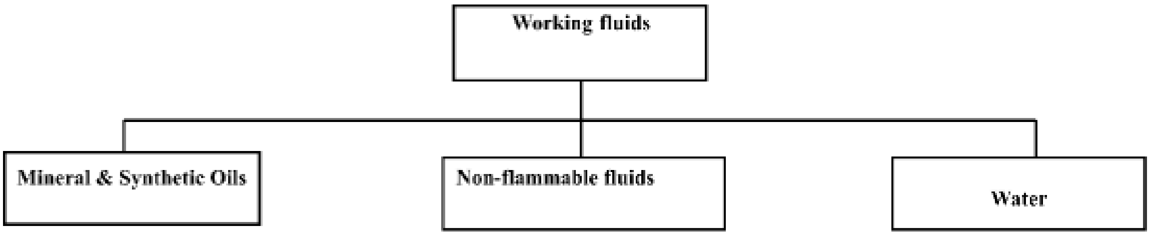


Fig. 1 *Hydraulic system working fluids basic classification*

Mineral oils processed in the distillation of oil are most widely used in hydraulics as they satisfy the above requirements. Great improvements have been made to manufacture oils with still better properties. Since the paper is concerned with the new perspectives and advancements in industrial hydraulics, it seems worthwhile to examine the benefits and drawbacks of water as a pressure medium in comparison to typical mineral oils. This comparison is by no means exhaustive as selected aspects only will be addressed.

Density- defined as mass per unit volume [kg/m^3].

Water density ~ 1000 kg/ m^3 while mineral oil average density ~ 900 kg/ m^3

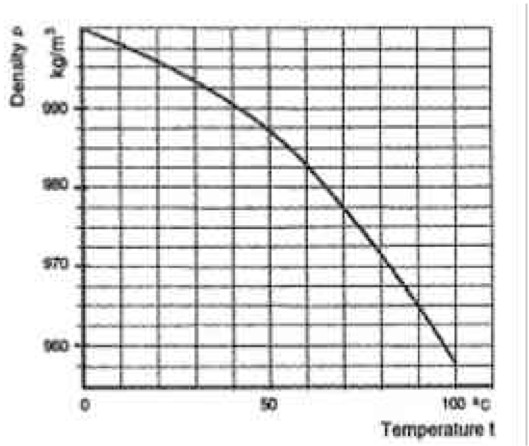


Fig.2. *Mass density ρ of water as function of temperature t at atmospheric pressure*

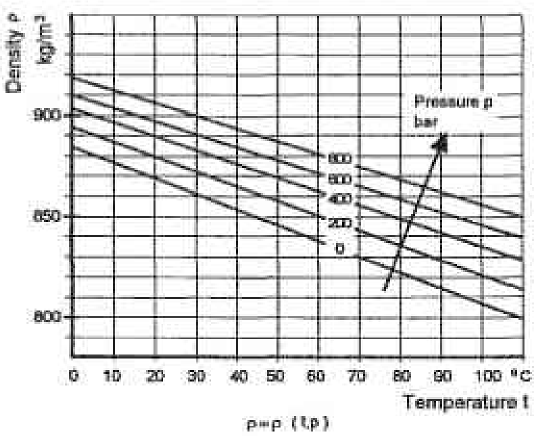


Fig.3. *Mass density ρ of mineral oil as function of temperature t and pressure p*

Compressibility. Fluid compressibility is defined as the relative change in liquid volume due to pressure increase. It can be used in the conditions of temperature changes and in isentropic processes.

Compressibility is expressed by the compression modulus (bulk modulus): T = isothermal bulk modulus, = isentropic bulk modulus; where: V- fluid volume, p-pressure.

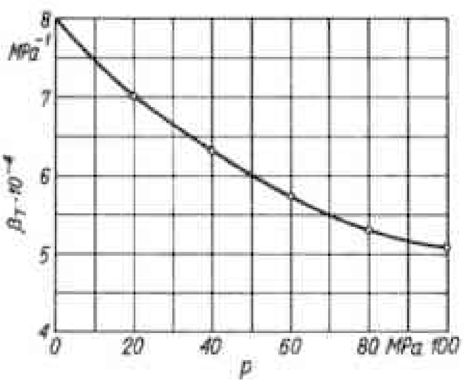


Fig.4. *Isothermal bulk modulus as function of pressure*

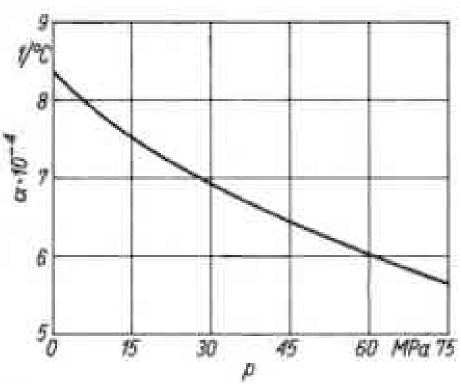


Fig.5. *Expansion coefficient for oil in the function of pressure*

Fluid compressibility is of key importance in the hydraulic systems containing cylinders since it controls the piston position when external loading is altered. This aspect has to be taken into account while designing systems where precise piston positioning is required.

$$\Delta s = \beta_s \cdot \Delta p$$

The modulus of elasticity is the reciprocal of the bulk modulus and is expressed in the units of pressure

$$E_{cT} = \frac{1}{\beta_s}$$

The average values of elasticity modulus are:

$E_{cT} = 1{,}25 \cdot 10^3 \div 2{,}0 \cdot 10^3$ MPa for oils,

$E_{cT} = 2{,}0 \cdot 10^3$ MPa for water

Expansion coefficient. The change in volume due to the temperature change is termed the expansion coefficient:

$$\alpha = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_p$$ where: V- liquid volume at the initial temperature

In oil hydraulic systems this quantity plays a minor role since heating the oil by ΔT= 50 [°C] brings about the increase of liquid volume by ΔV≈ 3,5%.. In water these variations are more significant yet in water hydraulic systems the temperature 50[°C] is never exceeded and the system is protected with safety valves. That is why the expansion coefficients are often neglected in engineering applications.

Specific heat and thermal conductivity. During the operations of hydraulic systems heat is generated due to the pressure medium resistance and the temperature of the hydraulic fluid is increased. Factors that control this process include:

- specific heat
- thermal conductivity

The average specific heat in the temperature range 0÷100°C:

for oil - $c = 1{,}88 \div 2{,}1$ kJ/kg·°C , for water–this parameter is lower by the factor 2

Thermal conductivity coefficient:

for oil - $\lambda = 0{,}134$ W/m·°C = 0,482 kJ/m·h·°C , for water–this parameter is lower by the factor 5

What is the interpretation of these coefficients: On account of its more favourable thermal parameters, water appears to be a more convenient pressure medium. It has a greater heat accumulation capacity and hence can accumulate more thermal energy. The thermal conductivity coefficient expresses how fast the stored heat is imparted to the surroundings.

Viscosity. Viscosity is a measure of the internal friction in a fluid when a layer of the fluid is moved in relation to another layer. Two viscosity coefficients are in widespread use:

· dynamic viscosity (proportionality coefficient) μ [N·s/m^2]= 1P - expresses the tangent stress between the fluid layers at the distance of 1 [m] from one another, in the direction normal to that of the fluid movement when the velocity is increased by 1 [m/s]

· kinematic viscosity ν [mm^2/s]= 1 cSt, defined as the ratio dynamic viscosity μ to the mass density ρ of the fluid.

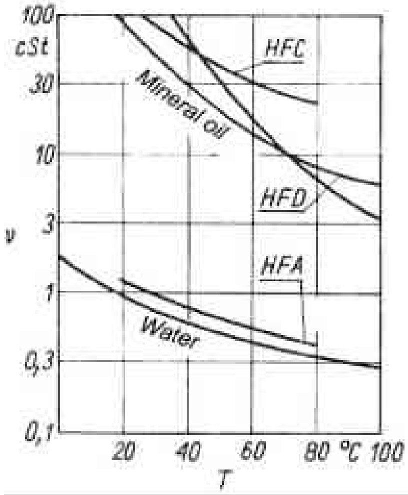


Fig.6. *Viscosity-temperature relationship*

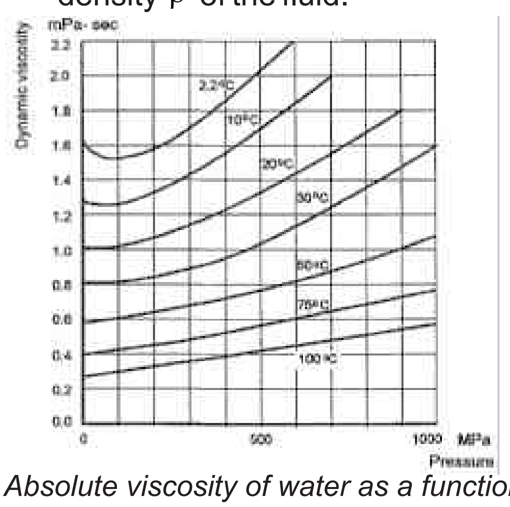


Fig.7. *Absolute viscosity of water as a function of pressure and temperature*

Fluid volume increases with an increase of temperature and the same number of molecules occupy the sane volume, thereby reducing the internal friction. As regards oils, viscosity changes with the temperature difference may vary. Generally speaking, oils with lower viscosity tend to change less, which is a major advantage. The effects of oil and water viscosity changes are shown on the plots in Fig. 6 and 7.

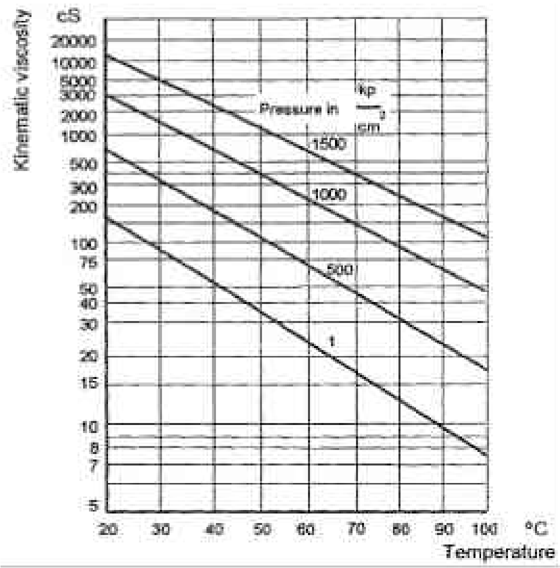


Fig. 8. *The kinematic viscosity of a mineral oil as a function of temperature and pressure*

Water has low viscosity and that is why the service life of roller bearings might be shorter, posing certain constraints in the design of pumps and motors. To prevent that roller quality deterioration, sliding or hydrostatic bearings are employed and lower torques and pressures are recommended.

Vapour pressure. Vapour pressure for water is higher than for oils, which is shown in the plot below. This fact has to be taken into account in the design objectives for water hydraulic systems. High pressure of water vapour might be responsible for cavitation already at low pressures. A high freezing temperature is another issue. In practical applications, therefore, operating temperatures of water hydraulic systems range from 0 to 50 [°C]. Major parameters of oils, water-oil emulsions and water are summarised in the table 1.

The viscosity of all liquids, including water and oils, normally increases with pressure. The rate of viscosity changes may differ between the fluids and depends chiefly on pressure variations. For low pressure increments, viscosity variations are insignificant and major changes are reported at large pressure variations. Water viscosity changes in the function of pressure and for different temperature are shown below.

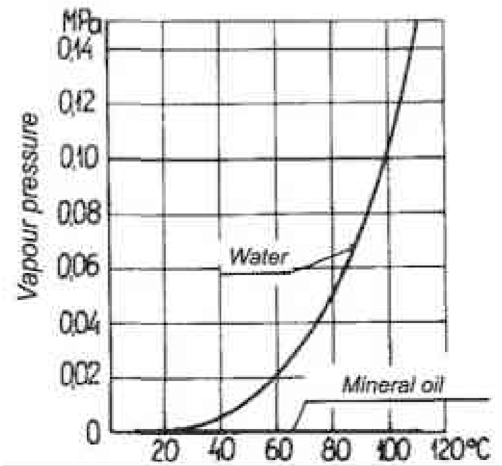


Fig.9. *Vapour pressure for mineral oils and water*

2. Water hydraulics system markets

In 1994 Danfoss developed a new water hydraulics technology known as Nessie®. Nowadays the market demand for such system is growing and the advanced materials, designs and technologies open new perspectives, allowing for modification and use of high-pressure water systems. Such systems are in widespread use in the following sectors: food processing, pharmaceutics, ship-building, nuclear technologies, reverse osmosis processes, purification processes, on the oil rigs.

TABLE 1.	Medium					
	Mineral oil HLP	HFA	HFC	HFD	Bio-oil HTG	Water
Kinematic viscosity at 50°C [mm^2/sec]	15-70	□1	20-70	15-70	32-46	0.55
Density at 15°C [g/cm^3]	0.87-0,9	□1	□1,05	□1, 05	0.93	1
Vapor pressure at 50°C [bar]	$1.0 \cdot 10^{-8}$	0.1	0.1-0.15	$<10^{-5}$	?	0.12
Compression modulus β_3 [N/m^2]	$(1.0\text{-}1.6) \cdot 10^9$	$2.5 \cdot 10^9$	$3.5 \cdot 10^9$	$(2.3\text{-}2.8) \cdot 10^9$	$1.85 \cdot 10^9$	$2.4 \cdot 10^9$
Speed of sound at 20°C [m/s]	1300	?	?	?	?	1480
Thermal conductivity at 20°C [W/m·°C]	0.11-0.14	0.598	~0.3	~0.13	0.15-0.18	0.598
Specific heat at 20°C and constant pressure [kJ/kg·°C]	1.89	-	-	-	-	4.18
Max. working temperature range [°C]	-20-90	5-55	-30-65	0-150	-20-80	~3-50
Flash point [°C]	210	-	-	245	250-330	-
Ignition point [°C]	320-360	-	-	505	350-500	-
Corrosion protection	Good	Sufficient	Good	Good	Very Good	Poor
Environmental impact	High	High	High	High	Small	None
Relative cost for liquid [%]	100	10-15	150-200	200-400	150-300	~0.02
Usage [%]	85	4	6	2	3	None

Symbols: HL - oils chiefly intended for turbines, water resistant. Recommended for middle-pressure systems and where additives are not required, HFA- emulsion of oil in water, HFC- water solutions of polymers, with water contents less than 80%, HFD- water-free synthetic fluids, phosphate esters. Despite those obvious benefits of water as a pressure medium, its corrosive action has for many years precluded its widespread use.

2.1. Applications of water hydraulics systems

Nowadays water hydraulics systems are widely used in food processing industry, in the dairy sector and pharmaceutics.

The strict sanitary and epidemiological standards preclude the use of oil in those installations while some of them require fluid power. In most hydraulic systems power is transmitted from a internal combustion or ac electric motor (a prime mover) to a reciprocating motion motor (a hydraulic cylinder) or a torque motor. The development of the first water hydraulic systems was he results of extensive experimental research and model testing. Not all the issues could be addressed in calculations and in theoretical predictions, and the prototyping tests and pilot tests proved vital in that respect. The comparison of water and oils highlights the differences between the two pressure media.

Obviously they cannot be used interchangeably in the same sub-assemblies. The chief differences between the water and oil hydraulic system components are:

1) type of materials
2) manufacturing technology

2.2. Materials. Water is aggressive to metals, hence pumps, motors, hoses and hydraulic connectors have to be made from appropriate materials.

2.3. Manufacturing technology. As water is a poor lubricant, sufficient clearances have to be left between the interacting elements, such as roller bearings, slides in valves, pistons in pumps and in hydraulic cylinders.

3. An overview of water hydraulic components

Prior to the design of the test stand, an overview of currently available hydraulic components was conducted. The selection procedure took into account the functional and operational parameters and the diversity of available components. The widest range of products was offered by the Danfoss Nessie program. Danfoss offers high and low speed motors, pumps, power units as well as valves and hydraulic cylinders. The exemplary list of available Danfoss water hydraulic components with the major parameters is provided below.

Danfoss Nessie

* Power packs (PPH 4/6.3, PPH 10/12.5) Q= 2.6-17.2 l/min, p=25-140 bar, n=750-1500 [min-1]
* Hydrostatic Motors
* Flow control valves (manual or electronic control), Qmax=2-30 [l/min], pmax=140 [bar]
* Pressure control valves Qmax=15-120 [l/min], pmax=140 [bar]
* Distributor valves (available configurations: 2/2, 3/2, 4/3), Qmax=0-120 [l/min], pmax=140 [bar]
* Hydraulic cylinders (AQUA 70)- the length and type of connections tailored to the customer's order, vmax= 0.2 [m/s], pmax= 140 [bar]

Hauhinco Water Hydraulics specialises in high-pressure hydraulic systems. The company offers a wide rage of valves, also with ceramic elements, and piston pumps. The list of available hydraulic components with the major parameters is provided below.

* Piston pumps (EHP-3K 50, 60, 70, 110), Q= 31-163 [l/min], p=210-800 [bar], n=1500 [min-1]
* Piston pumps (EHP-3K 125, 125S, 150, 150S, 200, 200S, 400S), Q= 202-539 [l/min], p=170-415 [bar], n=1500 [min-1]
* Distributors (2/2, 3/2-way, ball/ slot valve DN3, DN6, DN10), Q= 8-60 [l/min], pmax=320 [bar],
* Distributors (3/2, 4/2, 4/3- way, slide valve with ceramic elements DN3, DN6, Dn10), Q= 8-60 [l/min], pmax=320 [bar], Proportional valves (2/2, 3/2-way valves DN3. DN6, DN10), Q= 8-60 [l/min], pmax=320 [bar], Control valves for pumps (DN12, DN25, DN40, DN50), Q= 90-1400 [l/min], pmax=320-400 [bar]

	MAH (4-12.5)	MVM 160
Speed [min-1]	300 - 4000	15-200
Torque [Nm]	8 - 25	100
Power [kW]	do 8.0	Up to 2.5
Pressure [bar]	do 140	Up to 50

4. Applications of water hydraulic drive and control systems

Fluid power has many diverse applications, the only limitation is that water hydraulic systems must not operate at low temperatures. In some sectors of industry (for example in the nuclear sector) water installations are prevalent whilst in other sector water hydraulic options are now being often selected. Water hydraulic installations are widely used from nuclear sector, to reduce the risk of fires, to food processing industry. The specificity of food processing requires the strict hygienic standards be rigorously observed throughout the whole process. Apart from the pressure medium itself, the elements of the installation are made from corrosion-resistant materials (stainless steel) that are easy to clean. For example, a MVM motor performs really well in applications requiring low torques (15-200 rpm) since the transmissions can be eliminated.

Fig.10. *Energy –saving and ergonomic saw driven by a water hydraulic system*

Of particular interest is the phenomenon observed by Danish scientists and termed “a cold hand”. Staff operating the pneumatic-powered tools suffer from “cold hands” when the decompressing medium causes the frosting of the housing and tool handles. Application of water hydraulic –powered tools eliminates that problem as the average working temperature of the medium is 50 oC. Besides, such tools are lighter and less noisy.

Hamburger machine

Danfoss designed a water hydraulic installation for the hamburger machine for the Swedish customer LPI System AB (Fig.11). That is not possible in conventional electric motors. Furthermore, the power supply source (i.e. the electric installation) is located outside the process rooms thereby eliminating the risk of electric shocks during the maintenance and cleaning.

4.1. Meat production, particularly the slaughterhouses

The diagram of the hydraulic systems (Fig.10) show the machine used for cutting meat and dividing large pork or beef pieces. In water hydraulics systems there is no risk of uncontrolled leakage and meat poisoning.

Specification: 1 pump PAH32, 1 MVM motor 12.5, 1 hydraulic cylinder, maximal working pressure 10 MPa, Maximal flow rate 44 l/min

Meat cutting equipment

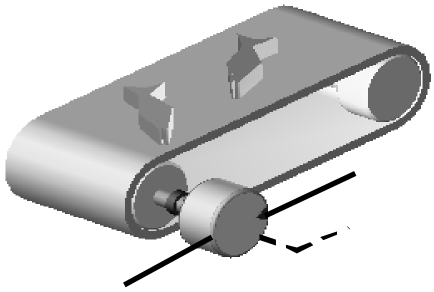
Water hydraulic installations are now beginning to replace pneumatic systems. That is so for several reasons: energy savings (up to 80%) due to better position control of units driven by hydraulic cylinders and improved ergonomics.

Fig 11.*Hamburger forming machine driven by Nessie water hydraulic components and diagram showing the principle of water hydraulic system*

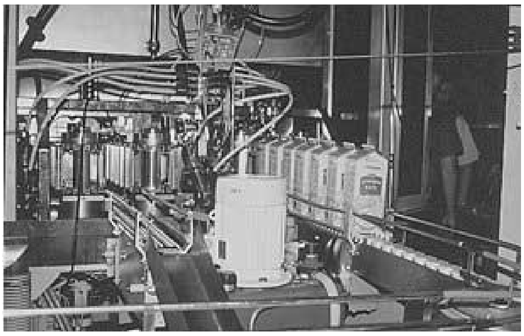
The operating principle: two hydraulic cylinders equipped with knives are used to mince meat. Hamburgers are formed by the system of hydraulic cylinders that press, push and cut the meat. In one hour the machine processes about 600 kg of meat, forming 18 000 of ready-made hamburgers.

Process supervision and control are implemented using an electronic PC system.

Specifications: 1 pump PAH 32, motor MAH 4 with 2 planetary gearboxes, 7 cylinders, maximal working pressure 10 MPa, maximal flow rate 44 l/min.



a)



b)

Fig 12. *Selected applications of water hydraulics systems in the food processing industry: a) idea of the, very common in the food industry, belt conveyor driven by a water hydraulic motor (it is planning to built it in Fluid Power Laboratory in Krakow, b) existing milk packaging line in dairy industry*

The machines and hydraulic systems presented here contain the Danfoss Nessie subassemblies and are listed in the catalogue of applications as follows: pharmaceutics, textile industry, off-shore industry, steelworks (rolling processes), wood and paper industry (production of water spray in the process of wood drying (parquet floors) and in high-precision paper cutting, agriculture. So far, water hydraulics installations are chiefly used for air moisturising and adiabatic cooling in large greenhouses and on farms. These systems ensure the optimal condition for plant and animal growth without the risk of contamination. The installation is small in size and the working pressure at the level of 160 bar ensures effective system performance. As they produce little noise, they can be also used as central heating installations in office buildings and in hospitals.

Fig 13. *Municipal vehicles in which all cylinders are powered and controlled by water hydraulics systems*

4.2. Mobile municipal machines

Machines use in utility installations are intended for operation in the conditions where the strictest environmental standards have to be rigorously observed and no leakage due to inadequate sealing or faulty operation of the system are allowed. That is why the town Goeteborg (Sweden) in its pilot programme of old town maintenance uses mobile machines where the oil hydraulics is replaced by water hydraulics systems. All pumps, valves, cylinders and hydraulic motors use tap water as a pressure medium and despite most adverse operating conditions (long exposure to dust and dirt) their performance is reliable and unfailing. In case the temperature should fall down to zero, glycol is added to water in a specified proportion. The hydraulic system is supplied from a positive displacement pump driven by a diesel car engine via a transmission. The diesel engine meets all the relevant environmental standards, Fig.13.

Fig 14. *Yacht washing installation, without the need of a dry dock.*

The main benefits are: low costs of the pressure medium, no costs associated with storage and disposal of other hydraulic fluids (oils), potential leaks present no threat to the environment, staff is not exposed to noxious and allergenic oil vapours. Costs of machines with water hydraulic installations are by nearly 20 % higher that those of oil-hydraulics systems. However, water hydraulics is the environment-friendly option. The costs of purchase of 12 thousand litres of hydraulic oils used previously in Goeteborg in one year were thus eliminated.

Articulated arms and a rotating brush mounted on floating pontoons are water hydraulic-powered. The yacht washing installation utilises two piston pumps, distributors and flow control valves and a water hydraulic low-torque motor MVM 160, Fig.14. The mounting of such motor allows us to get rid of all oil-lubricated systems, mechanical transmissions. At the same time all problems associated with their servicing and maintenance are thus eliminated. Modular structure enables fast replacement of subassemblies even by fresh personnel. The whole machine is remote- controlled from a pulpit, which make the operation really easy.

The size of the washing installation operated in Denmark is such that 90% of yachts can be catered for.

5. Krakow Fluid power Laboratory water hydraulics control system - aquatronics project

Using the commercially available components of water hydraulic installations (Nessie), the research team from the Fluid Power Laboratory of the Institute of Machine Design of the Cracow University of Technology developed the test stand retaining the kinematic system of a construction machine or a manipulator with two degree of freedom, Fig. 15. In the final stage of the research programme variable loads were realised through changing the mass placed at the end of an extension arm. The operations of the lifting cylinders were controlled using an electromagnetic controlled valve distributor and a proportional flow control valve. The system is equipped with sensors of pressure, temperature, displacement and flow intensity signals. Control signals are implemented with the use of a card, controlled by digital signals from a analogue/digital card in a PC. This control approach allowed for generating the desired characteristics of flow intensity at specified phases of the mechanism motion.

Fig 15. *Experimental setup for testing a water hydraulic installation having the structure of a typical construction manipulator*

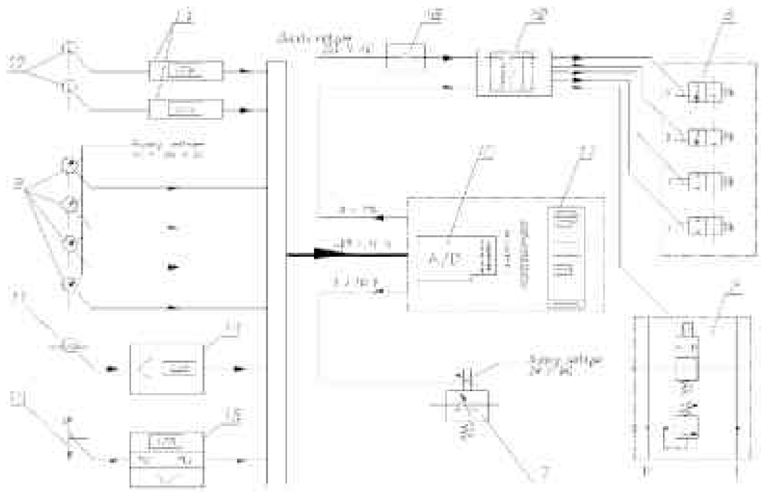


Fig 16. *Schematic diagram of a aquatronic system for a testing stand; where: 2- power pack control block, 6 – direction control valve block VDH 30 EC 3/4, 12 – temperature transducers, 13 – temperature meter, 14 – impulse counter, 15 – displacement meter, 16 – D/A card PCL 818 HG Advantech, 17 – computer PC, 18 – safety cut-out switch, 19 – relay card type PCLD-885 Advantech.*

Of particular interest is the control signal from a most advanced system component- i.e. the voltage-controlled, proportional flow control valve, As it is impossible to control valve opening, all measures to limit the dynamic excess of pressure in response to the control signal are targeted at finding such signal form that the dynamic excess be vastly reduced for the same voltage levels. For that reason a precisely control characteristic of control voltage changes is introduced to ensure more smooth starting up of the cylinder and to reduce the amplitude of pressure pulses. The system is equipped with sensors of pressure, temperature, displacement and flow intensity signals. Control signals are implemented with the use of a card, controlled by digital signals from a analogue/digital card in a PC. In the final stage of the research programme variable loads were realised through changing the mass placed at the end of an extension arm. The operation of the lifting cylinders were controlled using an electromagnetic controlled valve distributor and a proportional flow control valve. The water hydraulic control system, which author proposed to name **aquatronic system** is shown in Fig 16. In the case of water hydraulics system this term seems justified. This mode of control allows for generating the desirable flow rate characteristics at the subsequent phases of the mechanism motion. Of particular interest is the control signal from a most advanced system component- i.e. the voltage-controlled, proportional flow control valve, As it is impossible to control valve opening, all measures to limit the dynamic excess of pressure in response to the control signal are targeted at finding such signal form that the dynamic excess be vastly reduced for the same voltage levels. For that reason a precisely control characteristic of control voltage changes is introduced to ensure more smooth starting up of the cylinder and to reduce the amplitude of pressure pulses.

6. Water hydraulic research project results and conclusions

Within the framework of a research programme, the test stand using the commercially available components of water hydraulics systems was built and extend. The measurement technology was developed, supported by the computer software for data acquisition and processing. The test stand was equipped with the required measurement transducers.

The processes taking place in water hydraulics installations were thoroughly investigated. Mathematical models of vital components of water hydraulics installations were developed and pilot simulations were run. The model of position control utilising hydraulic cylinders as actuators is developed by way of synthesis.

The results obtained in the course of the research programme, particularly the new laboratory facilities might be used in further research, based mainly on well-proven mathematical models of water hydraulic systems and components.

Identification tests helped in the parameterisation of the developed mathematical model. Extensive simulation tests were run on a verified model of the system. The results and conclusions are already published or are to be published soon.

7. General conlusions - the industrial perspective of the water hydraulics

Of particular interest are the applications of water as the pressure medium and available water hydraulics installations. Special attention should be given to dynamic behaviours of the systems and hence the development of the appropriate control strategies.

The current status of water hydraulics leads us to the conclusions that these installations will find still more widespread use in the driving systems in machines in various sectors of industry.

One of the factors that might prompt their wider use are environmental regulations and internal codes of practice in the companies.

The sectors where water hydraulics is the first choice are: the food processing industry where transport facilities and manufacturing machines have to meet strict hygienic and sanitary standards, the chemical sector, pharmaceutics, wood and paper making industry, manufacturing of medical equipment.

In vehicles, boats and mobile machines water hydraulic drives are mounted whenever the strict environmental standards have to be met: in centres of large agglomerations, parks, leisure centres, off-shore regions, archipelagos.

Water hydraulics installations in farming machines are particularly well suited to the applications in agriculture and forestry- in those areas global effects of contamination with oil are clearly visible, even from satellites.

The results of pilot tests led to some particular conclusions which might be useful in designing water hydraulics driving and control systems for most diverse applications.

Nowadays we are at the stage of implementations of systems with water as a pressure medium mainly in the food processing industry and in pharmaceutics. Widespread application of water hydraulics in mobile machines requires that more refined elements, chiefly control elements, be first developed. When that happens, water hydraulics installations will be soon found in agriculture and forestry, where soil contamination is clearly visible from satellites. All things considered, in the years to come water hydraulics will certainly develop rapidly, in the first place on account of more strict sanitary and environmental regulations being imposed.

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E-LEARNING FOR COMPANIES

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Abstract

The use of the Internet and Web technologies lead to E-Learning activities which are offered by many universities in order to meet students needs. But only a few companies – mostly the big ones – established E-Learning for their vocational training. One cause could be that they do not believe that E-Learning is shaped for helping them to make judgements and take decisions about their business and their future.
When considering the future of ICT generally there is no shortage of material. They include global scenario projects, national foresight studies, etc. Such information sources are also necessary in order to shape the E-Learning particularly for small and medium-sized companies (SMEs). In the following we present the methods of scenarios and foresight studies and give some examples.

1. INTRODUCTION

New emerging Information and Communication Technologies (ICT) are leading to the development of many new opportunities to guide and enhance learning. For example the use of the Internet and Web technologies lead to E-Learning activities which include online learning, Web-based training, virtual universities and classrooms, digital collaboration and technology assisted distance learning. There are already about one million courses on the Internet.

Web services descending more from text processing as binary communication protocols are an efficient help within E-Learning (Mateosian 2002). The core Web services standards SOAP, WSDL, UDDI have received widespread adoption and generated tremendous interest (Bunell, 2002).

The acceptance of E-Learning is due also to growing availability of commercially available Learning Management Systems such as WebCT, BlackBoard, Learning Space, IntraLearn, Top Class, eCollege, Click2learn, Authorware, LearnLinc, Virtual-U, Web Course in a Box, IniLearn and WebBoard (Abernathy, 2001).`

Over the last two decades the number of students from colleges and universities over age 40 has more than doubled and most full-time college students work part-time. They need innovative ways to help them study and work more efficiently in the global and competitive work. To meet students needs many universities offer E-Learning courses. The use of E-Learning can be also a solution for small and medium sized companies (SMEs) to meet new staff qualification requirements and make possible a learning process linked with the work tasks.
But performance and reputation of E-Learning have not lived up to the lofty expectations set by the early realization of the enormous potential benefits of this marriage of learning and technology. For example, in 2000 the American Society for Training and Development (ASTD) prognosticated optimistically that the world of vocational training would change within 1000 days making the transition to the E-Learning age. But the reality in companies shows another picture: In the last years it seems that the quality standards of the E-Learning products are likely to decline and the use of E-Learning decreases. Only a few companies – mostly the big ones – established E-Learning for their vocational trainings.

It is one point of interest of the authors´ observatory project “ARIEL” (www.ariel-eu.net) to identify the reasons. Some of these reasons could be that SMEs have no interest in the project (either because of a lack of incentives or a lack of commitment to the project goals), have no time for the project (due to conflicts with regular work duties, deadlines, or personal schedules), the wrong SMEs were selected for the project (they lacked the necessary knowledge or were not star performers) or they do not believe that such projects could help them to make judgements and take decisions about their business and their future.

The results of a monitoring of projects funded by Leonardo da Vinci programme show a shift in the orientation of the E-Learning projects: “During the first years of using the internet and ICT, most of the E-Learning projects, even those aiming to design learning processes, were focused on technical innovation to create technology based learning environments. There would appear to have been a change in thinking on E-Learning in the past three to four years, with a new focus in the discussions on E-Learning. Rather than the emphasis on technology, the new focus of thinking on E-Learning is increasingly on the learner him/herself and on methodologies and didactics. This is seen as more important in developing the quality of E-Learning provision and ensuring the success of ICT supported learning processes” (Attwell et al. 2003).

When considering the future of ICT generally there is no shortage of material. They include global scenario projects, national foresight studies, etc.
Such information sources are also necessary in order to shape the E-Learning particularly for SMES.
In the following we present the methods of scenarios and foresight studies and give some examples.

2. SCENARIOS

To know the future development in E-Learning for companies is crucial for decision making for all involved actors (companies, developers and distributors for E-Learning applications, consultants, politicians etc.). The high complexity of the field, preventing us from making reliable prognoses, is a serious problem. To cope with this challenge different methods are used. One of the most promising methods is the use of scenario planning.
Scenario technique has its origin in the use of military planning of WW II. Its civil breakthrough came with a study produced by the Royal Dutch/Shell Oil Company under the guidance of Pierre Wack at the beginning of the 1970s. (http://www.shell.com/). In nowadays it is used in the strategy departments of big companies as well as for decision making in the political system.
Until now there is no legal definition what a scenario is or how to build it up. Scenarios are described as “Narrative descriptions of assumptions, risks and environmental factors and how they may affect operations. Scenarios attempt to explore the effect of changing several variables at once with objective analysis and subjective interpretations” (Wikipedia 2005).
Ogilvy (2004) said: “Scenarios are narratives of alternative environments in which today's decisions may be played out. They are not predictions. Nor are they strategies.” The basic idea about scenario planning is to mix up all known facts and use possible developments in these factors to describe “wanted” and “unwanted” futures. Based on this scenarios strategies can be found to avoid negative impacts in an “unwanted” future and to promote the way to a “wanted” future.
Referring to the future of ICT many global scenarios have been developed within a variety of different contexts, e.g. for military planning, business strategy or health policy. While they identify many key drivers of change (e.g. demographic change, environmental sustainability), there is also consensus that science and technology and, more specifically, **ICT** will be a fundamental driver of change in the **future**.

A useful overview of these global scenario studies is provided in the report Strategic futures thinking: a meta-analysis of published material on drivers and trends which was prepared by the Defence Evaluation and Research Agency (DERA) of the United Kingdom's Ministry of Defence for the Performance and Innovation Unit

One example of scenarios for shaping the future of ICT are the Madingley Scenarios generated for the UK's National Health Service Confederation. The Madingley Scenarios identified four main drivers of change:
1 .new technologies;
2. new organisational forms;
3. sustainability;
4. changing relationships between family members, generational groups, genders, ethnic groups and nations.
Madingley Scenarios contain two scenarios. In the first scenario, 'Find My Way', there is a great deal of individual choice, very little trust of institutions, wide diversity of lifestyles, an excluded group who cannot access information and cannot easily communicate their views to others. There is a general sense of excitement coupled with an anxiety among individuals who fear that they have chosen the wrong options and who lack any trusted reassurance.
In the second scenario, 'Trust Their Guidance', social institutions manage to revamp themselves in response to a wide spread loss of trust in experts, scientists, and professionals. They become trusted again because they have transparent protocols, they keep the public well informed, and they save individuals the time-consuming and frustrating experience of endlessly searching and choosing. However, this is also a world that limits individual choice and creates the nagging suspicion that perhaps these powerful organisations are not as open and altruistic as they pretend.

In the following we give an example of a scenario within the project ARIEL.

3. THE “ARIEL”-SCENARIOS AS AN EXAMPLE FOR SCENARIO BUILDING

The “ARIEL” (Analyzing and Reporting the Implementation of Electronic Learning in Europe) project uses the scenario technique to build up scenarios for the question: “*Can E-Learning support European SME´s to be successful and to integrate into the European market?”* In a first step the project group, consisting of experts from five countries, arranged a workshop to find the factors playing a decisive role in the use of E-Learning for SMEs. These factors, later used as indicators or sub-descriptors, were grouped in five clusters:
· Vocational system
· Cost-incentive structure
· Technology
· Content
· Business

These issues have been considered as descriptors for the scenarios. The ARIEL team at the IAT in Germany proposes to single out the descriptors “vocational training system” – VET and “business” as being most important for the context of the project.
The factor **VET** is presented here as a complex vector which scores either high or low in two respects: financial investment and trust. The business vector, though presented as a simple parameter, represents multi-layered developments. The ARIEL consortium decided to develop a small set of four basic scenarios for Europe. At the moment each scenario is linked with the name of a European city: the optimistic scenario has the name of the Lisbon strategy, Manchester serves as an icon for “Manchester capitalism”, the German city Nuremberg represents a highly invested vocational training system as a kind of tradition which is not part of the business success anymore, Naples remembers us this city in the 2nd decade of the 20th century.
For illustration how a scenario could look like we present “working in progress” version of an E-Learning scenario for SMEs in the situation of stagnating economy with a high trusted VET-system (internal named ”Nuremberg”).

"Nuremberg"-Stagnation
A world in which individuals learn but not organizations, esp. not SMEs. Technology is not integrated with VET

Business
As a consequence of the depressed economy in Europe there is an overall loss of jobs, mainly from bigger companies. SMEs are more important than ever, their number is increasing and they employ higher numbers, both relatively and in total, of the available workforce. But the SMEs cannot compensate for the loss of jobs in bigger companies. Even though they suffer from similar problems resulting from the economic depression they are unable to share knowledge to compete successful in the European and worldwide markets because of a lack of cooperation. Furthermore, they cannot realize economies of scale for vocational training procurement so individual SMEs pay higher prices for poor fit training offers.

Unemployment is a more serious problem than ever because the economy is depressed and shows no foreseeable upturn. Well educated and trained people become "export goods". Skilled workers, qualified through the VET-system with high investments, often see no chance of finding a job, so they emigrate. Others try to build up their own businesses, but there is a high failure rate due to the depressed economy, the climate of economic change, and their lack of business training.

Vocational System
Despite the move towards flexibility in vocational training, VET institutions in general are still unable to meet the needs of SMEs.

SMEs investment in vocational learning and training is small, compared with big companies, they feel that the balance of incentives and risks is not in their favour and the benefits are not directly visible. Thus the total spending on VET by enterprises is falling so adversely affecting the VET sectors capability to adapt to changing needs.

If SME invest in training it is for specific tasks; increased market specialisation means that SMEs have a broadening band of specific needs but a narrowing band of generic needs. The VET sector can accommodate the generics through public investment but now lacks the resources to meet the specifics. SMEs are not interested in formal systems of continuous vocational training and certification and actively avoid involvement in them. They do not understand that investment in their workforce through life-long-learning (L^3) is necessary for competitiveness and in order to be successful in an integrated European (World) market, nor do they accept that E-Learning is an effective way to conduct L^3.
It seems that individuals understand, better then the SMEs, the benefits of up-skilling and qualification. They are forced to spend time and money on learning and training to obtain new certified skills, because they are afraid of "being fired" as a consequence of depressed business of the companies.

Cost incentive structures
The question who pays is perhaps the most pressing and complex issue in the development of E-Learning for SMEs, their common strategy for formal vocational training is to externalise the costs to the individual or the public and not to pay for it themselves. They see it as a cost not an investment.
Also, E-Learning has up to now been promoted more as a cheap or cost effective answer to the policy issue of engendering and promoting L^3 rather than being justified as opening up access to L^3 or in providing richer environments for learning by SMEs. Forms of learning, Learning culture, E-Learning promotion
For their in-house competence training staff from SMEs use an unplanned and unstructured mix of informal methods such as learn-as-you-do, discussions with experienced co-workers or suppliers, e-mail consultation, and visits to expo/trade fairs. What's missing is a company learning culture that conducts formal foundation learning first and subsequent learning less formally.

SMEs prefer informal learning methods primarily because the costs are not as visible as for formal learning and they perceive (erroneously) that it is less expensive. They also see it as more flexible than formal structures, and they suffer from an absence of suitable formal learning offerings.

The massive promotion of E-Learning by the EU and its member states has not led to a durable use of E-Learning in SMEs. Most of the E-Learning products are not designed for SMEs (though this requirement is stressed in public funding programmes), and there is a poor conversion rate from publicly financed E-Learning-projects to sustainable products.

Technology
Typically ICT investment by SMEs is carried out only to fulfil business needs, such systems are often incompatible with the flexibility required for E-Learning. Current E-Learning authoring and packaging lacks the flexibility and adaptability needed to satisfy SME needs, whilst high investment is made in E-Learning platforms with sophisticated functionality that also do not match SME needs. The role of technology as an enabler of new forms of learning (e.g. m-learning) is not understood and changes in the VET system to take account of continual evolution of ICT is not seriously considered.

Content
E-Learning is regarded as an issue or aim in itself, it has not been considered within the context of organisational development, including the introduction of new forms of work organisation and new technologies within the SME work place.
Multidisciplinary teams developing E-Learning programmes for SMEs with the active participation of SMEs staff for E-Learning content development are missing.

"Bought-in" trainers may know the technology but will lack skills to discover the specific needed content or to capture the knowledge of SME's employees, so even "blended learning" (as the most recommendable kind of E-Learning for SMEs) cannot be successful. The alternative of development and support for SME employees who are competent to become trainers and to author suitable E-Learning content is not commonly recognised.

There is a poor match between the collective and individual learning and training needs of SMEs and their employees and the available E-Learning offerings. Partly due to the misleading public promotion policy, public money goes into unsuitable products and an unwillingness to invest in content generation by SMEs themselves.
The next steps in ARIEL to be done are a further evaluation for the scenarios, including an estimation of the probability for becoming real, and to find recommendations for suitable strategies to deal with the scenarios.

4.NATIONAL FORESIGHT STUDIES

National foresight studies are another particularly relevant source of information. There has been a boom in these kinds of exercises around the world in recent years with many countries seeking to identify national priorities for potential research in science and technology areas. Most EU Member States have engaged in such foresight exercises, although they differ markedly in their approach, methods used and outputs. A useful starting point for us is provided by a review of the outcomes of national foresight exercises regarding information society technologies (IST) or information and communication technologies (**ICT**), undertaken as part of the FISTERA programme (Foresight on Information Society Technologies in the European Research Area).

The first FISTERA review and analysis report considers three aspects within these studies:
technology, in the narrow sense;
application areas;
technology related to societal issues.

The initial FISTERA review makes a number of observations about the nature and limitations of national foresight studies that are pertinent to our aim of exploring possible **future** developments of **ICT**:

There is little homogeneity across country studies in terms of scope, motivation, methodology, treatment of **ICT**, time horizon, method, participation, etc.

A key observation is that national visions are underdeveloped in many studies because their primary motivation is 'catching up' or keeping pace with global competition.

In many cases the time horizon was set only in the very near **future**, as little as five years in some cases, and it is unclear how this shaped the thinking of participants in the studies. It is suggested that, particularly with information and communications technologies, it is difficult to escape from zeitgeist, the spirit of the times. For instance, many studies seem to be dominated by issues of the day, e.g. to do with obstacles to e-commerce. As a result, the recommendations and findings are oriented mainly towards short-term policies.

The studies are also criticised for their limited ability to envisage new applications for a technology about which little is known other than it will be important. To some extent, this is in the nature of the 'foresight beast'- the past is littered with examples of this, e.g. forecasts that the world would only need about five computers. Similarly, most studies failed to investigate alternative developments or the possibility of unexpected events or 'wild cards', such as unexpected technological breakthroughs, disruptive factors or technology related catastrophes.

5. CONCLUSIONS

To be successful with E-Learning in SMEs in the future, it is important to understand that creating new E-Learning software is not the highest priority for the SMEs. It is important that the E-Learning methods are blended with conventional methods and integrated in work- and business environments of the companies. Scenarios and foresight studies can lead to an appropriate design of the E-Learning programmes for the SMEs.

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SECTOR OPERATIONAL PROGRAM ' IMPROVEMENT OF THE ECONOMICAL COMPETITIVENESS '
CO FINANCED BY THE REGIONAL DEVELOPMENT EUROPEAN FOUND
' INVESTMENTS FOR YOUR FUTURE'

CENTRE FOR RESOURCES GRID-BENCHMARKING FOR ANALYSE, ASSESSMENT AND DATA PROCESSING FOR IMPROVING THE ORGANISATIONS COMPETITIVENESS IN ORDER TO ACHIEVE THE HIGH PERFORMANCE/ GRID-BENCHMARK

Authors: Diana Mura Badea, Dumitru Vlad, Constantin Petre - INCDMTM

Abstract

Modern tool of company management, applied with spectacular results in many countries of the world, the benchmarking can improve the activity of a firm by comparison between his own organizational system and his product performances with other successful companies. The results of this comparison are experiences and good practices from other companies who can be acquired inside the analyzed company, offering the improving of quality management.

The "dissemination" of good practices become the engine of "changement" by elimination of reported deficiencies and by the increase of the company competitiveness, taking inside the positive experiences validated by other companies.

In this paper are presented some more important issues from GRID computing history, the development at worldwide and European level and also in Romania, a short description and the connection with the application GRID – BENCHMARKING.

By the project financed by Structural Founds The GRID Centre for Resources will join the national/European/international network to run its own applications or of the others

1. 1. Introduction

In 1998 Ian Foster and Carl Kesselman have published a book ' The GRID – Blueprint for a New Computing Infrastructure'. A lot of people consider this event as being the beginning of a new era in the distributed computing. Foster and Kesselman wished to provide distributed resources for public transparent use, based on an standardized interface. The idea was that people may have easy access to the computers power, content and other services.

The GRID Computing concept has passed from the research and scientific world into the business world, as big companies as IBM, Oracle, HP, Dell, Microsoft etc. are investing in this technology for the future, existing nowadays more different projects. [3]

The basic idea is world wide development of a common resource.

Another novelty is the efficient management of GRID resources.

GRID Computing concept is similar to the Internet one. Internet is including a world wide net for data and information. GRID provides a very high level processing power, available everywhere. [3]

A GRID represents a distributed computational infrastructure allowing the partition and the common use of the computing resources, storage and other kind of resources.
GRIDs use the available resources at a certain moment on more separated computing systems, interconnected by a net (ex. Internet) to solve intensive problems from the execution time or the necessary storage capacities point of view.

2. GRID – the European level

In Europe, the main part is played by GEANT (1) a cooperation between 26 national research networks.

The document "i2010 – European Information Society 2010" proposed by the European Commission in April 2005, promotes an opened competitive digital economy and underlines the role of communication in wide band for the services promoting this support of communications.
Examples: Program e-Science from Great Britain; GRID initiative from Holland; GRID.IT from Italy; SweGRID from Sweden; Hellenic GRID from Greece and others.

3. GRID – in Romania

RoGRID was set up in May 2002 as an initiative of the Ministry of Communications and Information Technology and of the Ministry of Education and Research.
Partners:
1. The National Research and Development in Informatics Institute – ICI Bucharest
2. Polytechnic University from Bucharest (UPB)
3. The National Institute for Physics and Nuclear Engineering (IFIN-HH)
4. The National Institute for Aero spatial Researches (INCAS)
5. The University from Bucharest (UB)
6. Technical University from Cluj-Napoca (UTCN)
7. West University from Timisoara (UVT)

In July 2005 initiated by the National Authority for Scientific Research was set up the Working group for GRID national infrastructure including representatives from the Ministry of Research and Technology, the Ministry for Foreign Affairs, universities, research institutes and the network RoEduNet.

The main objective of the working group is the promotion of the strategic plane for the pilot project "The Implementation of GRID national Infrastructure".
In March 2006 was set up RT2F (Romanian Tier 2 Federation) representing Romania`s contribution to World LHC Computing GRID (http://lcg.nipne.ro)
The consortium is formed by:
1. The Institute for Physics and Nuclear Engineering "Horia Hulubei" – IHIN-HH;
2. The Institute for Space Sciences-ISS;
3. Polytechnic University from Bucharest (UPB);
4. The National Research in Informatics Institute – ICI;
5. The National Institute for Researches in Isotopic and Molecular Technologies – Cluj Napoca

In 2007 was certified the Authority for Certification (CA) within the Romanian Space Agency.

The National work net for Education and Research from Romania RoEduNet has appeared for the first time as a result of a project on processing and communicating data between Polytechnic University from Bucharest and Technishe Universitat Darmstadt, in 1990.

In December 2008 by GO 1609 is established The Agency for the Administration of the Informatics National Network for Education and Research by reorganizing The Office for Administration and Operation of Data Communication Infrastructure "RoEduNet".

In 2009 RoEduNet Network – national network based on DWDM (Dense Wavelength Division Multiplexing) technology built by RoEduNet.

To run a Centre for GRID resources must be certified by an Authority for Certification Romanian GRID CA and must be affiliated to RoEduNet.

RomanianGRID CA is organized as a Certification Authority providing PKI services for GRID research Romanian and academic communities services.

RomanianGRID CA was established and is managed by The Romanian Space Agency (ROSA).

4. Presentation

The great number of data generated by LHC will solicit a lot the PC infrastructure.

The applications need rapid nets, arbitrary access to individual recordings an a big capacity. Instead of store and process centrally the data, the LHC researchers intent to use the existing resources or the new created ones owned by the participating countries. The aim is the distribution of the calculation and storage thus being one of the reasons why this project is a major motivating factor for GRID Computing. Linux seems to be a blessing and a curse in the same time. (www.linux-magazin.ro; RUDIGER BERLICH).[10].

The fundamental characteristics of GRID

Virtualisation at each level;

Virtualisation allows the GRID parts such as storing capabilities, processors, data basis, servers for applications to work together without generating a rigidity in the system. Instead of creating static connections determining the physical place where a data basis stores its data, the virtualisation makes possible for each GRID part to rapid reaction and to adapt to some parts failure without compromising the system performance as a whole. [10]

Resources allocation according to each company specific policy

This allocation of resources refers to providing them where is necessary . After their visualisation , the resources must be dynamic allocated for a great number of tasks in the organization according to its priorities. Thinking to hardware resources, the hardware elements such as the storage units and servers must be allocated to data basis and servers for applications. Thinking to data, these must be allocated where is necessary.[10]

In the project was developed a database and a software for analyse, assessment and data processing for improving the organisations competitiveness in mechatronics, automation, precision mechanics. Were analyzed about 2500 SMEs and according to benchmark indicators were evaluated and classified.

This method represents an important tool in the hands of managers who can increase business competitiveness, given that:

- Information assurance is an essential resource for business performance.
- A trend in management (especially in large companies) is accompanying a strategic planning firm providing capability to quickly and effectively capitalize on the opportunities and face the risk / economic shocks. This can be done only by companies adaptable and flexible.
- Adaptability and flexibility of the company are provided in the first place, the quality of human resources and less technical components.
- Firms can obtain qualitative leaps without great cost, by adopting new operating principles and the formation of a new organizational culture.

Benchmarking is thus a necessary step to performance, both by nature or formative (creating) the mechanisms and practices through the formation of new performance-oriented attitude and mentality), and through concrete gains in competitiveness.

Firms that practice benchmarking will be able to adapt to change and may be used for their benefit.

5. Conclusions

Following the GRID resources necessary appeared by running on some applications within fundamental research field The National Institute for Research and Development for Mechatronic and Measurement Technique/INCDMTM it was decided to participate to the competition included in the Operational Program" **Improvement of the Economical Competitiveness"(POS CCE).**

The priority axe 2 Competitiveness by Research, Technological Development and Innovation

D2.2: Investments in infrastructure for RDI and administrative capacity development

O2.2.3: The development of some R-D centres, coordinated at national level and connected to the European and international specific networks (GRID, GEANT) and following the results is was admitted for financing the project "**Centre for resources GRID-BENCHMARKING for analyse, assessment and data processing for improving the organisations competitiveness in order to achieve the high performance".**

Code SMIS – CSNR: 2732

The total value of the project is 1.906.022 lei financial assistance not reimbursable of 1.820.000 included.

The project is implemented in Bucharest in 24 month.

The objective of the project is to set up a centre for GRID resources for analyse, assessment, data processing and improvement of the competitiveness to reach the high performance for a convenient access of different categories of users to high level computing resources and for the specific software applications of this field.

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COST ACCOUNTING FOR CROSS-ENTER PRICE CUSTOMERERS

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Introduction

The cost accounting in enterprises applies, most often, to the production control, however, the activities related to the service of customers are also important. Especially, in the times of crises, it is necessary to pay attention to this type of costs. It is impossible to achieve satisfactory economic results without a properly constructed cost accounting. This means that beside the manufacturing costs, the out-of-production processes have to be subjected to a control, in particular those related to the sales and customer service.

Nowadays, in the majority of enterprises, 1/3 of the costs incurred are the costs dependent on the type of customer. The amount and the structure of these costs depend on many factors to be agreed upon between the company and the customer, among others: a higher quality of products, transport frequency and type, product packages, payment terms [1].

The recognition and the correct establishment of the amount of expenses incurred per customer in order to satisfy its needs is the basic requirement to assess the profitability of customers. The reliable assignment of the costs incurred to individual customers is made possible through the ABC activity cost accounting (Activity Based Costing).

Customer Based Costing – Creation Rules

The traditional approach to the accounting of the customer service costs in proportion to the sales value is insufficient now. This is applicable to a homogeneous commercial offer only. For a differentiated offer addressed to heterogeneous customers, having various requirements, a demand for different types of services, the ABC concept yields good results; since the service of such customers does not constitute a standard process of similar costs.

The analysis of the course of the processes related to the customer service costs allows to systemize and separate the areas that require additional activities, which means the introduction of a more detailed recording of operations, or a change to the work organization so that the organizational effort, in agreement with customers' expectations, yields better results.

Four functional areas to create the customer service costs are discriminated, comprising:

· **logistics**: number and form of customer orders, frequency of deliveries from the customer, distance to the customer;

· **sales and service**: visit at the customers', integration meetings with customers, phone calls, publicity stuff, commission fees;

· **production**: special quality requirements, special packages, additional product marking (e.g. under the customer brand name);

· **finances** (costs related to the crediting time period, and also the costs of write-offs created for overdue liabilities) and **law** (warranties, bank commission fees, letters of credit).

It follows from the above-described processes that they are not directly related to the typical, traditional notion of sales costs according to the standard calculation approach, but to the customer and sales. In effect, all the costs related to the service of the specified processes shall be accounted per customer or customer groups.

Methods of „assigning" the costs to the customer

Depending on the type of activities on behalf of the customer, two different ways of the cost transfer from the source objects onto the objects that consume the available resources (here; the customer's objects) can be introduced.

1. Original cost incurred on behalf of a specific customer and assigned to it during the recording, e.g. the recording of a purchase requires an invoice that is described with the symbol of that customer.

In such a way it is possible to assign the costs related, inter alia, to visits at customers', product transportation costs, warranties, letters of credit.

This type of cost assignment does not require much labor input and is reduced to the specification, in the source document, of the proper customer designation or customer groups designation.

2. The costs calculated on the basis of the activity time on behalf of customers, e.g. time to make up the invoice adjusted by the number of invoice items introduced (the so-called variability factor), the time of preparation of goods for shipment, adjusted by the number of goods forwarded (variability carrier).

The application of such an approach is consistent with the concept of ABC TD, using the so-called time driver activity based costing. Owing to the introduction of the ABC accounting, which uses the so-called time driver activity based costing, a higher work effectiveness is obtained by streamlining the work organization, and the costs of the processes being accomplished are not averaged but calculated proportionally to the operation duration time.

The determination of unit times is more precise and the assessment of activities takes into account the actually available time to be used. This type of activity based costing, which is time-controlled, allows to determine the total labor consumption of activities and the demand for work done by people or equipment [2]. This method of the cost assigning to customers can be applied especially in the case of sales and customer service processes of a high degree of complexity and complication and variety, requiring the involvement of large resources.

Customer profitability

The new cost calculation way on the basis of the ABC TD method allows the full analysis of the customer profitability. It provides the reply to the question whether the sale of the given product is profitable and whether the customer, in the totality of its commercial contacts, is profitable for the company. The persons in charge of commercial contracts will obtain better information bases to negotiate the sale prices, terms of deliveries and other elements related to the cooperation with customers.

This method supports the sale management processes, provides the information on the actual costs of individual processes and their impact on the profitability of serviced customers. Owing to the assignment of costs to specific activities on behalf of a specific addressee (customer or customers group), the averaging of costs and the statistical assigning to individual cost objects is significantly eliminated. The seizure of costs using ABC TD facilitates the look at the company through the prism of business processes (activities) and not organizational structures. The sales profitability analysis made using this calculus allows to learn the factors that raise the customer service cost. Here are the examples of the main factors affecting the customer attendance costs.

TABLE I. Factors affecting the customer service costs

Factors that increase the customer service costs	Factors that decrease the customer service costs
1. Small-volume and frequent orders	1. Orders for a larger production volume
2. Unpredictable (irregular) reception of orders	2. Regular (predictable) reception of orders
3. Non-typical terms of delivery	3. Typical terms of delivery
4. Changes of requirements in the scope of delivery	4. Non-occurrence of changes in agreed terms of delivery
5. Manual data operation and processing	5. Electronic data processing, e.g. EDI)
6. Numerous post-sale activities, e.g. meetings at the customer's	6. Occurrence of post-sale activities
7. Keeping the stock for customer	7. No stock
8. High level of accounts receivable	8. Making the payment by customers for purchased products in time
9. Frequent design changes of products	9. The product is manufactured without engineering changes.

Source: Paper on the basis of R.S. Kaplan, A.A. Atkinson, Advanced Management ACCouting, Prentice Hall Inc.1998.

Calculation scheme of customer profitability

In the company acting in the motor business, dealing with the sales of seals, a new approach to the customer cost calculation based on the ABC TD calculus was applied, using the time driver.

To this aim, the calculation scheme of the customer and product profitability was used, by dividing the costs by their variation and the share in processes, e.g. production costs and sale costs.

In Table II the costs are split into two types: production-related costs, *KP*, and sale–related costs, *KK*. Under this costs breakdown, four categories of cost variation have been introduced:

- **Variable costs** – items corresponding to the assumption: "No production, no cost", closely related to manufacturing and sales processes. No orders from the customer means the lack of these costs (Table II, Items 4 to 7).
- **Relatively variable customer costs** – related to the sales and, under such a system, they are variable, however, no sales not always is equivalent to their total reduction. The costs of this category are clearly related to the item of fixed costs assumed as "fixed costs of the reduced activity effectiveness" (Table II Items 9 and 10). To this item are reckoned the costs related to the mercantile credit (Table 2 Item 12).
- **Profit centre fixed costs –** here, the costs incurred by the profit centre have been qualified, irrespective of the production volume (Table II Items 14 to 17, 19 to 20 and 22).
- **Enterprise's fixed costs** assigned to be covered by the profit centre. The profit centre has no impact whatsoever on the size of these costs and is not accounted for them (Table II Item 24).

The knowledge of processes included in the customer profitability calculation scheme (Table II) allows to understand the mechanisms that control the creation of costs and their assignment to the final recipient – customer or product.

TABLE II. Customer profitability calculation scheme

Item	Product manufacturing costs (KP)	Sale costs Customer costs (KK)	Sign	Total profitability (RR)
1				Sales revenues
2			-	Rebates and discounts granted
3			=	**Total sales**
3.1				Weight of sales
Variable costs				
4	Variable product costs; direct materials, half-finished products, direct packages, external treatment	Variable logistics costs - shipment packages, - transport,	-	Variable product costs (Items 4, 5, 6, 7 of manufacturing costs) Variable sales cost (Item 4, 5 of customer costs)
5	Variable costs of machine operation	Sale-related variable costs – commission fees		
6	Variable cost of people's work			
7	Variable costs of additional activities assigned to the product			
8			=	**GROSS MARK-UP I** (item 3 of profitability - Σ (items 4 to 7)/item 3of profitability)
Relatively variable costs				
9		Costs of customer logistic service – servicing of customer orders, - preparation of shipments, - invoicing	-	Customer service costs (items 9 and 10 of customer costs)
10		Costs of customer service - costs of contact to the customer, - costs of publicity addressed to the customer		
11			=	**GROSS MARK-UP II** (item 8 RR – Σ (items 9 to 10)/item 3 of profitability)

12		Costs related to the customer financing - cost of mercantile credit - banking costs	-	Customer financing costs (item 12 of customer costs)
13			=	**GROSS MARK-UP III** (item 11 of profitability – item 12/item 3 of profitability)
Profit centre fixed costs				
14	Fixed costs of machinery		-	
15	Fixed costs of production preparation		-	
16	Development costs		-	
17	Fixed costs of the workshop		-	
18			=	**GROSS MARK-UP IV** (item 13 of profitability - Σ (items14 to 17)/item 3 of profitability)
19		Fixed logistics costs – assigned	-	
20		Fixed sales costs – assigned	-	
21			=	**GROSS MARK-UP V** (item 18 of profitability - Σ (items19 to 20)/item 3of profitability)
22	Fixed costs related to the reduced activity effectiveness - related to the work of people - related to the operation of machinery			
23			=	**GROSS MARK-UP VI** (item 21 of profitability - item 22)/item 3 of profitability)
Fixed costs of the enterprise				
24			-	Overhead costs of the enterprise operation
25			=	**GROSS MARK-UP VII** (item 13 of profitability – item 24)/item . 3 of profitability)

SOURCE*:* Own study

In the profitability calculus according to the adopted calculation scheme seven control mark-ups are considered.

GROSS MARK-UP I – responsibility for the costs: production manager – in the area of the product (items 4 to 7 of product costs), logistics manager (item 4 of customer cost), customer manager in the customer-related area (item 5 of customer costs),

GROSS MARK-UP II - responsibility for the costs: logistics department manager (item 9 of customer costs) and customer manager (item 10 of customer costs),

GROSS MARK-UP III - responsibility for the costs: customer manager,

GROSS MARK-UP IV - responsibility for the costs: profit centre manager,

GROSS MARK-UP V - responsibility for the costs: logistics manager (item 19 of customer costs), profit centre sales manager (item 20 of customer costs),

GROSS MARK-UP VI – responsibility for the costs: profit centre manager,

GROSS MARK-UP VII - responsibility for the mark-up level, profit centre manager, without influence on the level of overhead costs.

Customer profitability analysis – example

The customer profitability analysis was conducted according to the traditional method and to the ABC TD calculation. The customer who has been cooperating with one of the profit centres for at least five years has been selected, whereby, despite low sale for three years the turnover is falling down systematically. The customer is qualified as a difficult one, permanently demanding lower prices.

The following assumptions have been adopted for the assessment of activities in the ABC TD calculation using the time driver:

- Actual load – 80% of rated work time,
- Cost of one minute of the trade department operation – PLN 0.8,
- Cost of one minute of the logistics department operation – PLN 0.65,
- Time to issue a document (VAT invoice, delivery from the store document (WZ)) – 5 minutes,
- Time to record an item on the document – 0.5 minutes.

* *Over 4 months, the customer has issued 16 orders by fax, 1.5 items on the average, which yields: 16 documents x 5minutes+ 16 documents x 0.5minutes x 1.5 items on the document = 92 minutes x PLN 0.8 per minute = PLN 73.6;*

** *15 WZ (delivery from the store) documents have been issued to the customer and the same number of invoices, on the average 1.5 items, which yields: 15 documents x 5minutes + 15 documents x 0.5 minutes x 1.5 items on the document = 82.5 minutes x PLN 0.65 per minute = PLN 53.6;*

*** *In the period of time under study, a visit has been paid to the customer once – by 2 persons, in the distance of ca. 200 km from the company;*

**** *The cost of capital has been adopted at the ROE level, i.e. 7.4%, the manufacturing cost of products sold has amounted to PLN 149,565, the average payment term was 15 days. By substituting to the formula (1): 149,565 x 7.5% x (15 days / 120 days) = PLN 1,383.*

The cost analysis using the traditional method, maintaining the breakdown into variable and fixed costs, is presented in Table IV.

TABLE IV. Customer profitability calculated according to the traditional method.

Revenues from sales	135,128
Cost of direct materials	104,075
Cost of machine operation	22,088
Direct payroll	11,619
Total variable costs	**137,782**
GROSS MARK-UP I	*-2%*
Fixed costs of the workshop	7,782
TOTAL ENGINEERING COST Of MANUFACTURE	**145,567**
GROSS MARK-UP II	*-7.7%*
Cost of sales	6,884
Overheads	11,878
TOTAL OWN COST	**-29,201**
GROSS MARK-UP III	***-21.6%***

SOURCE: Own study

TABLE. III. Customer profitability according to the ABC TD method

Item					Sign	TOTAL PROFITA-BILITY
1	Revenues from sales					135,128
2	Discounts and rebates granted				-	-
3	**Total sales**				=	**135,128**
3.1	Weight of sales				kg	16,228
Variable costs						
	Variable costs of product	104,075	Variable costs of logistics and transport	3,661		
	Variable costs of machine operation	10,126				
	Variable costs of human work	8,813				
Total variable costs		123,014		3,661	-	126,675
Result obtained *GROSS MARK-UP I*					=	8,453 *6.3%*
			Costs of logistic service - servicing of orders* - shipment** - invoicing**	73.6 53.6 53.6		
			Costs of contacts to the customer***	942.0		
Total costs of customer service					-	1,122.8
Result obtained *GROSS MARK-UP II*					=	7,330.2 *5.4%*
			Cost of mercantile credit****	1,383	-	1,383
Result obtained *GROSS MARK-UP III*						5,947.2 *4.4%*
	Fixed costs of profit centre	34,141				34,141
Result obtained *GROSS MARK-UP IV*						-28,193.8 *-20.8%*
			Fixed costs of logistics and sales – assigned	4,222		4,222
Result obtained *GROSS MARK-UP V*						-32,415.8 *-24.0%*
	Fixed costs of reduced activity effectiveness – related to human work	2,805				2,805
Result obtained *GROSS MARK-UP VI*						-35,220.8 *-26.1%*

SOURCE: Own study

It follows from the calculations made per traditional method that the customer is not profitable. Indeed, the profitability calculated according to the new ABC TD accounting shows, at the last level, the negative mark-up (-26.1%), then, however, all the variable costs o sales and production will be covered, even upon considering the full costs related to the customer attendance. There followed a shift of the costs of the profit centre from variable costs to fixed costs. This follows from the considerable reduction in the profit centre's production in comparison to the original assumptions. The lower production means the non-use of full production capacities. Most probably, the work of the staff is not used properly, and the free time has not been fully adapted.

The following conclusions result from the analysis conducted:

- The variable costs of the customer are covered and the cooperation with it should be continued, by making attempts to reduce its considerable service costs;
- The profit centre has difficulties with the proper use of the resources accumulated, therefore efforts should be made to use them optimally.

Summary

The cost calculation performed using two methods has demonstrated a various profitability for the same customer. The lack of the accurate recording of processes and the statistical cost allocation can lead to many erroneous conclusions and managerial decisions. The decisions taken on the basis of the erroneous cost information negatively affect the profitability of the enterprise.

The ABC TD calculus provides a more accurate calculation of the costs of activities and a proper assignment to customers since it uses the information already recorded in various modules of the system, e.g. the number of invoices for that customer, the number of orders and that of internal manufacturing orders. This type of the system enforces the organizational order within the company. Each cost-related document shall also be described using the designations of the cost recipients adopted in the system, which might be the customer or the customers group. It is also necessary to apply the work time distribution indexes, which, doubtless, contributes to the improvement of the work organization and effectiveness.

For those companies that have significant costs of customer service the introduction of the calculus based on the time drivers will be, doubtless, advantageous since it allows the full and complete study of customer profitability, which, in turn, will allow to determine the priority sales directions.

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CURRENT INNOVATION ISSUES

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Abstract:
The present paper presents some of the main issues the world is facing today, when approaching the intellectual property domain. In the beginning the role of innovation in economic growth is presented. A more particular viewpoint upon the reality or importance of IP is showed, and in the end, it is emphasized the role of IP in green technological transfer.

Key words: intellectual property, economy, role of innovation, green technological transfer

Introduction

As it's becoming clearer every day that innovation is the central driver of economic growth, more and more countries are trying to be innovation leaders. Unfortunately, in that quest all too many countries are choosing to go down a path of "innovation mercantilism" by implementing beggar-thy-neighbor strategies designed to gain advantage at the expense of other nations and overall global innovation progress. These nations see the royal road to prosperity as through expanded technology exports and the best way to do that they believe is through gaming the international trading system through a number of mercantilist practices, including by manipulating their currencies, distorting technology standards, providing export subsidies, forcing technology transfer as a condition of market access, pirating intellectual property, and favoring indigenous over foreign technology products and services in government procurement.

While China is perhaps the most egregious example of a country practicing innovation mercantilism, similar practices can be found in Brazil, Argentina, India, Japan, Russia, Singapore, South Korea, and even in European Union nations. As these countries bend and break the rules and think only about short-term gains for themselves at the expense of the rest of the world, they undermine and destabilize the international economy and risk killing the innovation.

Studies

In a report, “The Good, The Bad, The Ugly and The Self-Destructive of Innovation Policy”, the Information Technology and Innovation Foundation (ITIF), provides a comprehensive catalog of countries' innovation policies toward skills and immigration, trade, tax, scientific research, intellectual property, government procurement, standards, and regulations. The report assesses whether countries are implementing innovation policies in ways that are either:

1) "Good," benefiting the country and the world simultaneously;

2) "Bad," failing to benefit either the country or the world;

3) "Ugly," benefiting the country at the expense of other nations; or

4) "Self-destructive," actually hurting the country while benefiting others. It finds that, unfortunately, the Good policies tend to be outnumbered by the Bad, Ugly, and Self-destructive ones.

Many of the fastest growing innovation policies are of the Ugly variety: benefiting the country, at least in the short run, but hurting the rest of the world. Mercantilist practices can indeed be effective. China's "Ugly" practices such as currency manipulation, pilfering intellectual property, and forcing technology transfer as a condition of market access have in fact boosted the country's exports, moved productive activity to its shores and affect foreign.

From 2006 to 2010, China's share of world exports jumped from 7% to 10% and the country ran up a $826 billion trade surplus in the years 2007 and 2008 alone.

But many of the policies that nations think are beneficial to them are actually Bad. That is, the policies hurt not only the rest of the global economy, but also the economy of the nation implementing it. An example is mercantilist countries' practice of manipulating their currencies to artificially lower them in an attempt to help their exporters. But doing so, raises the price of capital goods, especially for information and communications technology (ICT) products, inhibiting the diffusion of ICTs throughout all other sectors of their economy, making those sectors less competitive, and causing overall economic productivity to stagnate. As another example of a Bad innovation policy, for every $1 of tariffs India imposed on imported ICT products (as part of its efforts to spur an indigenous computer industry), the country suffered a net economic loss of $1.30.

Many nations pursue Ugly, Bad, or even Self-destructive innovation policies, most of them convinced that they need this to economically succeed. That is wrong. They believe that "exports are needed to create jobs." In fact, exports don't create jobs, at least in the moderate to long-term. These nations could achieve full employment just as readily by implementing a loose monetary policy, aggressive fiscal policy, and an effective social safety net. They don't need trade surpluses to employ all their workers.

They also claim that innovation mercantilism helps them move up the value chain and get richer. But in reality, the much surer way to get rich is through raising the productivity levels of all industries, not just export-oriented ones, particularly by applying innovation and leveraging information technology. A good example is Japan. It certainly boasts world-leading manufacturers in automobiles, consumer electronics, and ICT products, but the non-traded sectors of its economy, such as retail, have only a fraction of the productivity of Western ones, it trails badly in the usage of ICTs, and it conspicuously lacks any world-class service firms.

Consequently, the overall productivity of Japan's economy is 70% of America's. Japan has reached the dead-end of a predominantly export-led growth strategy and had fallen into economic malaise.

Many of these policies impoverish, not enrich, their citizens. For example, if China wouldn't have run its $428 billion trade surplus and instead, imported real goods and services instead of Treasury bills, Chinese households would see a 17 % average increase in their disposable income.

When a country steals intellectual property, instead of itself expanding R&D funding, it lowers global knowledge stocks. Likewise, when one country manipulates its currency, others feel forced to follow suit to stay competitive. Thus, the global trading system devolves into a competition where every country is incented to cheat and so the overall global economy suffers. Other countries' mercantilist policies not only move innovation-based jobs away from the United States, but also undermine globalization, which is bad for all.

As such, we need a system of globalization that moves nations away from Bad, Ugly, and Self-destructive polices toward Good ones, such as improved education systems, an openness to high-skill immigration, increased R&D funding, effective science and technology policies, policies to spur widespread digital transformation of their economies, etc. Good innovation policies benefit the entire world, because innovations in one place ultimately spillover to the benefit of citizens worldwide. Think of a new pharmaceutical developed in South Korea or France that benefits all peoples, or when nations adopt new techniques in teaching and training. Ideally, countries' constructive innovation policies spur other countries to emulate or improve on them, and all countries win.

What can be done?

We need to start with a recognition that the current approach to globalization is not working. The new approach should be grounded in the perspective that markets drive global trade; countries adhere to their trade agreements; genuine, value-added innovation across all sectors drives economic growth and that fair competition between nations to develop the best innovation policies is good for the world.

One should insist upon putting an end to countries' rampant innovation mercantilism and developing a more sustainable vision for globalization top the agenda; demand that the World Bank and other multinational development agencies reformulate their strategies with a focus on supporting only countries that mostly practice Good innovation policies, and withdraw support from those whose predominant strategy is based on Ugly and Bad ones. The only way to stop countries' systematic manipulation to gain competitive advantage by beggaring their neighbors is by diminishing the number of the nations which engage in it.

It may be time to think about establishing a new trade zone, perhaps modeled on the Trans-Pacific Partnership, which would include only those nations committed to good innovation policies. Innovation is poised to continue to bring globally shared growth and prosperity, but policymakers must understand this will only happen if all countries are compelled to play by the rules mutually established by the international community to guide the economic interactions between nations.

Another issue is that patents create incentives for more patents, not innovation

While many people (especially politicians and the press) like to equate patents and innovation (often falsely suggesting that fewer patents means less innovation), studies have shown that patents are actually a really bad proxy for innovation, in that there's simply no direct link between the two. And that is a problem, considering that the patent system is supposed to be about creating more incentives for innovation. In fact, however, it often appears that the patent system is actually creating incentives to get more patents.

One has to go back to China to give an example. Just recently, we noted that patenting was on the rise by Chinese companies, but a closer look at what's happening in China suggests that it's very much about incentives to increase patents, rather than incentives for greater innovation. In fact, it's quite direct:

The Chinese government has created an ecosystem of incentives for its people to file patents. Professors who do so are more likely to win tenure. Workers and students who file patents are more likely to earn a hukou (residence permit) to live in a desirable city. For some patents the government pays cash bonuses; for others it covers the substantial cost of filing. Corporate income tax can be cut from 25% to 15% for firms that file many patents. They are also more likely to win lucrative government contracts. Many companies therefore offer incentives to their employees to come up with patentable ideas. Furthermore, the incentives for the patent examiners are also skewed towards simply approving more patents (which has a snowball effect, in encouraging more people to file weaker and weaker patents), so the bureaucrats in Chinese patent offices are paid more if they approve more patents. That must tempt them to say yes to ideas of dubious originality.

Regarding the issue from this viewpoint and if you actually believe that patents are correlated to innovation, then such strategies make sense. But, if the reality is that patents are simply correlated to patents, then it's a huge dead weight loss to focus so much on patenting, rather than actual innovation.

A new Harris Interactive survey, 'Fortune 1000 Executives Perspectives on Enterprise Innovation, sponsored by Olympus, found that while the vast majority of the 304 executives who responded believe that enterprise innovation is extremely important, 53% believe their organizations are not doing enough to promote innovation. The survey identifies several barriers to enterprise innovation.

For purposes of the survey, Harris and Olympus defined enterprise innovation, as opposed to product innovation, as "the transformative business processes, practices, organizational planning and models that enable a business of any size to operate more effectively, profitably and/or competitively."

Olympus cites the Model-T as product innovation and the assembly line as an enterprise innovation.

The top 5 barriers to enterprise innovation that the study revealed are:

1. Too much focus pressure to achieve short-term goals/quick results.
2. Other business goals/objectives take priority.
3. Lack of time.
4. Lack of incentives to inspire or reward innovation.
5. Lack of systems or tools for fostering enterprise innovation.

Of particular note: “47% report that their company has no team, process, or system for vetting new ideas in order to decide which ones to invest in.”

However, all the process in the world will not change a thing unless there is organizational support and resources for change. At least 70% of survey respondents thought CEOs could improve enterprise innovation by doing the following:

- Creating a corporate culture that encourages innovation, even at the risk of failure;
- Allocating budget to innovation initiatives;
- Rewarding innovation with recognition or other non-financial incentives;
- Rewarding innovation by providing financial incentives;
- Leading by example by personally participating in the innovation process.

In previous decades libertarians viewed intellectual property as a boring and technical area of the law. They also assumed it to be a legitimate, if arcane, type of property in a capitalist, free-market society. Today it should not be ignored anymore or its legitimacy shouldn't be taken for granted.

The injustices of IP have multiplied in the Internet age. We hear regularly about multimillion- or even billion-dollar patent lawsuits, and about the millions of dollars spent by corporations on patent attorneys and litigators just to cross-license with each other, leaving smaller companies outside the walls of the barriers to entry erected on these patent arsenals. In the name of IP, books are banned, movies are ordered destroyed, singers are prevented from singing, car owners prevented from photographing their own cars, churches are prohibited from having Super Bowl parties, and imports of watches are blocked. Trumped-up charges of IP infringement are used as an excuse by the government to investigate political opponents.[1]

One can see there is something wrong here. We must start by taking a close look at the traditional libertarian assumption that IP is, in fact, a legitimate type of property right. And it turns out that advocates of the free market have made a mistake all along. Patent and copyright, to take the two worst manifestations of IP, are nothing but state monopolies that violate property rights. IP is antithetical to capitalism and the free market. Copyright is rooted in censorship. Patent law finds its origins in mercantilist monopoly grants, and even legalized plunder — letters patent were used to legalize piracy in the 16th century — making it ironic for IP to be used against modern-day "pirates" who are not real pirates at all.

Once IP is seen this way, one finally admits that it is not part of a free-market order, that might make possible a reassessment of aspects of economic or social thought, until know neglected or seen confusingly through the IP haze.

IP is also seen as another mercantilist-corporatist state intervention in the free market. And one simply must have a sound, coherent, and libertarian understanding of property rights, the nature of homesteading, and the nature of contractual exchange, to understand the IP issue.

To develop an understanding of property, contract, and homesteading sophisticated enough to understand the nature of IP and exactly how and why it does not fit into libertarianism and the free market, you must look closer at the nature of homesteading (Locke), contract theory (Evers-Rothbard), and at the nature and function of property rights. This last category, in particular, provides a good illustration of why Austrians are especially suited to libertarian theorizing, as it requires a close study of praxeology and the very structure of human action. On this topic, one must examine the work of Austrian luminaries such as Mises, Rothbard, and Hoppe to fully appreciate the relationship between scarcity and property rights, and the unique role of ideas and emulation in a free market and in society in general.

As noted above, coming to grips with IP is not easy. Thinking it through helps firm up the case for property rights and contract. And the implications of what we learn, extend far beyond just this area; it reaches into social theory and competition theory as well.

The last issue presented in this paper is the role of patent protection in (clean/green) technology transfer

Climate change is one of the great challenges facing world leaders. Cooperation, however, has proved elusive as the green-versus-growth trade-off is very difficult politically. Technology, according to many, is one of the best ways of relaxing the trade-off. Driven by this realization, economists have become increasingly interested in the mechanisms that encourage the development and diffusion of new green technologies. Chief among these is intellectual property in the form of patents.

In its latest report, the UN Framework Convention on Climate Change (UNFCCC) Ad-hoc Working Group on Long-term Cooperative Action proposed specific intellectual-property-related regulations for the post-Kyoto framework on climate change. The regulations proposed by developing countries include patent pooling, royalty-free compulsory licensing of green technologies, excluding green technologies from patenting, and even revoking existing patent rights on green technologies (UNFCC 2010). Considering the public good character of environmental protection, parallels have also been drawn with the implications for developing countries from patent protection in the pharmaceutical sector (Abbott 2009). Industrial economies such as the US are committed to "prevent any weakening of, and ensure robust compliance with and enforcement of, existing international legal requirements [...] for the protection of intellectual property rights related to energy or environmental technology" (US House of Representatives as quoted in Rimmer 2009).

Despite this, in December 2009 the US Patent and Trademark Office launched its 12-month "Green Technology Pilot Program" following a similar initiative in the UK in May. Under the programme, patents related to green technologies benefit from a substantially accelerated examination process. The underlying assumption behind these initiatives is that a speedier grant process of patents on green inventions will spur the development and diffusion of green technologies.

The economics of intellectual property and climate change

Intellectual property has been widely studied as a means to addressing the externality that results from imperfect "appropriability" of investments in knowledge. The climate change problem involves a second externality, however. Environmental pollution is a textbook example of an activity for which social costs exceed private costs. The problem is now even more complex. On top of this double externality, there is the global dimension of the climate change problem and a vast range of different green technologies applicable to the problem. In light of this, we re-examine the role of intellectual property protection in promoting the development, transfer, and diffusion of technology.

In a recent paper (Hall and Helmers 2010) one reviews the available evidence with regard to this debate and arrives at several conclusions.

The first is that climate change-related technologies comprise a vast range of fundamentally different technologies addressing distinct climate change-related problems.

Patenting propensities and patent effectiveness differ substantially across the various technological fields. A large range of different technologies can achieve emission reductions, and for a significant share of these green technologies, the underlying technology is mature and in the public domain. Most technological progress is expected to come from incremental improvements of existing off-patent technologies.

While such incremental innovation may be patentable, such patenting will leave ample scope for competing technologies.

This limit the role specific patents may play for technological progress in this area. Improved biomass cooking stoves aimed at increasing efficiency and thus reducing emissions from the burning of biomass are an example of such innovations. This suggests that insights from the existing experience with technology development and transfer in certain technological areas such as pharmaceuticals may not translate directly to green technologies and the parallels in terms of intellectual property protection drawn between the pharmaceutical industry and green technology are not warranted.

A second conclusion is that although intellectual property rights can address the gap between private and social returns to innovation that results from the public good characteristics of knowledge, they are not designed to remediate environmental externalities. As a result, patent protection offers only a limited instrument for mitigating environmental externalities. Therefore, it may be more conducive to frame the discussion of intellectual property rights and green technology within a setting defined by policy interventions specifically designed to address environmental externalities rather than to focus solely on the role of intellectual property rights.

Intellectual property rights and technology enhancement: Emerging economies versus least developed

The limited existing empirical evidence on intellectual property right and technology transfer suggests that there are two groups of developing countries. In the first group are emerging economies, such as Brazil, China, India, and Mexico, and in the second group a larger number of less-developed countries. The evidence on green technologies suggests that a strengthening of intellectual property rights for emerging economies will most likely have a positive impact on the domestic development of technology and its transfer from developed economies.

The available evidence does not allow for a similar conclusion in the case of the least developed countries.

There are a number of other issues apart from intellectual property rights that are of first-order importance in setting incentives for the development and transfer of technologies. Developing countries themselves may generate powerful distortions inhibiting the production and transfer of green technologies.

A report by Copenhagen Economics (2009) suggests that subsidies for the consumption of fossil fuels in some developing countries, such as Venezuela, Iran and Indonesia, may represent a significant barrier to the development and transfer of green technologies in these countries. Barton (2007) suggests that import tariffs on photo-voltaic and wind technology in place in India and China may also act as a barrier to technology development and transfer. In contrast, import tariffs and subsidies for biofuels in place in industrialized countries, above all the EU and US, are viewed as hampering the development of this industry in developing countries, such as Brazil (World Bank 2010).

Such import barriers on green technologies represent a complex issue. Due to the environmental externality, it is desirable to have policy interventions in place in developed countries dedicated to market creation, such as subsidies, to promote demand for green technologies (Taylor 2008). From a political economy perspective, however, it is unclear to what extent developed economies are willing to subsidies' demand for green technology produced abroad, in particular in large emerging economies.

On the whole, the existing empirical evidence on the role of intellectual property rights in promoting the development and diffusion of climate change-related technologies is surprisingly sparse and does not provide sufficient insight to reach more substantial conclusions. This is an area in which further research on the relationship between intellectual property rights and the development and diffusion of innovation, especially with a view to developing countries, would be highly desirable.

Conclusions

IP is a very complex and debated subject. There are many ways to look at it, approach it, use or ignore it, but all in one, no matter what some might say, it is an important reality of today's economic and social life.

For example, if one positions itself in the creator's shoes, then with all his strength will defend its rights. If positioned on any other level, one could not care less about the way IP works, what it is useful for or how it should be defended.

In conclusion, I think it is a matter of interest and self acceptance.

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THE DEVELOPMENT OF EDUCATION FOR THE VIABILITY THROUGH THE INOVATION VECTORS : MECHATRONICS- INTEGRONICS (M&I)

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ABSTRACT

The project “The Development of Education for the viability of labor market through the innovative vectors: MECHATRONICS – INTEGRONICS (M&I)”, financed by the Sector Operational Programme Human Resources Romania 2007÷2013, responds to the directives of the Key Aria of Intervention 2.1 from the priority axis 2: Call for project proposal no. 90 – Learn a trade, on: carrying out a wide set of activities for promoting the new HIGH-TECH ADVANCED field of MECHATRONICS & INTEGRONICS, on the internal labor market, especially in the ranks of university higher education graduates. This apex field is an integrative science that offers a wide perspective on the contribution of science and technology to the unfolding of the programmes corresponding to the national strategies for sustainable economic development and aligning to the ones promoted at the community level.

1. INTRODUCTION

Promoting MECHATRONICS & INTEGRONICS will lead to the formation of new occupation niches on the labor market since their current occupation degree is very low at the national scale stemming from the lack of interest in concerns for specialization and facilitating the insertion of university higher education graduates in the fields.

The innovative vector MECHATRONICS involves a complex engineering structure, the synergetic combination and integration of precision mechanics, electronic, electric and computer science engineering / micro-engineering, all these existing in an architectural correlation with material engineering / micro-engineering, industrial engineering / micro-engineering, system / bio-system engineering / micro-engineering, etc., (see figure 1).

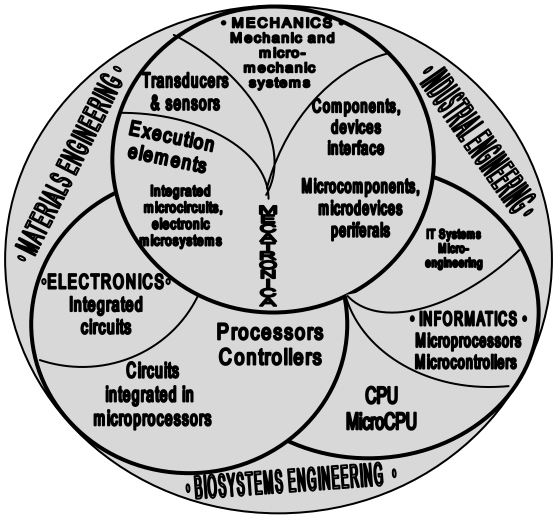

Fig. 1

The innovative vector INTEGRONICS involves the vision of mechatronics in an engineering structure fully integronized and into a systemic integrated and synergetic engineering structure, cumulating constructive and functional solutions, similarly to the human body, behavior and expression of intellectual, physical, moral, social, human states and so on etc.

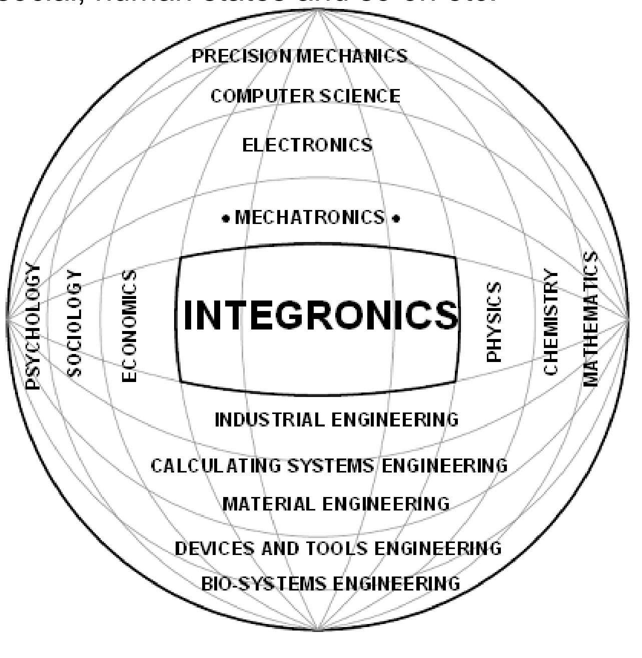

Fig. 2

Micro-Mechatronics and Nano-Mecatronics (µm & nm) are the most representative and advanced interdisciplinary fields of engineering and the youngest of the integrated sciences.
Currently, they are developing at very fast pace, because of their impact in the fields of physics, solid mechanics, fluid mechanics, optics, pneumatics, electro techniques, thermodynamics, all of them intermingled, interdisciplinary and integrated on one hand with the sciences of electronics, informatics and applied mathematics and on the other hand with chemical, biological, psycho-sociology, economy sciences and arts in general.

Micro-Mecatronics (µm) and Nano-Mecatronics (nm) penetrate daily in other new mechatronic subfields, as well as micro-nano-robotics, mechatronic micro-nano-technology mechatronics and medical micro-nano-technique.

This evolution and development at the Micro and Nano scale of Mechatronics cannot be conceived out of the evolution and of the development of components and micro-nano-components and micro-nano-technologies of the materials, intelligently coupled and architected on the basis of dedicated, special and efficient software, integrated into a competent, useful and successful design.

The work shows an original point of view on the current and future problematic of µm & nm, in both a formative and an informative scope.

THE CONCEPTS OF MICROMECATRONICS (µm) AND NANO-MECATRONICS (nm)

The integration of µm & nm in the advanced fields of Nano-sciences and Nano-technologies requires a discussion over the concepts, theories and scientific accomplishments, with tangible examples of applications in research projects taken on by the author and by the dedicated institute.

The concepts of µm & nm (Gheorghe, 2007) were initiated and developed as a consequence of the rapid development of micro-nano-mechatronic structures and micro-nano-structures, as well as due to the perfecting of the perfecting of the micro-nano-programming, micro-nano-command and micro-nano-control.

The concepts of µm & nm have developed through the synergetic mingling of the micro-nano-structures matrices and of the principles and laws that coordinate the movement of masses, the carriers of electrical charges and the informational transfer at superior logical levels and in the micro-nano-technological integration and fusion of all micro-nano-components.

The concepts of µm & nm synthesize the simple, mixed and complex phenomena, diverse structures, integrated links of all constitutive sciences and informatic and informational technology, subordinated to the generative ensemble at a micro and nano- scale of high and total quality.

The implementation of de μm & nm concepts (Gheorghe, 2008), in technical and technological applications, arguments their contribution to the evolution and the development of Nano-sciences and Nano-technologies, justified by the favorable immediate effects on the superior quality of products and services, high work productivity, rapid increase in the comfort of life in as a whole, carrying out lasting economic efficiency and the informatization of all processes in industry, economy and society.

2. PROJECT OBJECTIVES

The specific objectives pursued in the project:

- improving learning conditions by industrial practice, that is to ensure higher capacity and the capabilities for absorbing young graduates on the labor market;
- developing and providing services for the orientation, counseling and guiding the transition from school to active life;
- formation, encouraging and developing partnerships between universities and enterprises with the view to ensure professional specialization and staff absorption;
- promoting equal opportunities;
- occupation programme multiregional development;
- promoting innovative actions on the transition from school to active life.

Within the target group, the project regards highly important the formation of specialized staff for:

- counseling, orientating and professional during and at the end of the higher learning circle.
- activities of interface in the perfecting of contracts and partnerships between universities and enterprises (productive commercial societies, of import-export, research and development institutes), for unwinding strategies of practical training of students.

On the long run, the project will generate positive effects, such as:

- developing occupational programmes at the national and trans-national scale;
- aligning and integrating in European educational desiderata;
- innovative developments meant to favor insertions and assimilations towards new modern occupational fields on the market labor;
- increase in the occupational degree based on safe fields and perspective ascending trend fields facilitating the sources of integration on the national/international labor market.

3. FORSEEN RESULTS

The anticipated results of the project, quantified on the basis of indicators:

- ➢ forming the management team; management procedures; logistics for management;
- ➢ acquisition lists, documentations for equipment and services, reports;
- ➢ organizing promoting, information and media campaigns; promotion plan, information and media plan, presenting and promoting conference; promoting and media campaigns, etc.;
- ➢ building the target group (selecting and constituting the strategy and the programme);
- ➢ stuff groups (students in final years of faculties specialized in mechatronics and integronics, practical instruction trainers/tutors and staff – interface between universities and commercial societies, for perfecting practical instruction contracts);
- ➢ databases structured on objectives/target groups;
- ➢ planning the instruction in target groups;
- ➢ development, implementation, modernizing and evaluation, counseling and professional orientation reports (body of counsels, programme of service, counseling and professional orientation);

- methodological and information documentations;
- strategies of counseling in the university environment;
- monitoring and annual evaluation reports;
- coercive measures programmes, measures of organizing practical training stages for students;
- partnership contracts between universities and commercial societies for practical training;
- body of tutors for practical training in the host enterprise;
- stages of practical instruction of students;
- reports of monitoring and evaluation of practical training stages;
- round table for experience exchange between partners;
- reports of external audit of the project:;
- etc.

4. GLOBAL INDICATORS

Output indicators:

- No. of tutors who will take part in the instruction: 21
- No. of studies, analyses, reports, strategies: 12
- No. of partnerships for experience exchange and good practices: 18
- No. of students aided in the transaction from school to active life: 360
- No. of beneficiaries of the services of career counseling: 400.

Results indicators:

- The share of aided students in the transaction from school to active life: 55%
- The share of persons who benefited from counseling/orientation and who found a job: 50%
- Persons who benefited from counseling/orientation and who continued their studies:

200.

Target group:

- Staff in enterprises with tutor abilities: 21
- Young graduates (in the first stage of the first relevant job): 100
- Young graduates: 100.

5. CONCLUSIONS

In conclusion, the current project aims at accomplishing the development objectives in Romania, with the view to reduce as fast as possible the gaps from the EU, by the development and the most efficient use possible of the human capital of Romania, complementarily to the EU strategy and the provisions of the reference National Strategy Framework 2007÷2013.

6. REFERENCES

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Investeste în oameni !

Proiect cofinanțat din Fondul Social European prin Programul Operațional Sectorial Dezvoltarea Resurselor Umane 2007-2013"

ELAN http:\\www.elan-romania.eu

ELAN, Promovarea Culturii Antreprenoriale: Adaptabilitate, Dinamism, Initiativă în Industria Electronică

ELAN - un proiect complex, prin care electroniştii vor învața gratuit să devină antreprenori de succes. Elan urmăreşte dezvoltarea spiritului antreprenorial şi inovativ în industria electronică din România. În proiect s-au implicat ca parteneri consultanți şi asociații importante din domeniul electronic: CETTI (Centrul de Electronica Tehnologica si Tehnici de Interconectare), AMCOR (Asociatia Consultantilor in Management din Romania), AROTT (Asociatia Romana pentru Transfer Tehnologic), SVASTA (cunoscută pentru activitatea în domeniile consultanței şi trainingului în special pentru ghidurile tânărului întreprinzător sau ale consultantului), APTE (Asociatia pentru Tehnologie si Internet) şi ARIES (Asociația Română pentru Industria Electronică şi Software).

Prof. dr. ing. Paul Şchiopu, CETTI, managerul proiectului ELAN**,** explică impactul pe care ELAN îl poate avea asupra industriei electronice: *„După un trend puternic descrescător în anii '90, am asistat în anii 2000 la o puternică revigorare a industriei electronice în România marcată de investiții precum Solectron, Celestica, Infineon, Nokia. Acum electronica este cel mai important factor de dezvoltare durabilă şi creativă generând 50% din brevetele de invenții la nivel mondial. În România suntem sub media europeană a domeniului pentru că am uitat să punem accent pe un singur lucru: spiritul antreprenorial. Iar aici intervine proiectul ELAN.*

Prin proiectul ELAN ne propunem nu numai să relansăm cultura inovării şi îi transformăm pe români în lideri de afaceri, dar şi să interconectăm toți actorii şi toate schemele de suport pentru promovarea inovării şi valorificarea rezultatelor cercetării autohtone din domeniu, rețelele de incubatoare de afaceri şi parcuri ştiințifice şi tehnologice, programele de suport tehnic şi tehnologic, programele de achiziții publice etc."

Proiectul este destinat tuturor celor dornici să reinventeze electronica din punct de vedere antreprenorial, dar în special studenților, tinerilor întreprinzători şi angajaților interesați de formarea continuă. El include:

- campanii de informare şi încurajare a antreprenoriatului
- organizarea de cursuri GRATUITE de formare antreprenorială
- servicii de consultanță, asistență şi suport tehnic şi tehnologic pentru afaceri noi
- instrumente electronice pentru analiza şi proiectarea afacerii
- o bursă pentru castigatorii concursului profesional „Tehnici de Interconectare in Electronica"
- sensibilizarea publicului la oportunitățile antreprenoriale şi problemele domeniului electronic în special cele legate de eficiența energetică şi poluare

Programul include **cursuri de formare atât în săli de curs din toată țara**, dar şi prin intermediul Internetului, prin **cursuri e-learning**, pentru a avea un impact national cât mai larg. Practic **programul este deschis tuturor celor interesați**, din orice zonă a țării, de orice vârstă sau apartenență socială. Organizatorii vor încerca să îl facă cât mai accesibil şi categoriilor defavorizate asigurând egalitate de şanse tuturor beneficiarilor.

Obiective:

Creşterea constientizării si promovarea atitudinii pozitive faţă de cultura antreprenorială; Incurajarea spiritului antreprenorial, prin creşterea numărului de participanţi la cursuri de formare antreprenorială pentru ca persoanele care doresc să înceapă o afacere în industria electronică sa înţeleagă locul şi rolul întreprinzătorului în dinamica pieţei, să fie în măsură să prevadă şi să soluţioneze probleme şi riscuri ce apar în derularea unei afaceri în industria electronică, să ştie unde şi cum să găsească asistenţă şi sprijin pentru a aplica ideile de afaceri;

Proiectul oferă:

A. Sprijin pentru persoane care doresc să iniţieze o afacere prin furnizarea de informaţii, consiliere şi îndrumare, formare antreprenoriala:

1. Serie seminarii „Initierea unei afaceri”

2. Ghidul întreprinzătorului

A fi sau a nu fi întreprinzător

Test psihologic pentru întreprinzători

12 aspecte de abordat de către fondatorul unei societăţi

Greşeli frecvente la înfiinţarea unei societăţi

Factori de succes pentru înfiinţarea unei societăţi

Aspecte juridice privind înfiinţarea unei societăţi

Planul de afaceri – instrument sau birocraţie?

Elemente iniţiale de marketing

Elemente de legislaţie fiscală, impozite şi TVA

Elemente de legislaţia muncii

Cum se poate finanţa afacerea mea?

Indicatori financiari relevanţi ai unei afaceri

Bugetarea activităţii curente şi a investiţiilor

Sisteme de control şi management al costurilor

Contabilitatea financiară – instrument sau birocraţie ?

Fluxul de numerar

Achiziţiile publice – cum se pot face afaceri cinstite cu statul

3. Cursuri de formare antreprenoriala online si clasice

Transfer tehnologic transnational

Formare antreprenoriala, marketing

Proiect management/atragere finantari

Certificarea firmelor conform standardelor ISO

Utilizarea tehnicii de calcul cu structura distribuita

Dezvoltare competenţe manageriale - joc de întreprindere

Cultura si managementul inovarii si calitatii”

4. Consultanţă management-marketing, organizare industrială pentru IMM (firme start-up, spinn-off)

Instrument de diagnosticare a afacerii, prin metode europene

- Intocmire plan de afaceri; ghid şi model de scriere a unui plan de afaceri
- Analiza pieţei de referinţă, analiza oncurenţă, segmentarea pieţei, selecţie piaţă, pozitionare în piaţă, strategii de intrare, strategii concurenţiale;
- Scriere de proiecte;
- Instrumente (matching tools) pentru realizare brokerage virtual (potrivire automată ofertă-cerere tehnologică după cuvinte cheie)
- Baze date cu oferte/cereri tehnologice

- Soluție financiară pentru dezvoltare – surse de finanțare -Informații despre apelurile deschise pentru IMM
- Proprietate industriala, Copy right

B. Suport tehnic şi tehnologic pentru formare personal şi/ sau lansare de produse noi de către firme start-up, spin-off

Cursuri online si training (cursuri scurte cu caracter practic) pentru actualizarea competențelor, tehnice şi tehnologice ale angajaților IMM din industria electronica

- Managementul proiectelor de dezvoltare a produselor
- Packaging Electronic
- Tehnologia de identificare prin unde radio – RFID. Aplicații
- Echipamente Radio Definite prin Program şi Virtuale
- Proiectarea pentru fabricatie - Design for manufacturing
- Structuri hardware si algoritmi specifici microsistemelor EMBEDDED
- Transfer Tehnologic si Inovare

Cursuri de instruire şi certificare pentru standarde IPC (instructori si specialisti)

- **CIT-610** Instruire si Certificare Instructor IPC in "Acceptabilitatea Ansamblurilor Electronice" adresat persoanelor cu sarcini de instruire din cadrul firmelor, personalului din serviciile de calitate, inginerilor de proces, etc.
- **CIS-610** Instruire si Certificare Specialist IPC in "Acceptabilitatea Ansamblurilor Electronice" adresat personalului care realizeaza inspectii ale aplicatiilor electronice, sefilor de puncte de lucru, inginerilor de proces, etc
- **CIT-600** Instruire si Certificare Instructor IPC in "Acceptabilitatea Cablajelor Neplantate" adresat persoanelor cu sarcini de instruire din cadrul firmelor, personalului din serviciile de calitate inspectii receptie materiale, inginerilor de proces, etc.
- **CIS-600** Instruire si Certificare Instructor IPC in "Acceptabilitatea Cablajelor Neplantate" adresat personalului din serviciile de calitate inspectii receptie materiale, inginerilor de proces, etc.
- **CIT-001** Instruire si Certificare Instructor IPC in "Cerinte pentru Ansamblurile Electrice si Electronice Lipite" adresat persoanelor cu sarcini de instruire din cadrul firmelor, personalului din serviciile de calitate, inginerilor de proces, etc.
- **CIS-001** Instruire si Certificare Specialist IPC in "Cerinte pentru Ansamblurile Electrice si Electronice Lipite" adresat personalului care realizeaza inspectii si interventii practice pe aplicatiile electronice, sefilor de puncte de lucru, inginerilor de proces, etc.
- **CIT-7711/7721** Instruire si Certificare Instructor IPC in "Reprocesari de Componente ale Aplicatiilor Electronice" adresat persoanelor cu sarcini de instruire din cadrul firmelor, personalului care face interventii curente pe aplicatiile electronice, inginerilor de proces, etc
- **CIS-7711/7721** Instruire si Certificare Specialist IPC in "Reprocesari de Componente ale Aplicatiilor Electronice" adresat personalului care face interventii curente pe aplicatiile electronice pentru reparatii, schimbari de componente, inginerilor de proces, etc.

Fiecare cursant care va absolvi cu succes cursul de instructor va primi:

- Certificatul de instructor, cu numar serial unic, eliberat de IPC;

- Standardul IPC conform programului, ultima versiune;

- Ghidul instructorului pentru clasa de CIS;

- Un CD cu fisierele de sustinere a orelor la clasa de CIS;

- Setul de intrebari pentru examenul final de CIS.

Fiecare cursant care va absolvi cu succes cursul de specialist va primi:

- Certificatul de specialist, cu numar serial unic, eliberat de IPC;

- Standardul IPC conform programului, ultima versiune;

Contacte:

Inscrieri doritori pentru cursuri e-mail: cetti@cetti.ro si : http://www.elan-romania.eu , .

Consultanta:Întocmire plan de afaceri; ghid şi model de scriere a unui plan de afaceri;Analiză piață de referință, Scriere de proiecte

Consultant Drd. Ec. Fuica Rosemari Contact Rose.fuica@apte.rog.ro Proprietate industrială, Copyright. **Consultant Victor Vulpe** Contact victor.vulpe@cetti.ro

Consultanță în managementul proiectelor CDI;Consultanță pentru utilizarea tehnicii specifice electronicii tehnologice; Consultanță pentru introducerea şi utilizarea tehnologiilor specifice electronicii tehnologice.

Consultant Ioan Plotog Contact ioan.plotog@cetti.ro **Consultant Gaudentiu Varzaru** Contact Gaudentiu.varzaru@cetti.ro **Suport tehnic:** Echipament Repair & Rework PDR X410; Cuptor Zephir SMRO-0252; Camera Climatică ESPEC SH-241; Etuvă termostatată CALORIS; Aparat inspecţie optică DIMA VC 3011; Aparat de inspecţie optică Miscope Pulsar MV40; Frezare PCB LPKF Protomat M100 – HF; Dispense Solder paste ASYMTEC A-6126; Pick & Place automat SAMSUNG CP20CV; Printer solder paste DEK260; Pick & Place manual DIMA SMFL3000; Stații lipit Weller PU81; Stații lipit SGS-2505; Cuptor PICCOLO DIMA-054; Cameră termoviziune SC640-FLIR SYSTEM;

Suport tehnologic:

Proiectarea pentru fabricaţie a modulelor electronice DFM; Proiectare tehnologică PCB; Tehnologia de lipire ecologică fară plumb la val; Tehnologia de lipire ecologică fară plumb utilizând cuptoare cu radiaţie şi convecţie; Tehnologia de lipire ecologică fără plumb în stare de vapori; Tehnologia de asamblare PIN-IN-PASTE; Tehnologii de asamblare manuală şi semiautomată a modulelor electronice; Tehnologii de plantare semiautomată şi automată a componentelor electronice; Tehnologii de depunere pastă de lipit; Tehnologii de inspecţie optică; Tehnologii de interconectare tip WIRE BONDING; Tehnologii de management termic prin termoviziune; Tehnologii de încercări mecano-climatice.

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COMUNICATORII DE ŞTIINŢĂ. NECESITATE ŞI ROL ÎN CADRUL ENTITĂŢILOR REŢELEI NAŢIONALE DE INOVARE ŞI TRANSFER TEHNOLOGIC

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ABSTRACT
This paper intends to be a brief argumentation for the necessity of the communicattors of science as a new service for the Romanian science. There will be presented their necesity and their role and the advantages of their activities in the entities of the National Network for Innovation and Technological Transfer from Romania.

1. Introducere

Până spre mijlocul secolului trecut, ideologia scientistă conferea explicaţiilor, soluţiilor şi realizărilor oferite de ştiinţa vremii autoritate absolută. Nu se punea problema contestării, iar costurile şi consecinţele nu alarmau societatea. Oamenii de ştiinţă comunicau în general *ad intra* - cu ocazia diferitelor manifestări specifice domeniului propriu de activitate. O serie de factori, cum ar fi: schimbarea configuraţiei politice mondiale, apoi explozia mass-media şi, în cele din urmă, procesul de globalizare în expansiune precum şi unele efecte nedorite ale revoluţiei tehnico-ştiinţifice ca: apariţia şi utilizarea armelor nucleare, poluarea, creşterea fondurilor alocate cercetării au obligat comunitatea ştiinţifică să-şi prezinte realizările, punctele de vedere, solicitările şi opţiunile sale din ce în ce mai mult *ad extra*, prin modalităţi care s-au diversificat odată cu evoluţia mijloacelor de comunicare.

Interesul crescând pentru cunoaşterea ştiinţifică, necesităţile mediului economic şi de afaceri au evidenţiat necesitatea fluidizării comunicării între specialiştii din diverse domenii, pe de o parte şi între aceştia şi nespecialişti, pe de alta, favorizând apariţia de noi specializări interdisciplinare: comunicatorii şi jurnaliştii de ştiinţă.

2. Situaţia din ţara noastră

După cel de-al dolea război mondial, în România s-a menţinut ideologia scientistă, totalitarismul comunist favorizând poziţia ştiinţei de a oferi singurele adevăruri şi soluţiile viabile, permanent perfectibile, de rezolvare a problemelor societăţii toate acestea consonand cu ateismul declarat al regimului. Dirijismul s-a manifestat în special prin modul diferit de susţinere a diverselor domenii de activitate ştiinţifică. Accentul a fost pus pe dezvoltarea ştiinţelor inginereşti în scopul dezvoltării ţării în direcţiile hotărâte a fi prioritare de către factorul politic. Comunicarea ştiinţei era unilaterală, axată fiind pe popularizarea rezultatelor, de multe ori în mod propagandistic sau polemic, în încercarea de a prezenta într-o lumină favorabilă sistemul politic.

Evenimentele din decembrie 1989 au determinat transformări radicale şi în ştiinţa românească. Tranziţia a condus la un nou evantai al ştiinţelor, situaţia economică şi opţiunile politice şi-au pus amprenta asupra modului de coordonare şi finanţare a cercetării.

La nivelul organizaţiilor de cercetare-dezvoltare, lipsa de abilităţi necesare prezentării rezultatelor şi problemelor proprii

distorsionează atât imaginea proprie cât şi a domeniului de activitate, împiedicând comunicarea cu mediul economic şi de afaceri precum şi cu societatea. Sunt favoritzate astfel tendinţele de subfinanţare a acestui domeniu de activitate umană, de minimalizare a rolului pe care ştiinţa îl poate avea în societatea şi economia românească.
La rândul lor, mass-media din ţară (cu foarte puţine excepţii) nu dispun de jurnalişti specializaţi în ştiinţă pentru a prezenta realităţile existente, preferând uneori senzaţionalul ieftin în locul unor anchete, reportaje şi interviuri profesioniste.
Evoluţiile din ultima perioadă au evidenţiat, implicit sau explicit, necesitatea comunicatorilor şi jurnaliştilor de ştiinţă în spaţiul serviciilor pentru cercetare din România, respectiv în mass-media.

3. Comunicarea ştiinţei şi Reţeaua Naţională de Inovare şi Transfer Tehnologic

În contextul economic românesc, date fiind condiţiile globale actuale, dar şi de perspectivă, ieşirea din criză presupune comunicarea fluentă între mediul ştiinţific şi cel economic şi de afaceri, între comunitatea ştiinţifică şi societate.
În ultimii ani, în ţara noastră a început să se dezvolte infrastructura de inovare şi transfer tehnologic. ***Reţeaua Naţională de Inovare şi Transfer Tehnologic*** integrează principalii actori din domeniul transferului de cunoştinţe şi tehnologie la nivel naţional (20 centre de informare tehnologică, 14 centre de transfer tehnologic, 16 incubatoare tehnologice şi de afaceri, 4 parcuri ştiinţifice şi tehnologice) fiind prezentă în toate regiunile de dezvoltare ale ţării.
După cum se poate observa din obiectivele entităţilor enumerate mai jos, la nivelul ***acestora*** sunt prevăzute a se desfăşura activităţi de comunicare a ştiinţei**:**
- creşterea vizibilităţii organizaţiilor de cercetare dezvoltare;
- creşterea gradului de valorificare a rezultatelor cercetării;
- îmbunătăţirea relaţiilor între unităţile de cercetare dezvoltare şi agenţii economici şi respectiv, între unităţile de cercetare dezvoltare şi societate.

La realizarea lor, comunicatorii de ştiinţă se pot implica prin:
- promovarea imaginii organizaţiilor de cercetare dezvoltare oferind informaţii structurate conform solicitărilor mediilor interesate;
- prezentarea rezultatelor activităţilor de cercetare dezvoltare în cadrul unor manifestări şi evenimente stimulând încheierea de noi contacte şi parteneriate;
- facilitarea comunicării şi a transferului de cunoştinţe şi tehnologii cu agenţii economici, informarea societăţii în probleme legate de activitatea de cercetare-dezvoltare.

Totodată, feed-back-ul activităţii comunicatorilor de ştiinţă poate constitui o sursă de informaţii extrem de utilă atât pentru unităţile de cercetare-dezvoltare, cât şi pentru entităţile de inovare şi transfer tehnologic în sensul unei mai juste şi rapide corelări a activităţii lor cu problemele concrete şi imediate ale economiei şi cu aşteptările societăţii.
Prin urmare, entităţile Reţelei Naţionale de Inovare şi Transfer Tehnologic oferă cadrul optim de desfăşurare a activităţii comunicatorii de ştiinţă pentru spre folosul activităţii şi comunităţii ştiinţifice, al economiei şi al societăţii în general.

4. Formarea comunicatorilor de ştiinţă

Formarea comunicatorilor de ştiinţă se poate realiza în două moduri:
1. pentru necesităţile imediate ale comunităţii ştiinţifice, considerăm că o colaborare între entităţile *Reţelei Naţionale Inovare şi Transfer Tehnologic* şi unităţile de învăţământ superior şi cele de formare continuă acreditate în domeniul comunicării poate conduce la crearea de consorţii interdisciplinare
2. pentru necesităţile pe termen lung, la nivelul unităţilor de învăţământ superior acreditate în domeniul comunicării se pot elabora programe de masterat prin care să fie formaţi viitorii specialişti în comunicarea ştiinţei.

În paralel, prin aceleaşi modaliăţi se poate demara şi formarea jurnaliştilor de ştiinţă specializare profesională, după cum am menţionat deja, de asemenea deficitară în România şi constituind o verigă deosebit de importantă în procesul de comunicare cu societatea.
De curând, la workshop-ului *Jurnalism ştiinţific şi comunicare* din cadrul Conferinţei ”Diaspora românească în cercetarea ştiinţifică şi învăţământul superior”, specialiştii români în domeniul comunicării care activează în străinătate şi-au exprimat disponibilitatea de colaborare cu cei din ţară în cadrul unor proiecte transnaţionale în domeniu.

5. Concluzii

În final, considerăm de mare importanţă apariţia comunicatorilor de ştiinţă în principal şi a jurnaliştilor de ştiinţă în secundar. Aceşti „porta-voce” ai mediului ştiinţific, respectiv ai societăţii pot conduce la mai buna înţelegere a rolului ştiinţei în societate, la o regândire a raporturilor între mediile ştiinţific, economic, de afaceri şi societate, la o apropiere între unităţile de cercetare-dezvoltare, IMM-uri şi autorităţile publice.

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[1)]INOE 2000 IHP

Rezumat
Articolul prezintă o idee de turbină antrenată de vânt, utilizată pentru acționarea unor mecanisme diverse, cum ar fi generatoarele de curent electric, morile de măcinat sau pompele de apă, care poate să realizeze o turație constantă, indiferent de variația vitezei vântului.
Articolul se bazează pe o cerere de invenție înregistrată la OSIM în anul 2010, de către INOE 2000 IHP București.

1.Introducere

Dezvoltarea durabilă a societății umane, impune de la sine căutarea altor surse de energie, nebazate pe funcționarea combustibililor fosili, care vor fi până la urmă epuizați.

Cercetărilă tehnologice ale oamenilor de știință în domeniile aplicative se orientează tot mai mult, către sursele de energie așa zise neconvenționale, cum sunt : soarele, vântul, energia geotermală sau energia potențială a apelor, care, se înțelelege, trebuie tot mai mult exploatate.

Aceste surse de energie, nepoluante, au fost cunoscute, dar puțin utilizate, de către oameni încă din timpuri străvechi.

Dacă apele curgătoare puteu învârti morile de măcinat și ulterior antrenau turbinele hidrocentralelor electrice, vânturile, preponderente în unele zone de pe Pământ, antrenau tot așa morile de măcinat sau puneau în mi8șcare corăbiile cu pânze.

Descoperirea potențialului electric de către om și a posibilelor utilizări ale sale, a condus la căutarea de surse energetice pentru producerea lui, apărând astfel centralele electrice, împărțite, în principal, în trei mari categorii:

- termocentralele, care utilizează, cărbune, păcură sau gaze naturale;
- hidrocentralele care utilizează energia potențială a apelor curgătoare, acumulată în lacuri, formate pe cursurile de apă de către baraje construite de om;
- centrale nucleare, care utilizează uraniu îmbunătățit.

Toate aceste tipuri de centrale electrice au dezavantajele lor cum sunt:

- termocentralele sunt poluante și utilizează combustibili care până la urmă se vor termina;
- hidrocentralele pot acoperi doar vârfuri de sarcină, debinzând de debitele cursurilor de apă,
- centralele nucleare produc reziduri radioactive periculoase pentru om și natură.

Sursele de energie neconvenționale (soare, vânt, geotermală) sunt complet „curate” și pentru noi practic inepuizabile.

Însă sistemele de captare și transformare sunt deocamdată scumpe, dar reprezintă o alternativă viabilă pentru societatea umană, care, în secolul XXI, se întrevede că va intra în „foame” de energie.

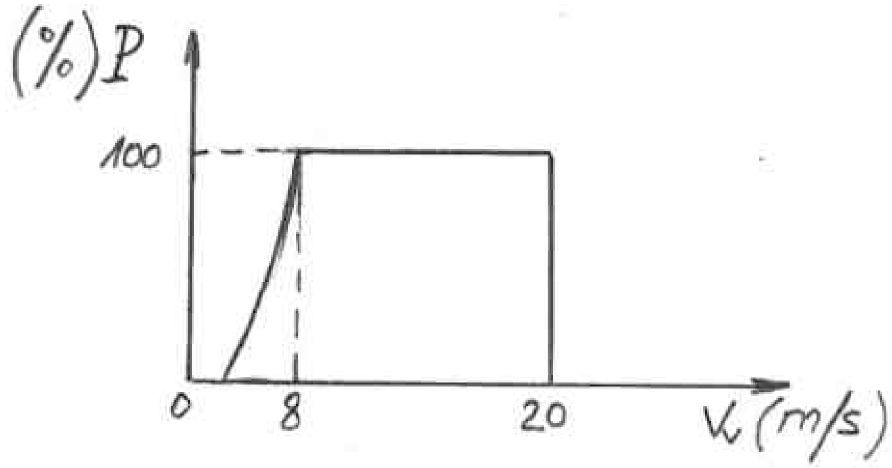
2. Sisteme de turbine eoliene

Zonele cu vânturi dese (peste 200 250 de zile pe an cu vânt moderat) se pretează la parcuri eoliene pentru producerea de curent electric.

În general o centrală eoliană se compune dintr-un stâlp de susținere, care poate ajunge și la zeci de metri, pe care se găsește montată o turbină, de regulă cu trei palete; mai conține o transmisie mecanică sau de altă natură, un regulator de turație și un generator de curent electric, care la centralele mari este poziționat jos pe sol, dar care poate fi și sus pe stâlp la centralele mici.

Problema generală a turbinelor eoliene este aceea că nu pot menține o turație constantă la axul lor, aceasta depinzând de viteza vântului, peste care se suprapune și asigurarea integrității ei la depășirea unei viteze critice a vântului.

Experimental s-a aflat diagrama de funcționare a turbinelor eoliene care arată ca mai jos:



Așa cum se vede, domeniul optim de funcționare se află între 8 și 20 m/s, viteză a vântului.

În lume există două soluții principale prin care se controlează turația turbinei:

- un sistem care poate să scoată partțial sau total turbine de pe direcția vântului;
- un alt sistem care menține turbina pe direcția vântului, dar îi transmite turația printr-o acționare hidraulică reglabilă.

Ambele au două mari inconveniente: scumpesc foarte mult întreaga insatalație și nu asigură integritatea centralei la viteze foarte mari ale vântului.

3.<u>Soluția nouă</u>

Soluția tehnică propusă de INOE 2000 IHP , care face obiectul cererii de brevet de invenție nr. A/0074, din 16.08. 2010, prezintă o turbină eoliană cu trei palate, care își pot modifica unghiul de înclinare față de ax , printr-un mecanism propriu, ce poate reacționa la variația vitezei vântului în intervalul optim de funcționare și care la depășirea vitezei maxime de siguranță, așează paletele în lungul axului turbinei, aceasta oprindu-se.

Se prezintă în figurile 1 și 2 construcția turbinei eoliene, reperele componente fiind următoarele:

1- cap de antrenare;
2- axe danturate;
3- inele elastice de siguranță;
4- palete;
5- șuruburi de fixare;
6- cremalieră multiplă în piston;
7- arc elicoidal conic;
8- inel elastic;
9- garnitură.

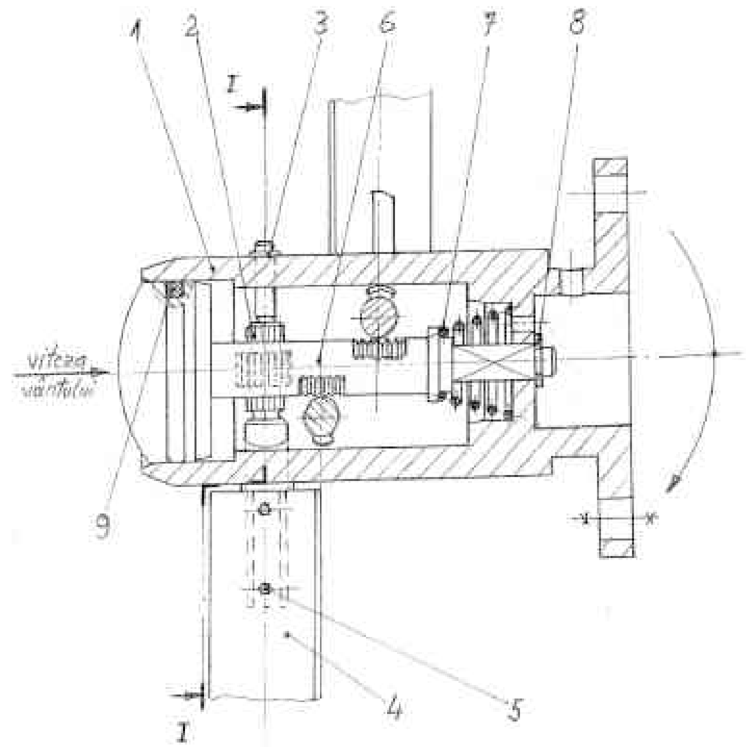


Fig.1

Secţiunea I-I

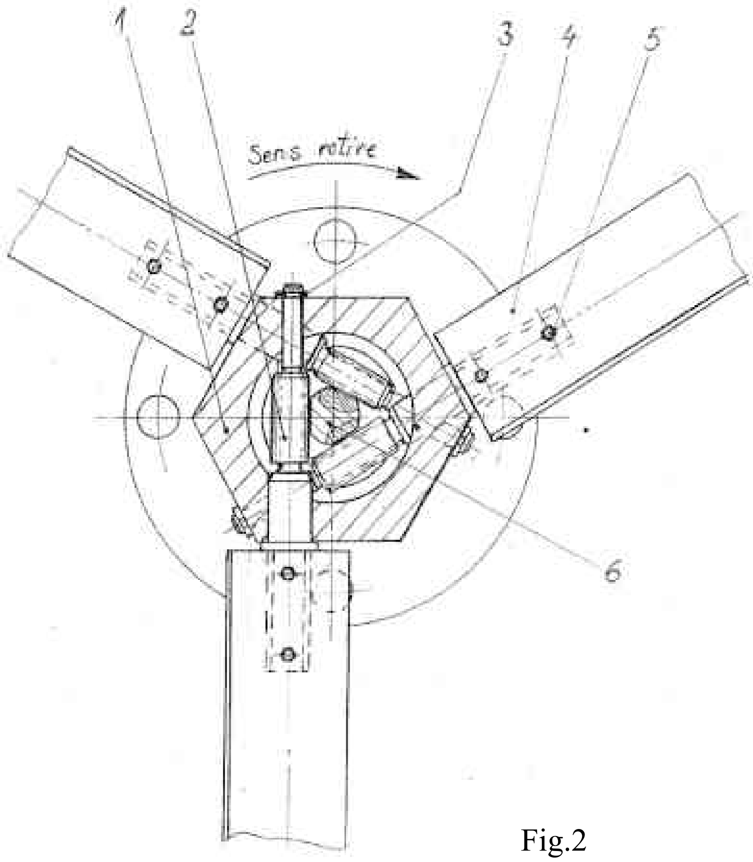


Fig.2

Modul de funcționare este următorul:
- la regimul sub optim (viteza vântului ≤ 8m/s), paletele nu își schimbă unghiul, întrucât presiunea dinamică a vântului ($p_v = 1/2\rho_a \times Vv^2$), nu poate egala sau depăși, prin apăsare pe poziția 6, forța realizată de arcul, poziția 7. În relația de calcul dintre paranteze, notațiile au următoarea semnificație:

p_v presiunea dinamică avântului;
ρ_a densitatea aerului;
V_V - viteza vântului.

- la regimul optim (viteza vântului cuprinsă între 8 și 20 m/s), presiunea dinamică a vântului este capabilă să deplaseze spre interior pistonul poziția 6, care prin intermediul axelor danturate 2, care se rotesc, modifică unghiul de așezare al paletelor poziția 4, în așa fel încât să păstreze o turație relativ constantă a turbinei.
- când viteza vântului depășește 20 m/s, unghiul de așezare al paletelor crește la valoarea de 90° și turbina se oprește.

Se prezintă în fig. 3, diferite poziții ale paletelor turbinei eoliene, în raport cu diferite valori ale vitezei vântului, unde notațiile au următoarea semnificație:

V_v - viteza vântului ;
V_r viteza de rotire a turbinei;
α_0 ungiul inițial de așezare a paletelor;
α_i - ungiul intermediar de funcționare;
α_r unghiul de modificare intermediară;
α_f unghiul final de așezare a paletelor, la care turbina se mai învârtește.

Turbina eoliană, conform invenției, prezintă următoarele avantaje:
- are de la sine turație relativ constantă;
- se opreșpte în condiții de siguranță și e menținută pe direcția vântului;
- are o construcție simplă, cu un preț de cost redus.

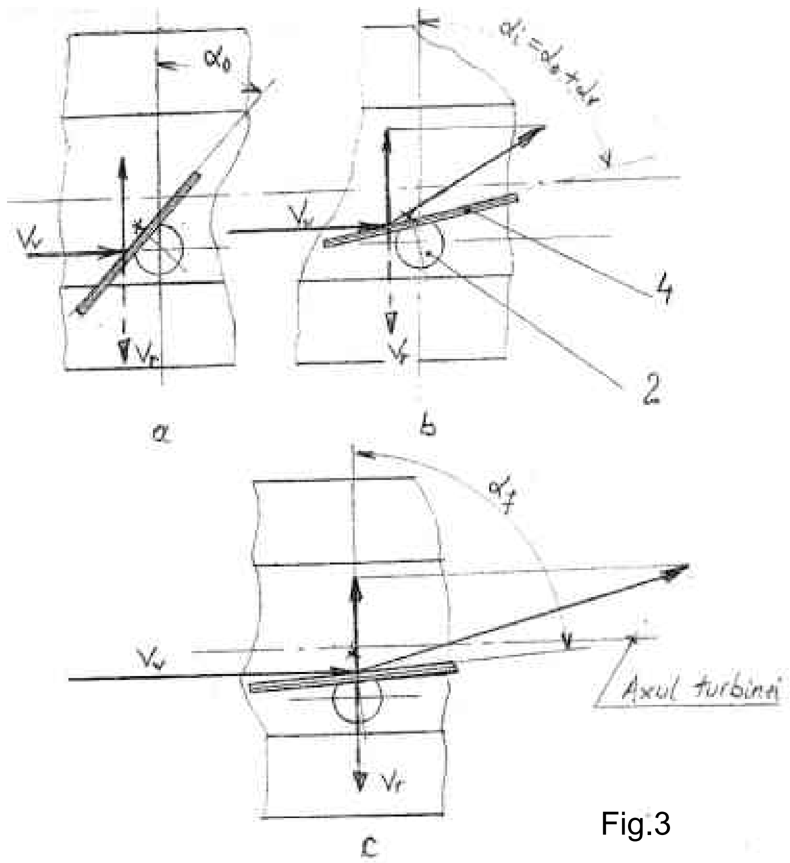


Fig.3

THE EURO-QLIO PROJECT: AN EXAMPLE OF E-LEARNING PLATFORM USED IN ORDER TO IMPROVE THE EDUCATIONAL PROCESS IN THE FIELDS OF QUALITY, METROLOGY AND LOGISTICS

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Abstract:
The paper presents an educational platform developed in order to improve the education process and the professional development in the fields of Quality, Metrology and Industrial Logistics, in the frame of the Erasmus project EURO-QLIO. The educational platform is based on two components: a virtual campus establishment and issuance of triple recognition diploma.

Keywords: virtual campus, e-learning, quality, metrology, logistics

1. EURO-QLIO – HISTORY OF THE PROJECT

In spring 2007, the project proposal „Filière Euro Qualité Logistique des Organisations” (acronym EURO-QLIO) was submitted in the competition of European Program ERASMUS. This project was built to ensure the preparation and conduct of the partnership for employment training in the field of Metrology, Quality Control and Organization Logistics. The partnership was established through the involvement of three renowned universities from three different countries: „Henri Poincaré” University from Nancy, France (project coordinator), "POLITEHNICA” University of Bucharest, Romania, and "Angel Kanchev” University from Rousse, Bulgaria. The Romanian company “SC Marco & Alex Instalații Frig SRL” was chosen as industrial partner.

The project was approved and was launched in October 2007. The total budget was 446.733 €, of which 300,000 € funding from the European Community (67,15%) and the duration was of 24 months. Its main goal was to achieve a platform for distance learning in the field of Metrology, Quality Control and Organization Logistics, endorsed on two very important components: establishment of a virtual campus, on the one hand, and issuance of a diploma with triple recognition, on the other hand. In order to reach the preset objective, the different partners have been working simultaneously on the organizational, institutional, pedagogical, technological and international axes.

The distance learning platform was developed as to enhance the students exchanges between the partners, to promote the cooperation between teachers and, thus, to increase the mobility of each partner. Also, an extension of the project by co-opting new partners was intended, so that the EURO-QLIO project would become a reference at European and international level in terms of education quality.

The project was based on the new paradigm of the information society by integrating the objectives of long-term development such as: equal chances, social justice, ecological protection, movement freedom, cultural diversity and innovative development, reorganization of industry and business environment.

The web page of the project is presented in figure 1.

Fig.1. *Web page of the project*

2. TRAINING AND ASSESSMENT IN THE FRAME OF THE PROJECT

The main objective of the EURO-QLIO project was to improve the quality of education in the field of mechanical engineering among the three partners. The following aspects were concerned: the exchange of teachers and students among the partner universities, the development of collaboration between teachers, the increase of partners' mobility in the process of higher education.

By applying the traditional way of teaching, the student can have a dialog with the teacher and colleagues in his native language, during the course and after reading the materials available on the online platform. In case that the support course needs to be modified, it can be done very quickly in each of the four languages (English, French, Romanian and Bulgarian). Also, the student can be helped by his colleagues through team work using the software tools.

A diploma with triple recognition is given to the students when they graduate the learning modules coordinated from distance by the teaching teams belonging to each of the partner countries, France, Romanian and Bulgaria. The diplomas obtained after going through the different learning stages are recognized by each partner due to the fact that the particularities of the national teaching system are eliminated by introducing virtual mobility both for students and teachers.

The teaching staff consists of teachers and faculty from all three countries. Their role is to assist students in their learning through mentoring modules E-learning Distance Education (EAD). The tutoring module is assigned to teachers from partner universities at the beginning of the academic year. The language of study is English, but EURO-QLIO students may also receive course materials in French, Romanian and Bulgarian.

The teaching activity is designed by a team of teachers formed from all three universities involved in the project, based on the following activities: establishing the teaching objectives; investigation of existing educational resources; setting the team of teachers; establishing the content; applying the methodology; ensuring evaluation of the teaching activity. For each group of students a tutor from each of the partner universities is appointed.

The practical training is performed either inside industrial units with similar profile (industrial logistics) or inside partner universities, by transferring software for the applications etc.

The evaluation/verification methods together with the teaching and learning ones are part of the teaching process. The evaluation methods may be different depending on the procedures, techniques used and on the examination forms they are integrated in. The evaluation methods may be as follows:

- Oral examination – free presentation, evaluation conversation, oral examination of the student, the interview – they are all difficult to initiate in the virtual campus though lately the information technology and especially voice over IP type techniques have considerably reduced the consumption of resources.
- Written examination – the theme and verification data can be published on the web page of the course, and the material accomplished by the student can be uploaded on the same page by conditioning the access to be configured in such manner that only the professor shall have access to see and download them. The evaluation instruments and tools are as follows: essays, medium and long term projects, written studies, current written studies (in the seminaries), final evaluation written studies (in the examination session), evaluation questionnaires, report papers, portfolios, etc.
- Applicative examination – consists of applicative studies and laboratory practice, projects, observing and analyzing practical activities carried out by students. This type of verification cannot be implemented for the virtual campus; therefore we shall use classical teaching and verification method within the new method, with the advantage of permitting a flexible working program, teaching and performing the applicative studies.
- Tests or knowledge tests, hand-written or electronically (online). This evaluation method has been one of the first methods initiated for a distance learning platform. The advantage of using e-learning platforms is the usage of alternative evaluation possibility: true-false, equivalence, multiple choice, completion and short answers.

There are three types of evaluations: initial evaluation, continuous evaluation (formative) and final evaluation (summative).

The methods of control knowledge are defined for distance education and those in attendance:

1. For distance education, the teaching team defines scores for each element concerned. Scores are provided in two forms:

    Remote evaluations (online) that can be summaries of lectures, exercises online, etc.

    Evaluations in presence, in the form of one or more individual events and monitored under the responsibility of each university.

2. For lessons in class, each component is subject to individual events monitored and reports of practical work where appropriate.

The evaluation criteria are intended to ensure a direct relation between the performance levels of the students and the evaluation level appointed by grades or qualificatives and by resolution of the qualificative system in order to obtain an objective element to compare the grades collected at different disciplines, for different students, at different evaluation forms and/or by different professors. These evaluation criteria are decided by a coordination group for the pedagogical activities of the EURO-QLIO project, taking into consideration the specific features of each country.

The teaching team meets in the subcommittee to consider the results obtained by students at the end of each semester. The EURO-QLIO responsible proposes, on the basis of the obtained results, the validation or not of the teaching units according to the rules of allocation of each program. Each university may then validate or not the teaching units, the training and decide on the awarding of his degree. The teaching units are validated to obtain the ECTS for a semester.

The personal and professional project is an integral part of training. It is inherently highly trans-disciplinary, assuming control of methods of expression, promoting the acquisition of knowledge relating to business opportunities as a degree.

If the personal and professional project presents challenges in guidance, it must also allow greater ownership of experiences in a professional experienced by students (internships, projects, tutors, etc.).

3. THE E-LEARNING PLATFORM

In order to assure a long-term project, the partners have been particularly careful about the technological aspects. In reference to various international norms and standards, they have searched for technical solutions efficient and scalable in the long term. Considering the requirements mentioned above, two systems were selected: MOODLE as the e-learning platform and SCENARI to produce the necessary pedagogical resources. The latter specifically enables to design the editing network, optimizes the costs and ensures the quality of the resources.

A screenshot of SCENARI is presented in figure 2.

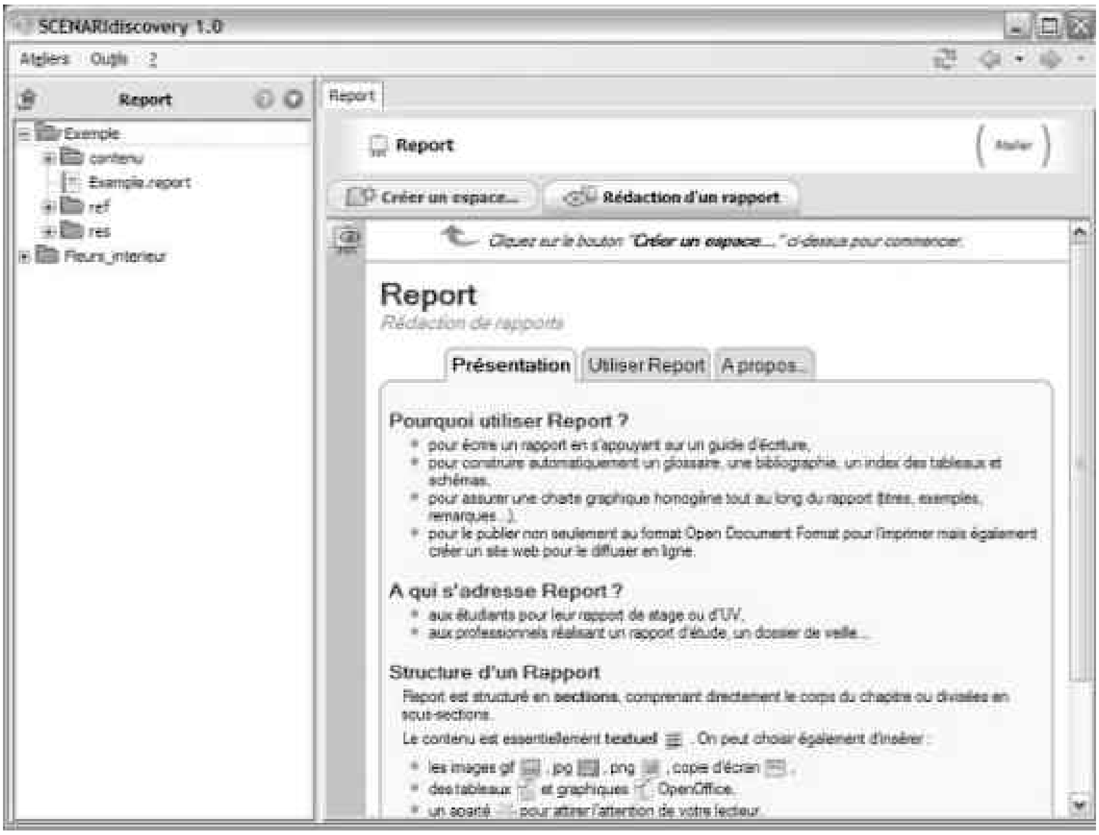

Fig.2. *Screenshot of SCENARI*

Generally, a virtual learning environment is developed to provide many of the characteristics of a traditional learning environment. The balance between the online and the face-to-face is the essence of the “blend” and is in a natural way situated at equilibrium. An e-learning tool may provide learning and teaching resources such as searchable online, study guides and digital lecture materials, video, discussion boards (both for general communication and for online collaboration for teaching and learning), and assessment. It may also provide administrative and logistical systems such as student records, student recruitment (even maybe online registration and payment of fees), assessment feedback and results, interactive and personalized scheduling and timetabling, and allocation and grouping support.

In terms of information resources, the virtual campus (fig. 3) is composed of:

- database, usually a relational data base which allows data recording and also its monitoring, accessing and documenting;
- integrated software space, which includes small codes or micro software tools;
- dynamic presentation environment, formatted data presentation through interrogation in a detailed, vivid and descriptive manner;
- audio and video environment for data transmission.

The design of the training activity involves management, ordering and correlation of the support course of each of the partner countries. The support course will be taught, learned and evaluated at the functional level between teacher and student, in order to provide the same knowledge and abilities in each of the three universities.

A problem that must be considered, due to heterogeneous teaching processes belonging to each country, is how the teaching process can be achieved: defining the teaching objectives; establishing the content; applying the methodology; ensuring the evaluation of teaching and learning activities. To solve this problem the teachers must communicate between them using the resources provided by the virtual campus and mobility programs, absolutely necessary for leading the work groups.

Designing the teaching process is based on the concept of work package. In fact it is a logic and semantic group of disciplines.

Each work package is coordinated, controlled and organized by a responsible and each team involved in a work package aims for research, theorization and implementation of training strategies. Inputs and outputs are associated to each work package.

The work package structure of the project is presented in figure 4.

4. CONCLUSIONS

The ERASMUS project EURO-QLIO is a European program of training (bachelor, master and doctorate) in the field of Mechanical Engineering, aiming the quality assurance process. It meets the needs of the labor market through the implementation of the transversal theme of a transnational pipeline in the field of Metrology-Quality Control by the internationalization of the learning process continues throughout the long life, using a virtual campus, and the creation of a joint partnership which also includes the offer of university education and the need of the industry.

A diploma with triple recognition is given to the students after they graduate the learning modules coordinated from distance by the teaching teams belonging to each of the partner countries, France, Romania and Bulgaria. The diplomas obtained after going through the different learning stages are recognized by each partner due to the fact that the particularities of the national teaching system are eliminated by introducing virtual mobility both, for students and teachers.

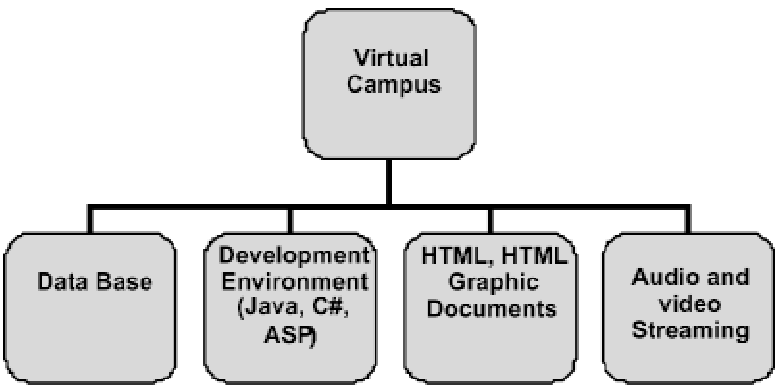

Fig.3. *Components of the virtual campus*

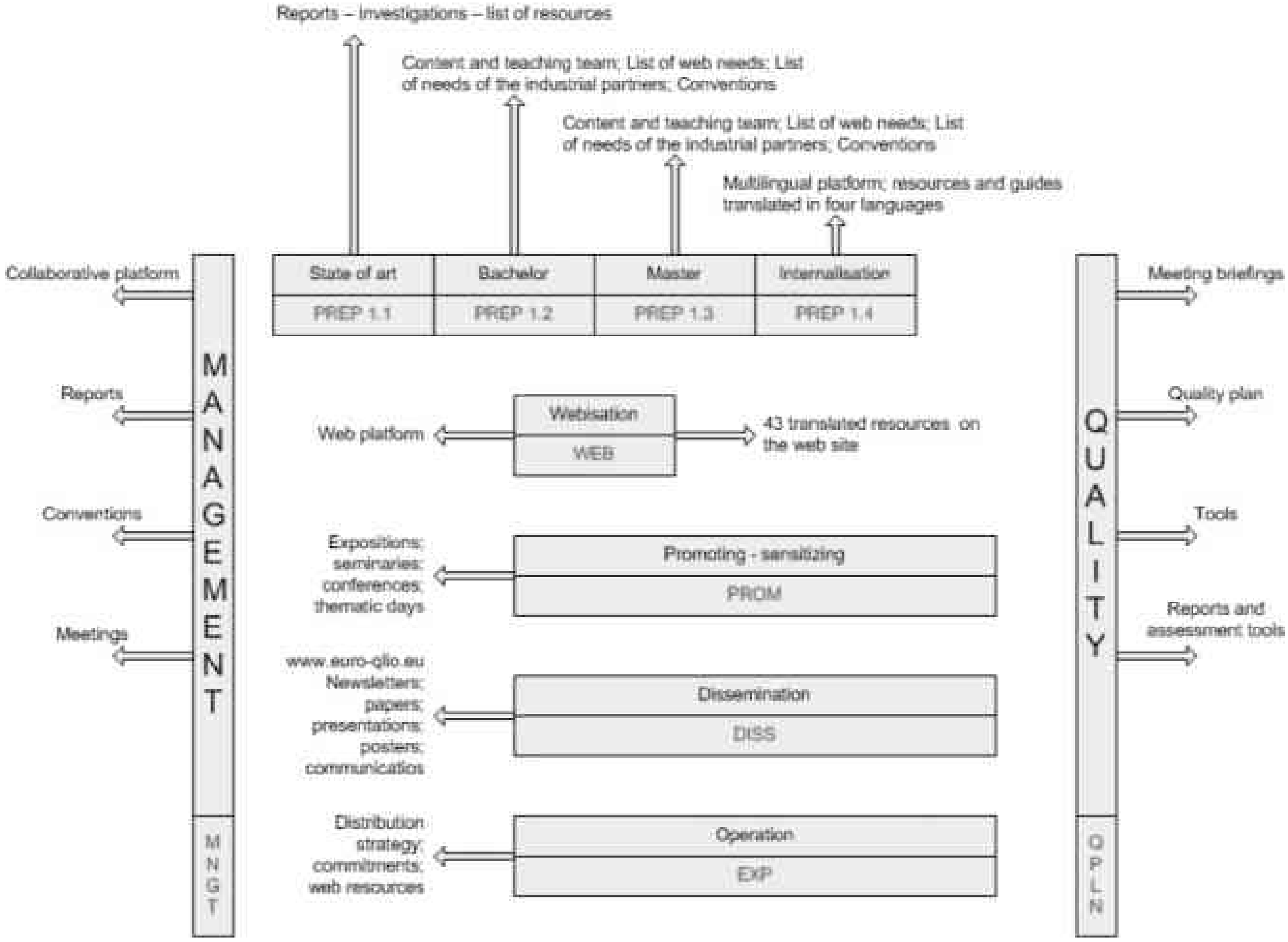

Fig.4. The work package structure of the EURO-QLIO project

A very important feature of this project is that it involves joint learning. Through joint learning both classical and modern ways of teaching are used. “Face to face” participation meets distance learning, each of them having their particular role.

ACKNOWLEDGMENT

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CALITATEA CA OBIECTIV AL ACTIVITĂȚII MANAGERIALE

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Rezumat. Oamenii trăiesc într - un mediu în care lucrează, fiind legați de şcoli, universități, primărie, magazine, teatre, cinematrografe, restaurane, agenții, fundații, biserici, cluburi sportive, etc. Toate acestea reprezintă organizații care permit vrearea unui portofoliu larg de activități şi specializări pentru a produce bunuri, servicii şi informații care să contribuie la crearea unei vieți mai confortabile, interesante pentru fiecare individ în parte din societate.

Prestigiul unei societăți comerciale se bazează pe principalele elemente ale competitivității: calitate, fiabilitate, distribuție, preț. Conceptul de calitate este cel mai important, deoarece prin calitate, societatea comerciala îşi clădeşte o reputație bună sau rea, iar reputația are amploare şi durabilitate, de aceasta depinzând însăşi supraviețuirea societății.

Pornind de la obiectivele calitatii se dezvolta cu obiectivitate managementul strategic al calitatii, costurile si bilantul calitatii, obiectivele calitatii. In final se dezvolta benchmarkingul calitatii si tipurile de benchmarking. Un capitol important este destinat diagnosticului calitatii ca metoda de expertiza a calitatii. Diagnosticul calității este o acțiune de investigație dusă asupra unei părți dintr-o organizație. Scopul său este de a ameliora competitivitatea organizației.

De aici rezulta ca auditul şi diagnosticul pot lua mai multe forme, în funcție de obiectivele căutate.

Key words: Managementul strategic al calitatii, Costul calitatii, benchmarking si braistorming, auditul si diagnosticul calitatii.

1.1. Managementul strategic al calității

Managementul strategic al calității este procesul de stabilire a unei game largi de obiective, respectiv de a defini modul de abordare a activității de atingere a acestor obiective. Managementul strategic al calității este dezvoltat, implementat şi condus de către managementul de vârf.

Plecând de la elementele de bază ale planificării strategice, se poate introduce indicatorul de calitate, realizându-se Managementul Strategic al Calității.

Termenul de "STRATEGIE" folosit în afaceri descrie drumul, direcția pe care trebuie să-l urmeze o organizație pentru a-şi atinge scopul. Strategiile trebuie să fie identificate corespunzător fiecărui nivel organizațional, putând fi clasificate în funcție de scopul pe care-l urmăresc.

Ciclul clasic managerial având originea în Franța anilor 1920 presupune cinci funcții: *planificare, organizare, comandă, coordonare şi control.*

Elementele ciclului managerial includ:

- ✐politici şi obiective pentru calitate;
- ✐descrierea amănunțită a obiectivelor;
- ✐planuri pentru atingerea obiectivelor;
- ✐structura organizatorică;
- ✐resurse, reacția inversă (feedback) pentru măsurare;
- ✐verificarea stadiului de progres, pregătire, perfecționare.

În procesul de *Management Strategic*, rezultatele analizei de mediu sunt folosite pentru a stabili direcția în care se va îndrepta organizația în viitor, după care vor fi înştiințați membrii organizației prin intermediul declarației privind misiunea şi al obiectivelor înrudite şi a-i îndruma în privința accentului pus pe calitate.

Ciclul evenimentelor unui Management strategic se prezintă astfel:
- ✐ managementul de vârf determină filosofia companiei, misiunea obiectivelor şi strategia organizaţională;
- ✐ la nivelul fiecărei organizaţii trebuie să existe un departament de programe cu rol de asistare a strategiei de cooperare în afaceri;
- ✐ fiecare strategie de cooperare în afaceri trebuie să dezvolte un plan strategic şi bugetele pentru fiecare zonă funcţională;
- ✐ pentru fiecare zonă funcţională, managementul devine parte integrantă a procesului managerial strategic.

Instrumentele pe care managerii le folosesc în mod obişnuit pentru a implementa strategiile privind calitatea produselor sunt politicile şi structura organizatorică.

Referitor la structura organizatorică a managementului strategic, Juran arată că *"pentru a ajunge la ritmuri revoluţionare de îmbunătăţire a calităţii este nevoie de o structură organizatorică specială".* El a propus înfiinţarea unui "consiliu al calităţii", care să fie alcătuit în mare parte din managerii de vârf, pentru a îndruma şi a coordona eforturile de îmbunătăţire a calităţii întreprinse de firmă.

Controlul strategic pune accentul pe monitorizarea procesului de management strategic pentru a verifica dacă acesta funcţionează în mod adecvat.

Din punct de vedere al calităţii produselor, controlul strategic se focalizează asupra activităţilor firmei pentru a verifica dacă strategiile privind calitatea produselor se derulează aşa cum s-a planificat. Pentru a realiza controlul strategic al calităţii produselor, managementul trebuie să determine succesul înregistrat de organizaţie în obţinerea calităţii produselor.

3.2. Costurile calităţii şi bilanţul calităţii

Conceptul de *"cost al calităţii*" a fost introdus în literatura de specialitate în anul 1955 de către expertul american Armand Feigenbaum printr-o lucrare publicată în Harvard Business Review, elaborând şi structura clasică a costurilor calităţii: prevenire, evaluare, neconformităţi interne şi neconformităţi externe.

Un produs sau serviciu competitiv bazat pe un echilibru *calitate cost* reprezintă principalul obiectiv al unui management responsabil. Acest obiectiv (fig.3.1) este atins în cea mai bună măsură cu ajutorul unei analize competente a costurilor calităţii.

Analiza costurilor calităţii impune:
- ✐ o metodă de evaluare a eficacităţii globale a managementului calităţii;
- ✐ un mijloc de a determina zonele cu problemele şi acţiunile prioritare.

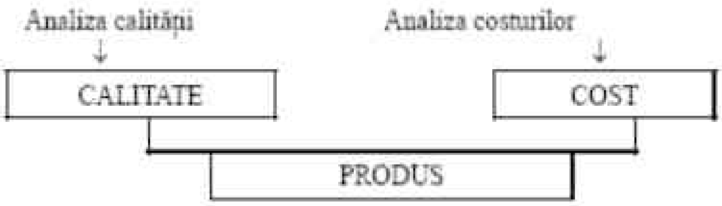


Fig. 1.1. *Compararea celor două aspecte: calitate cost.*

Preţul unui produs este format din costurile pe care le implică obţinerea produsului şi profitul pe care se aşteaptă firma să-l obţină prin vânzarea sa. Costurile de producere a unui bun sunt formate din costurile necesare şi pierderi provenite din ineficienţa activităţii (pierderi în aprovizionare, pierderi în fabricaţie, prelucrări suplimentare, etc.).

$$\text{PREŢ} = \frac{\text{COSTURI}}{\text{PROFIT}} = \frac{\text{PIERDERI NECESARE}}{\text{PROFIT}} \quad (1.1)$$

Devine evidentă necesitatea reducerii pierderilor în vederea creşterii profitului şi / sau scăderii preţului pentru creşterea competitivităţii.

Costurile suportate de o întreprindere în vederea îmbunătăţirii calităţii pot fi separate în patru categorii:

- costuri de prevenire
- costuri de evaluare } - costuri pentru asigurarea calităţii
- costuri cu neconformităţi interne
- costuri cu neconformităţi externe } - costuri ale noncalităţii -

La rândul lor costurile căderilor (costuri ale non-calităţii) pot fi compuse din căderi interne şi căderi externe.

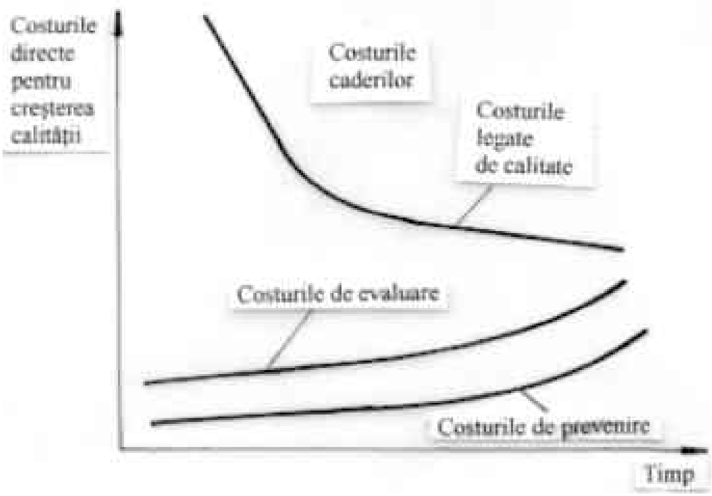
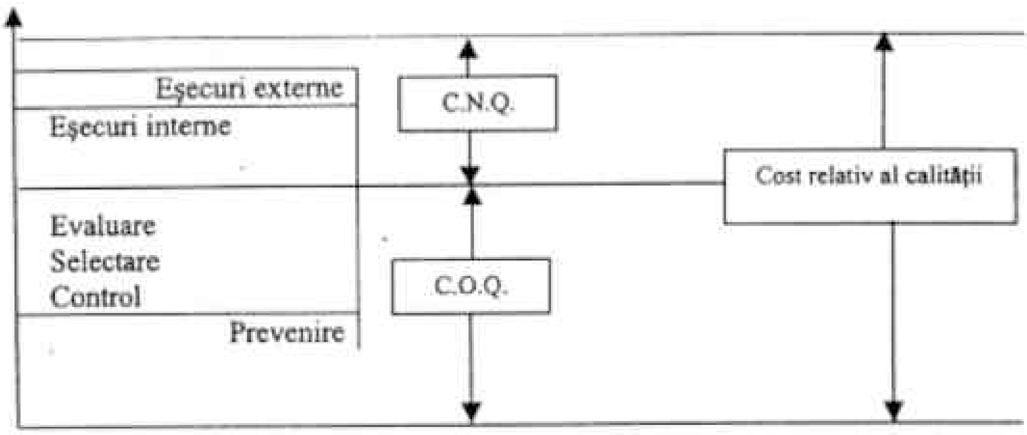


Fig. 1.2. *Evaluarea costurilor pentru calitatea totală.*

În fig. 1.2. se prezintă legătura costurilor directe ale prevenirii, evaluării şi căderilor şi priceperea organizaţiei să răspundă cerinţelor clientului.

În fig.1.3. se prezintă o tipologie stabilită după norma AFNOR X50-126 - Franţa. a acestor costuri, care să permită o analiză a acestora.



CNQ - costurile noncalităţii; COQ - costurile obţinerii calităţii

Fig.1.3. *Tipologia costurilor calităţii*

Managementul costurilor calităţii reprezintă ansamblul activităţilor generale de management care determină politica de management în domeniul calităţii, obiectivele şi responsabilităţile pe care le implementează în cadrul sistemului calităţii prin mijloace cum ar fi planificarea calităţii, controlul calităţii, asigurarea calităţii, îmbunătăţirea calităţii şi costurile calităţii. Sistemul calităţii, ca structuri organizatorice, proceduri, procese şi resurse necesare pentru implementarea calităţii stă la baza costurilor calităţii.

Managementul calităţii este un sistem al firmei care se intercondiţionează cu celelalte subsisteme ale firmei financiar contabil, resurse umane, informatic, etc. şi este subordonat managerului general al societăţii comerciale, subsistemului de dirijare.

Managementul calităţii include subsistemul calităţii (fig.3.4) pe care trebuie să şil creeze managerul de calitate prin decizia managerului general şi cu sprijinul

Departamentului de contabilitate şi al celorlalte compartimente.

Pentru aplicarea managementului costurilor calităţii conducătorii de la toate nivelurile trebuie: să lucreze activ, să analizeze greşelile, nu să caute cuiva vina; să realizeze o organizare transparentă, cu personal redus; să motiveze personalul prin calitate; să dezvolte filozofia firmei, care trebuie să fie simplă şi pregnantă; conducerea de vârf să lucreze numai în domeniul controlat.

1.3. Obiectivele calităţii

Un obiectiv al calităţii este o declaraţie a dorinţei de a ajunge la un anumit rezultat într-un timp bine precizat.

Aceste obiective formează ulterior bazele planificării detaliate a activităţii.

Obiectivele pot fi tactice, de obicei pe un an şi strategice pe termen lung, de obicei 5 ani. Obiectivele sunt dirijate atât pe probleme de hardware sau elemente cuantificabile, ca intrări, costuri, etc., cât şi obiective destinate pentru a răzbate şi include proiecte în domeniul fiabilităţii, programe de evaluare a furnizorului, manuale de investigare a reclamaţiilor, reorganizarea stafului ce răspunde de controlul calităţii, etc.

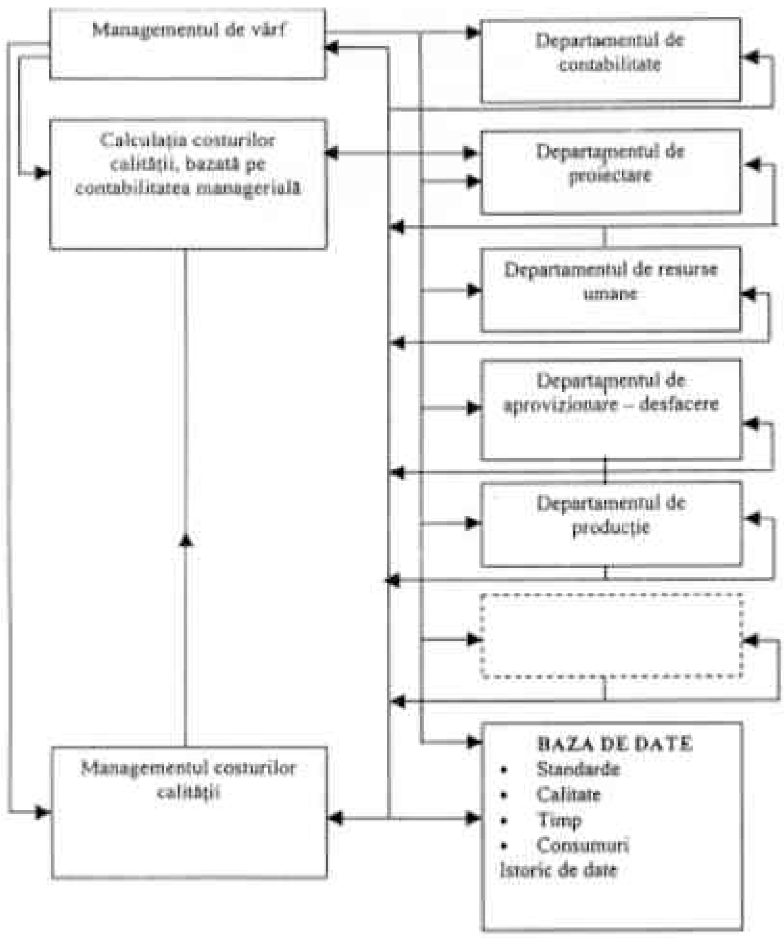


Fig.1.4. *Subsistemul Costurilor Calităţii (SCC)*

Obiectivele calităţii cuprind:

- ✐analiza Pareto a semnalelor de alarmă externe repetate (căderi pe teren, plângeri, retururi, etc.);
- ✐analiza Pareto a semnalelor de alarmă interne repetate (rebuturilor, reprelucrării, sortare, încercări 100%, etc.);
- ✐propuneri de la personalul cheie din interiorul organizaţiei (manageri, supervizori, experţi, etc.);
- ✐studii de teren despre nevoile utilizatorilor, costuri, etc.;
- ✐datele despre performanţele produselor aflate în exploatare (de la clienţi şi de la laboratoarele de încercări);
- ✐comentarii ale oamenilor-cheie din afara companiei, societăţii comerciale (clienţi, vânzători, dealeri, jurnalişti, etc.);
- ✐"găselniţe" şi comentarii ale funcţionarilor, laboranţilor, informatorilor, etc.

O extensie a abordării problematicii pieţei o constituie benchmarking-ul, în cadrul căruia performanţa celei mai bune organizaţii (din concurenţă sau nu) este utilizată ca standard.

1.4. Benchmarking, definiţie şi tipuri

Benchmarking-ul este definit ca procesul de căutare a celor mai bune practici, idei inovatoare şi proceduri operaţionale care conduc la un nivel superior de performanţă; arta de a afla, într-o manieră perfect legală şi etică, de ce alţii merg mai bine decât tine, altfel încât să te poţi îmbunătăţi imitându-le tehnicile, căutarea celor mai bune practici care conduc la o performanţă superioară; procesul continuu de identificare, înţelegere şi adaptare a practicilor şi proceselor celor mai bune, care va conduce la performanţe superioare.

Trebuie făcută distincţia între termenii de benchmarking, care definesc căutarea continuă a celor mai bune practici şi benchmark, care se referă la măsurile, de obicei numerice, prin care este exprimată performanţa unei funcţii, operaţiuni, activităţi, etc.

Benchmarkingul reprezintă un instrument compus din mai multe tehnici ce au ca scop compararea produselor sau proceselor şi nu numai cuantificarea acestora.

Noţiunea de benchmarking este una din cele mai nou introduse în lexiconul managementului modern, deşi conceptul de benchmarking nu este nou.

Evoluţia benchmarking-ului ca proces de management poate fi urmărită de-a lungul a cinci etape (fig.1.5):

- Analiza produselor concurente - concentrat pe compararea caracteristicilor, funcţiilor şi performanţei produselor concurente, la început doar la nivel tehnic şi apoi dintr-o perspectivă mai largă care să includă o evaluare competitivă a produselor din perspectiva pieţei;

- benchmarking competitiv - a marcat trecerea dincolo de comparaţiile focalizate pe produse către comparaţii focalizate pe procese, fiind dezvoltat de corporaţia Xerox în decada anilor 1976 - 1986.

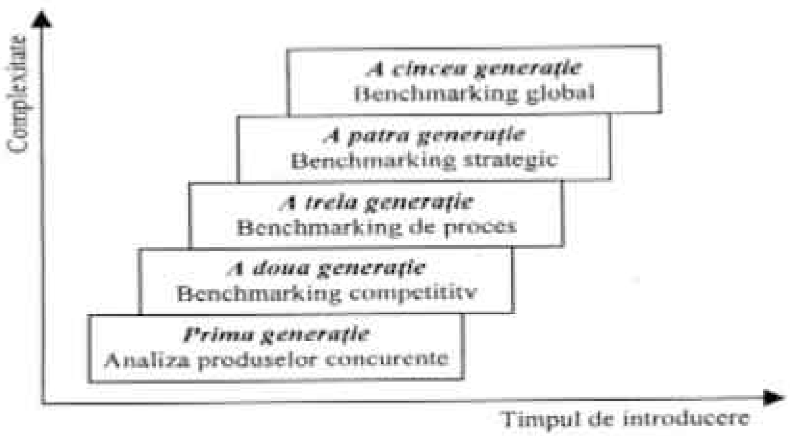


Fig. 1.5 *Evoluţia conceptului de benchmarking*

învață mai uşor de la companii din alte industrii decât din studii de benchmarking competitiv. Companiile concurente trebuie să facă față unor granițe obiective, dincolo de care nu poate avea loc un anumit schimb de informații. La acest nivel se extrag şi se utilizează informații de la organizații neconcurente.

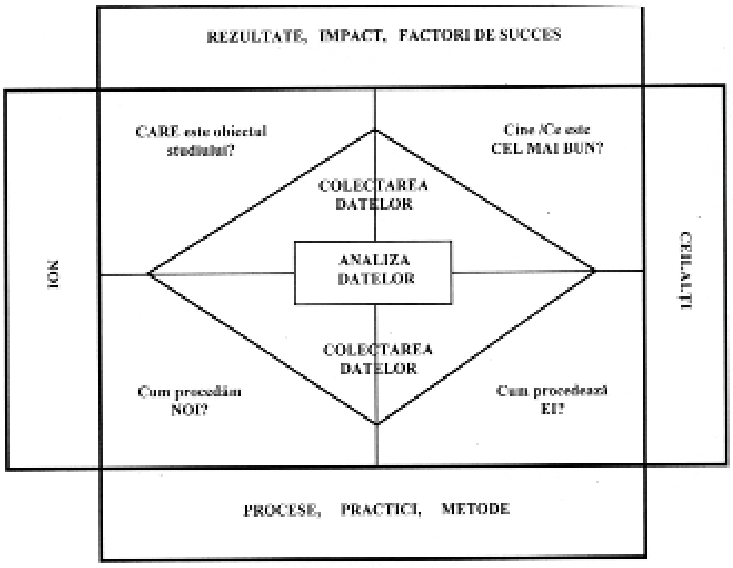


Fig.1.6.a *Cadrul conceptual al procesului benchmarking*

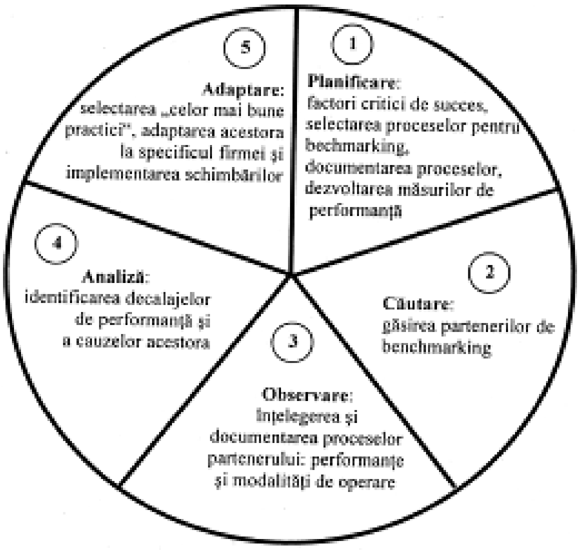


Fig.1.6.b. *Etapele procesului de benchmarking*

- **benchmarking strategic** - este un proces sistematic de evaluare a unor scenarii alternative, de implementare a strategiilor şi de îmbunătățire a performanței prin înțelegerea şi adoptarea strategiilor de succes ale partenerilor care participă la diferite alianțe în afaceri. *Benchmarkingul strategic* diferă de *benchmarkingul de proces* deoarece scopul său este mai larg şi mai profund. Este un proces de învățare care poate susține *re-engineering-ul proceselor* sau chiar de schimbare radicală.
- **benchmarkingul global** - constituie ultima generație şi se referă la o aplicare globală a benchmarking-ului, într-o manieră constructivă care să concilieze diferendele dintre companii şi care să faciliteze înțelegerea implicațiilor acestor diferende pentru nivelul de performanță al societății.

Cadrul conceptual al procesului benchmarking este prezentat în fig.1.6.

Deşi există o mare varietate de modele de benchmarking, elaborate de diferite companii, firme de consultanță sau instituții academice, pot fi identificate unele elemente comune care definesc cadrul de bază al acestora: selectarea şi documentarea proceselor, identificarea partenerilor, analiza proceselor partenerilor de benchmarketing, identificarea cauzelor care au determinat un nivel superior de performanță la partener, îmbunătățirea în cadrul proceselor proprii.

Benchmarkingul competițional Analiza competitivității este una dintre trăsăturile distinctive ale unui Management Strategic al Calității (MSC) moderne. Abordarea MSC pe baza analizei competitivității se numeşte *benchmarkingul competițional.*

Abordarea modernă a calității necesită investiții de timp şi resurse în întreaga organizație iar managementul de vârf are un rol cheie în asigurarea resurselor necesare pentru activitățile legate de calitate.

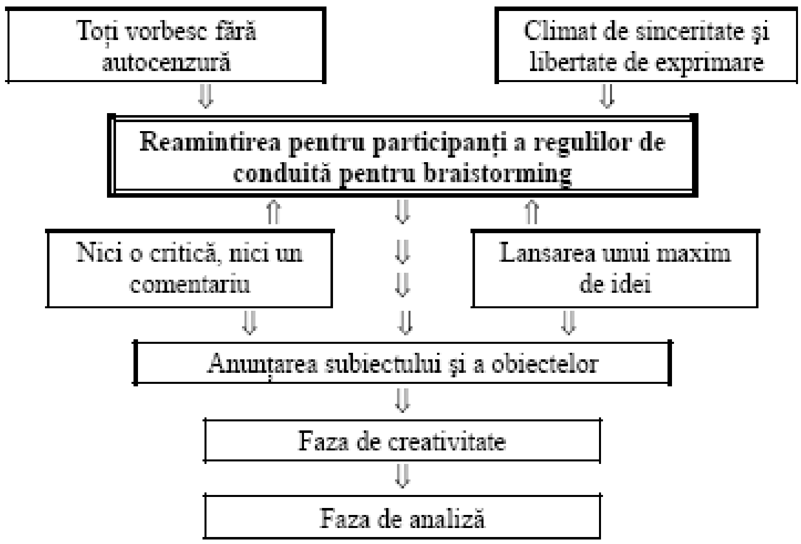


Fig. 1.7. *Structura unei şedințe de braistorming*

Braistorming tradus ca "asaltul creierelor" sau "asaltul de idei" este o tehnică pentru simularea gândirii creative a unei echipe în vederea generării sau clarificării unei liste de idei sau probleme. Se realizează într-o formație de lucru cu caracter temporar, în grup restrâns şi are ca obiectiv generarea de idei noi prin participarea colectivă.

Prin ***braistorming*** se înțelege consultarea colectivului, trecerea în revistă a opiniilor exprimate şi selectarea pe baza discuției colective, a variantei optime sau formularea ei prin efortul comun din datele furnizate în grup. Braistormingul este o variantă a discuției **colective.**

Şedința de braistorming prezintă două faze: după o expunere de deschidere, în care conducătorul pune problema, punctând esența ei, urmează faza productivă propriu-zisă, la saltul de idei, după care urmează faza de clarificare a ideilor emise, care are loc ulterior.

Faza productivă de braistorming este un act de creativitate în grup. La încheierea etapei productive, se organizează inventarierea completă a ideilor emise, precum şi clasificarea lor pe categorii. Lista este apoi prezentată juriului de selecție. Se precizează că dacă se aleg 10 - 15 % din totalul ideilor emise, şedința de brainstorming şi-a atins scopul. În fig. 1.7. se prezintă schema de desfăşurare a unei şedințe de braistorming.

1.5. Diagnosticul calității - metodă de expertiză si investigații

Orice problemă a vieții curente, oricare ar fi natura ei, trebuie să facă obiectul unui studiu, al unei evaluări care precede acțiunea. Diagnosticul este faza prealabilă a deciziei. Determinarea unei strategii, elaborarea unui plan de acțiune, alegerea unei soluții trebuie întotdeauna să se sprijine pe o reflecție, pe o analiză detaliată a avantajelor şi inconvenientelor fiecărei situații.

Valoarea unui diagnostic, oricare ar fi domeniul său, va depinde de respectarea unui ansamblu de reguli:

- ✐ Stabilirea cât mai clar posibil a obiectivelor urmărite;
- ✐ Existenta unui câmp de investigare perfect circumscris;
- ✐ Dispunerea de un demers riguros şi participativ;
- ✐ Cunoaşterea tuturor variabilelor şi controlul tuturor factorilor posibili ai evoluției;
- ✐ Accesul la orice informații utile şi puterea de a le trata;
- ✐ Analizarea metodică a rezultatelor astfel încât să se ia deciziile cele mai potrivite.

Instrumentele diagnosticului sunt destinate să genereze şi să primească informații şi date, să le ordoneze şi să le structureze şi prin punerea lor în legătură, să le permită să aibă o semnificație pe care nu ar avea-o dacă ar fi tratată separat.

Jean-Paul Sallenave [1]prezintă diagnosticul ca unirea a două niveluri de analiză:

- ✐ Punctele forte şi slăbiciunile interne ale organizației, în acceptarea ei cea mai largă;
- ✐ Amenințările şi ocaziile generate de mediul înconjurător.

Această analiză este în mod necesar dinamică. Se dezvoltă astfel metode exacte de analiză comparativă a unui produs şi ale concurenților, prezentate de QFD (Quality Function Development).

De asemenea în cadrul unui diagnostic al calității, se iau în considerare datele rezultate din mediul înconjurător, pentru a elabora politicile în domeniul calității şi a defini planurile de acțiune pe termen mediu.tului şi diagnosticului se încrucişează parțial.

Definiția diagnosticului în sensul său actual, lărgit, cuprinde ciclul complet: constatare - analiză - acțiune. Această definiție poate fi reținută pentru diagnosticul organizației.

Într-o abordare pragmatică, definirea diagnosticului se face pe baza întrebărilor la care trebuie să se răspundă:

Care este situația actuală?

- ✐ În ce situație de risc mă aflu dacă nu schimb nimic?
- ✐ În funcție de situația în care vreau (sau pot) să mă aflu, care sunt acțiunile pe care trebuie să le întreprind?
- ✐ Care sunt riscurile şi obstacolele de depăşit (şi cum să o fac)?

Diagnosticul este o acțiune de investigare dusă de o persoană (sau un grup de persoane) asupra unei părți dintr-o organizație, la cererea unei autorități competente. Diagnosticul utilizează metode şi instrumente adaptate, plecând de la un referențial mai mult sau mai puțin explicit.

Diagnosticul calității. Oricare ar fi dimensiunea strategică care se dă calității, diagnosticul calității nu trebuie confundat cu diagnosticul strategiei.

Diagnosticul calității îşi găseşte câmpul de acțiune în toate domeniile de organizare ale întreprinderii, în scopul verificării dacă activitățile, performanța şi structura lor corespund exigențelor politicii definite de conducere şi mizelor în materie de calitate a întreprinderii în vederea căutării tuturor surselor potențiale de ameliorare.

Diagnosticul calității poate acoperi:

- ✐ analiza cuplului produse - clienți, pentru a măsura adecvarea primelor la nevoile celei de a doua categorii (nevoi intrinseci şi extrinseci). Analiza este la frontiera diagnosticului strategic;
- ✐ aptitudinea serviciilor marketing şi comercial de a determina nevoile pieței, instrumentele de aplicare la acest nivel şi rezultatele obținute;
- ✐ analiza relațiilor cu furnizori şi subfurnizori pentru a aprecia neconformitățile şi câştigurile potențiale de competitivitate;
- ✐ funcționarea serviciului cumpărare - aprovizionare în raport cu responsabilitatea sa asupra calității furniturilor exterioare;
- ✐ analiza organizării interne în privința demersului calitate - produs;

- cercetarea tuturor neconformităților şi problemelor situate la interfețele dintre nivelurile prezentate şi între servicii. Neconformitățile între servicii sunt tratate în analizele organizaționale care le privesc;
- elaborarea unei strategii a calității, atât internă cât şi externă, incluzând alegerea de instrumente şi demersuri favorizând evoluția comportamentelor individuale şi colective în raport cu calitatea;
- aplicarea calității la nivelul serviciilor funcționale, în mod obişnuit puțin angajate în acțiunile privind calitatea.

Analiza neconformităților se sprijină pe o evaluare sistematică a consecințelor financiare.

Diagnosticul calității impune următoarele:

- Nu se poate gândi implementarea calității totale fără a efectua în prealabil un diagnostic de calitate;
- Această intervenție constă în a efectua o fotografie a calității întreprinderii, respectiv a organizării şi conducerii calității existente în întreprindere;
- Diagnosticul permite descoperirea zonelor generatoare de noncalitate şi definirea axelor unui plan de îmbunătățire a calității.

Diagnosticul necesită 3 - 5 zile pentru o echipă de mai multe persoane în funcție de mărimea întreprinderii şi de nivelul de cultură în domeniul calității existent în unitatea respectivă. El poate să se desfăşoare şi pe o perioadă de până la 6 luni dacă nu există organizată o gestiune economică a costurilor unității.

Audit şi diagnostic, sinteza. Există o confuzie între termenii de diagnostic şi audit. *AFNOR defineşte auditul calității ca un examen metodic şi independent, în scopul de a determina dacă activitățile şi rezultatele relative la calitate satisfac dispozițiile prestabilite şi dacă aceste dispoziții sunt aplicate într-o manieră eficace şi apte să atingă obiectivele.*

Auditul, în acest cadru, încearcă să verifice că:

- ceea ce s-a făcut (activități şi rezultate) este conform cu ceea ce era prevăzut a se face (dispoziții prestabilite);
- ceea ce era prevăzut să se facă permite să se atingă obiectivele.

Determinarea obiectivelor, analiza referențialului în raport cu un context dat şi revizia sa eventuală sunt de domeniul diagnosticului. Diagnosticul face apel la instrumente de un nivel de performanță mai înalt decât cele utilizate în mod obişnuit de audit (conf.fig.1.8). Domeniile auditului şi diagnosticului se încrucişează parțial.

<table>
<tr><th>Situația reală</th><th>Situația normativă</th><th>Situația țintă / optim</th></tr>
<tr><td colspan="2">⇐ ------------------ audit --------------------⇒</td><td></td></tr>
<tr><td colspan="3">⇐ ----------------------------------diagnostic ------------------------------------⇒</td></tr>
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Fig.1.8. *Schema simplificată a câmpurilor de acțiune ale auditului şi diagnosticului*

Auditul calității acoperă:

- verificarea datelor şi informațiilor comunicate de funcția calității (nivelul 1);
- controlul respectării normelor şi instrucțiunilor relative la calitate, care se traduc în funcționarea aşteptată (nivelul 2);
- analiza eficacității mijloacelor în raport cu obiectivele (nivelul 3). Această parte este cea mai apropiată de diagnostic şi uneori se confundă cu el.

Diagnosticul calității are ca obiectiv:

- să dea informațiile necesare, relative la calitate pentru a permite fixarea strategiei întreprinderii;
- să ajute la elaborarea obiectivelor şi politicii calității, ale strategiei şi politicii generale;
- să servească drept bază la elaborarea celei mai bune strategii în domeniul calității, pentru a atinge obiectivele calității şi planurile de acțiune, în domeniul calității, rezultante;

✐ să propună planurile de acțiune şi programe de ameliorare adecvate politicii, obiectivelor şi strategiei în domeniul calității, adaptate la funcționarea reală observată;

✐ să evidențieze toate neconformitățile în materie de calitate ale organizației la toate nivelurile, după obiectivele atribuite diagnosticului, precum şi cauzele lor şi să le ierarhizeze în scopul uşurării elaborării planurilor de ameliorare a calității, în diversitatea originilor - tehnice, umane, informative, financiare, organizaționale.

Caracteristicile generale ale tuturor formelor pe care le pot lua diagnosticul şi auditul constau în intervenția unei persoane din afara organizației. Această alegere rezultă din cercetarea făcută fie de o persoană neutră, fie de o competență specială asupra subiectului (sau amândouă laolaltă).

Metoda care se utilizează trebuie să definească obiectivele, etapele succesive şi principiile de acțiune. Auditul calității acoperă un domeniu mai restrâns şi urmăreşte devierile între rezultate şi obiective, pe de o parte şi între dispozițiile prestabilite şi funcționarea reală, pe de altă parte. Auditul şi diagnosticul pot lua mai multe forme, în funcție de obiectivele căutate.

1.6. Concluzii

a). Managementul strategic al calității este procesul de stabilire a unei game largi de obiective, respectiv de a defini modul de abordare a activității de atingere a acestor obiective,

b) Conceptul de *"cost al calității"* reprezintă principalul obiectiv al unui management responsabil. Acest obiectiv este atins în cea mai bună măsură cu ajutorul unei analize competente a costurilor calității.

C) Benchmarkingul reprezinta un instrument compus din mai multe tehnici ce au ca scop compararea produselor sau proceselor si nu numai cuantificarea acestora.

d) Diagnosticul calității este o acțiune de investigație dusă asupra unei părți dintr-o organizație. Scopul său este de a ameliora competitivitatea organizației. Auditul şi diagnosticul pot lua mai multe forme, în funcție de obiectivele căutate.

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11. *** ISO 9000 - 2000, *Quality Management Systems* - Fundamentals and Vocabulary

Hydraulic News - Actual Developments at IFAS

Thanks to contributors:

Ewald, Heitzig, Inderelst, Kamizuru, Liermann, Murrenhoff, Riedel, Schmitz, Vatheuer, Verkoyen

RWTH AACHEN UNIVERSITY

IFAS Institute for Fluid Power Drives and Controls

Prof. Dr.- Ing. H. Murrenhoff

A Retrospect of the 7th IFK and other developments

H. Theissen

HERVEX Calimanesti 10.11.2010

Outline

- Hydraulic Hybrid Passenger Car
- Self Energizing Hydraulic Brake
- Wind Energy
- Wave Energy
- Simulation of Hydraulic Systems
- Digital Pumps

Outline

- **Hydraulic Hybrid Passenger Car**
- Self Energizing Hydraulic Brake
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- Digital Pumps

Theissen: Developments at IFAS
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IFAS

Hydraulic Hybrid Road Vehicle

IFASter.de

- Key objectives:
  - Downsize combustion engine
  - Reduce fuel consumption
  - Provide additional power during acceleration
  - Recover breaking energy
  - Easy integration of the hydraulic system into the car
  - Less modification effort to the existing mechanical drive train
- Partners:
  - Sauer Danfoss and Bosch Rexroth (pumps)
  - Hydac GmbH (accumulator)
  - Mechanical workshop of ARAL petrol station in Nettetal

Theissen: Developments at IFAS
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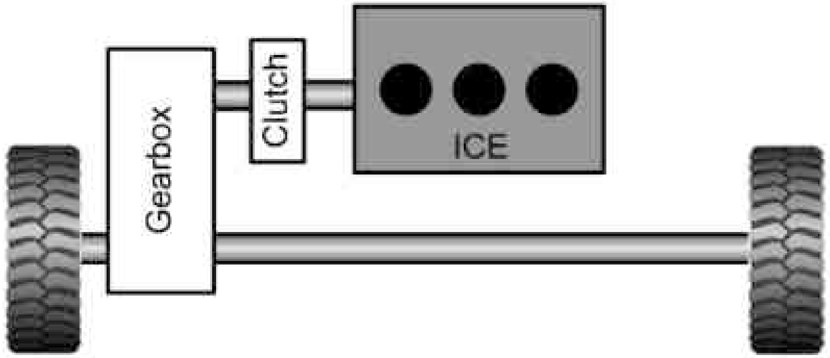
IFAS

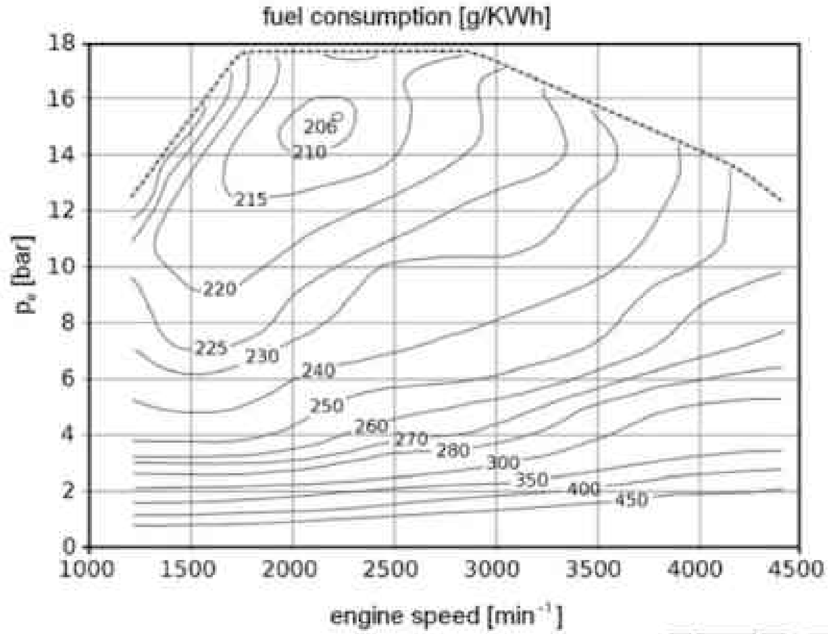
Drive Train Design

Common mechanical drive train of the test vehicle



- VW Polo IV (2004)
- 3 cylinder diesel engine with 55 KW
- Maximum torque: 195 Nm
- Manual transmission with 5 gears

- Drive and brake torque are driver-controll
- Automatic torque blending not installed ye
- Engine load is adjustable at any time
- If clutch opens, hybrid system deactivate:
- System specifications:
  - Booster: 100 Nm for 8 sec → 40 KW add. powe
  - Accumulator volume: 8 litres
  - Maximum acc. pressure: 350 bars
  - Pump displacement: 28 cm³



Theissen: Developments at IFAS
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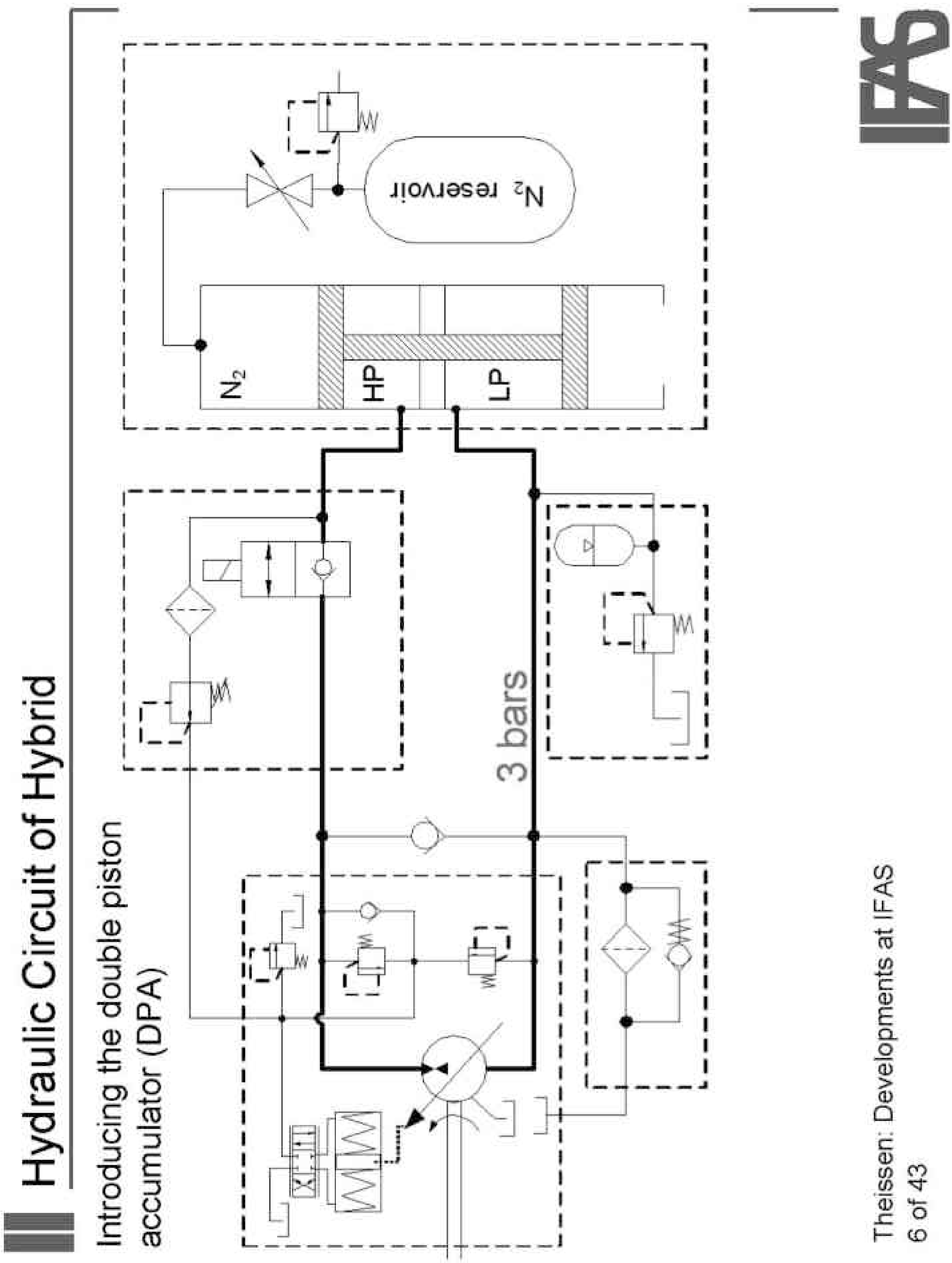
Hydraulic Circuit of Hybrid
Introducing the double piston accumulator (DPA)
N2 reservoir
N2
HP
LP
3 bars
Theissen: Developments at IFAS
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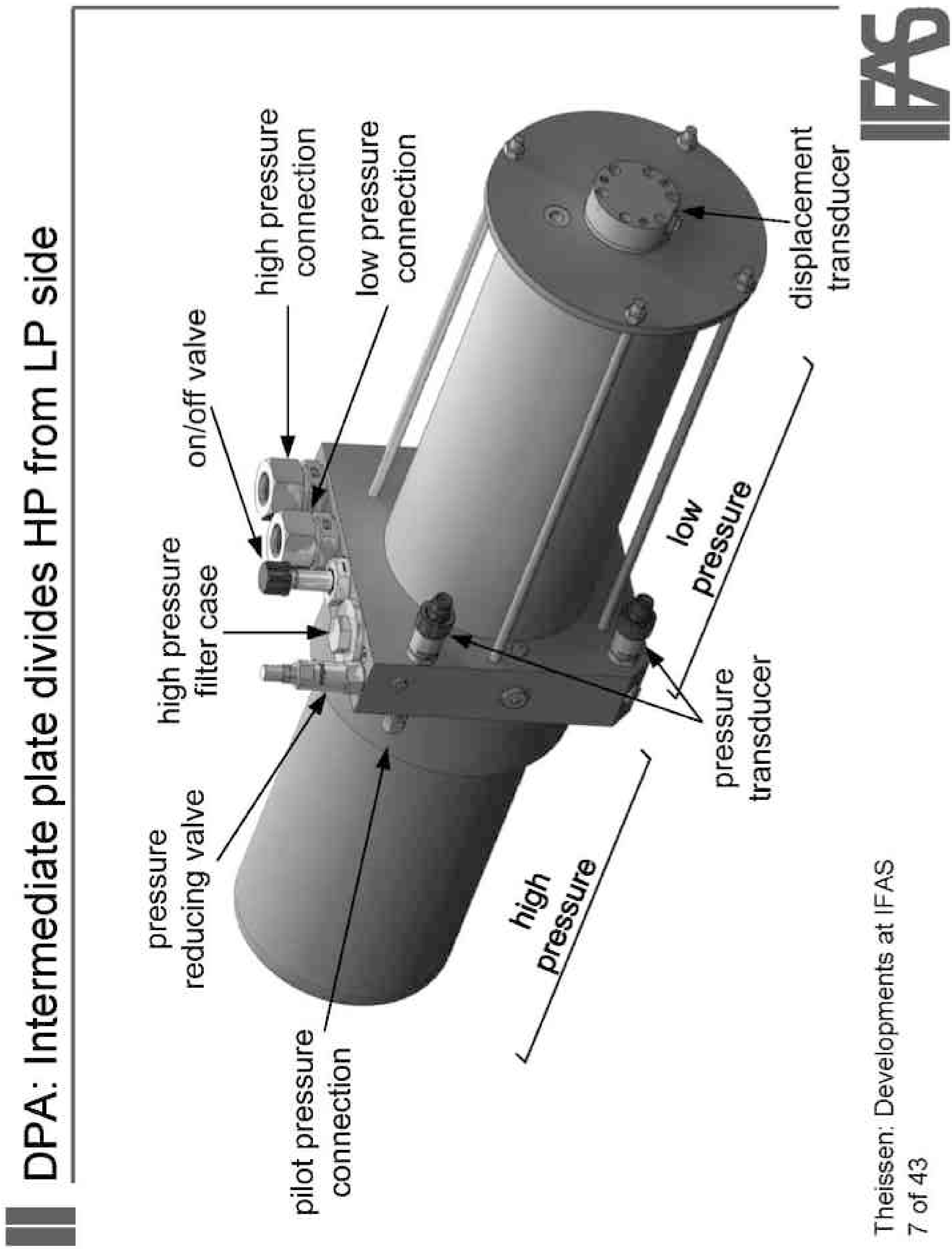
DPA: Intermediate plate divides HP from LP side
high pressure connection
low pressure connection
on/off valve
high pressure filter case
pressure reducing valve
pilot pressure connection
displacement transducer
low pressure
high pressure
pressure transducer
Theissen: Developments at IFAS
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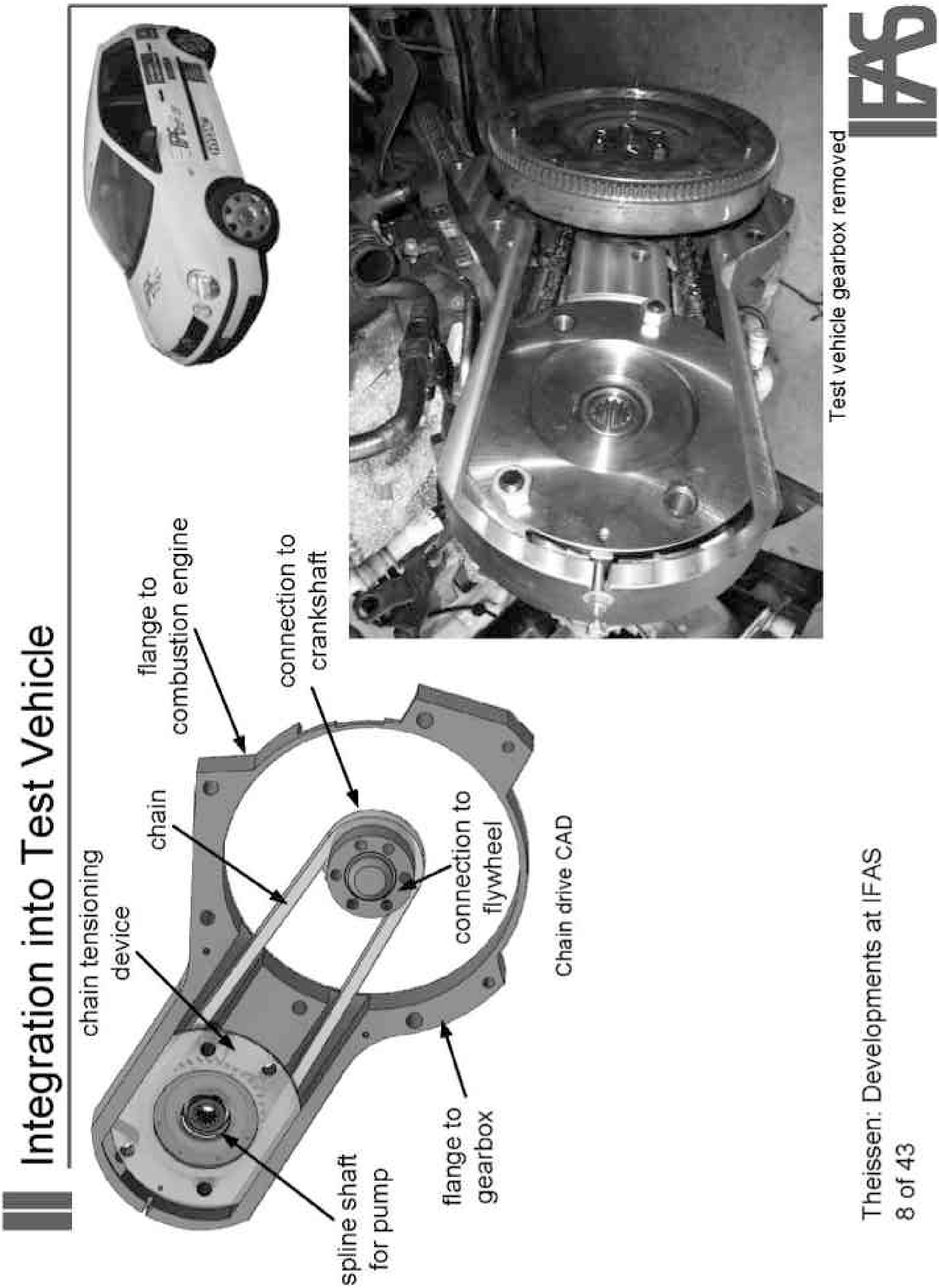
Integration into Test Vehicle
chain tensioning device
chain
flange to combustion engine
connection to crankshaft
connection to flywheel
spline shaft for pump
flange to gearbox
Chain drive CAD
Test vehicle gearbox removed
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Integration into Test Vehicle

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Outline

- Hydraulic Hybrid Passenger Car
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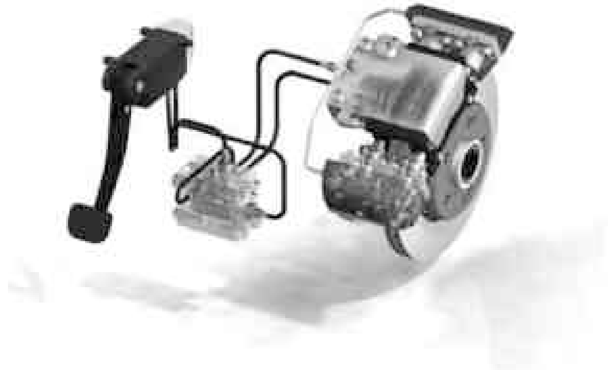

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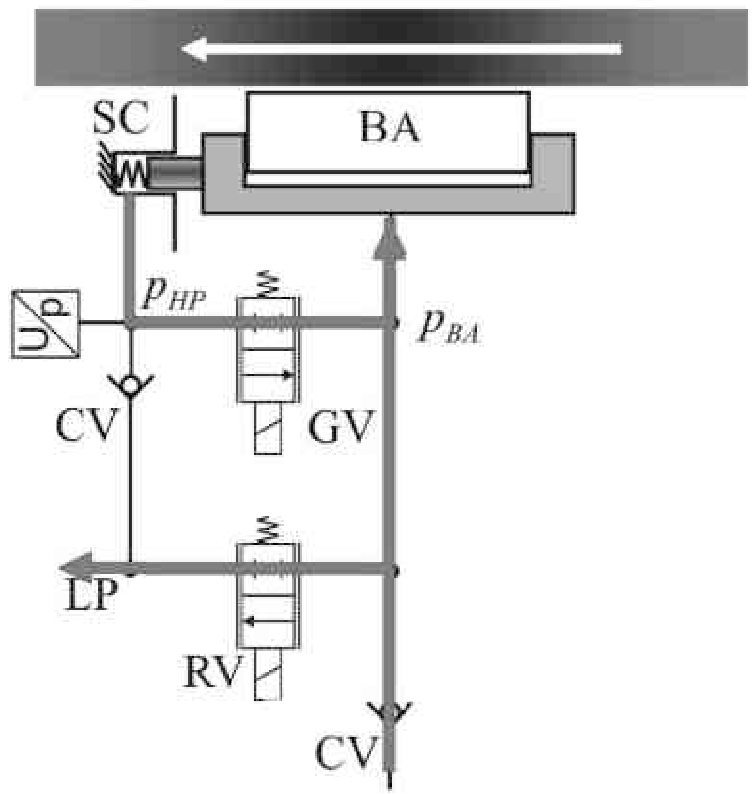
The Self-Energizing Hydraulic Brake (SEHB)

- Originally developed for railway applications
- Basic idea: Convert kinetic to hydraulic energy
  - Disc brake with movable caliper
- Closed loop control of a brake torque
  - Seat-type valves
  - Two 2/2-way valves



- Nomenclature
  - BA = Brake Actuator
  - SC = Supporting Cylinder
  - CV = Check valve
  - GV = Generator Valve
  - RV = Relief Valve

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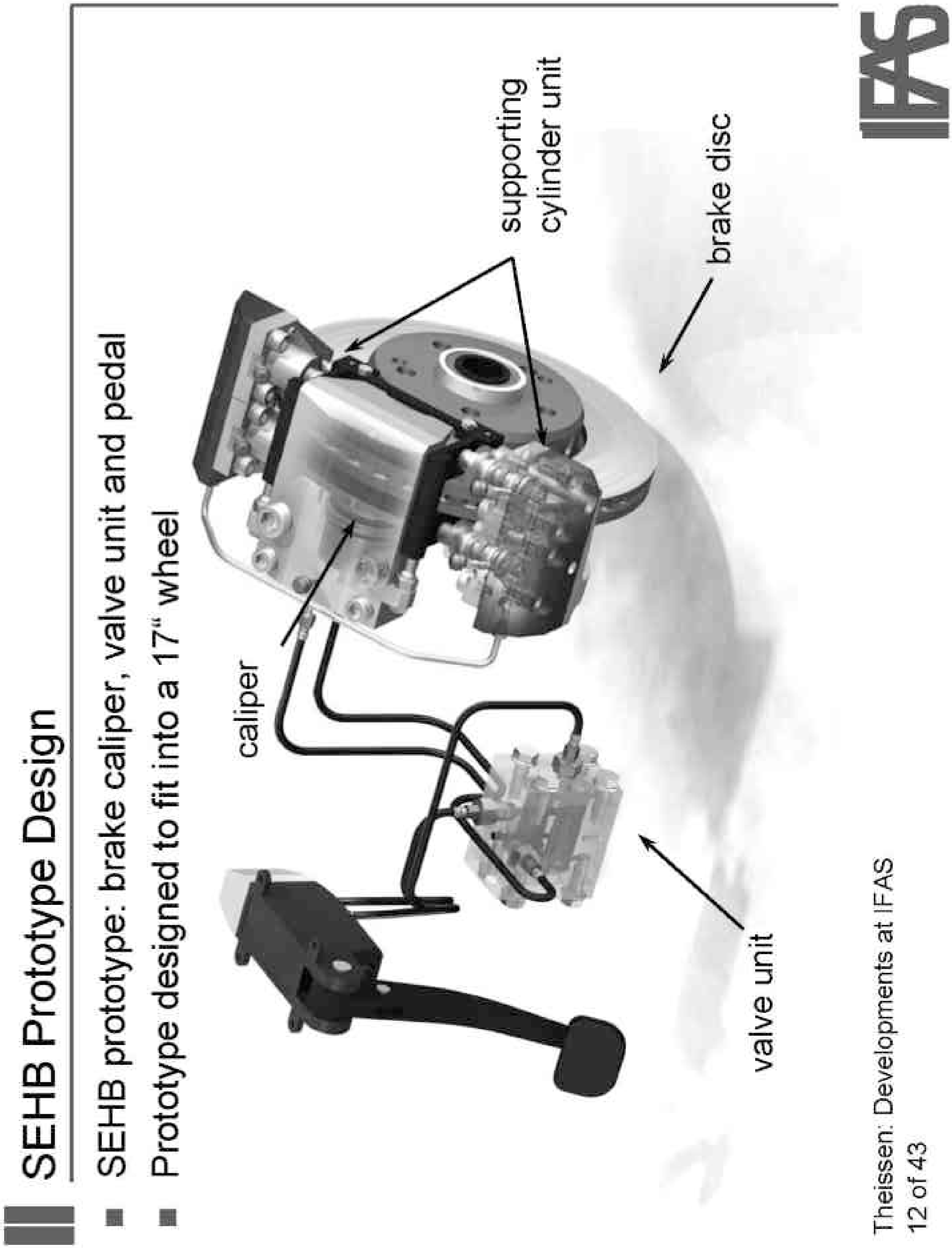
SEHB Prototype Design
SEHB prototype: brake caliper, valve unit and pedal
Prototype designed to fit into a 17" wheel
caliper
supporting cylinder unit
brake disc
valve unit
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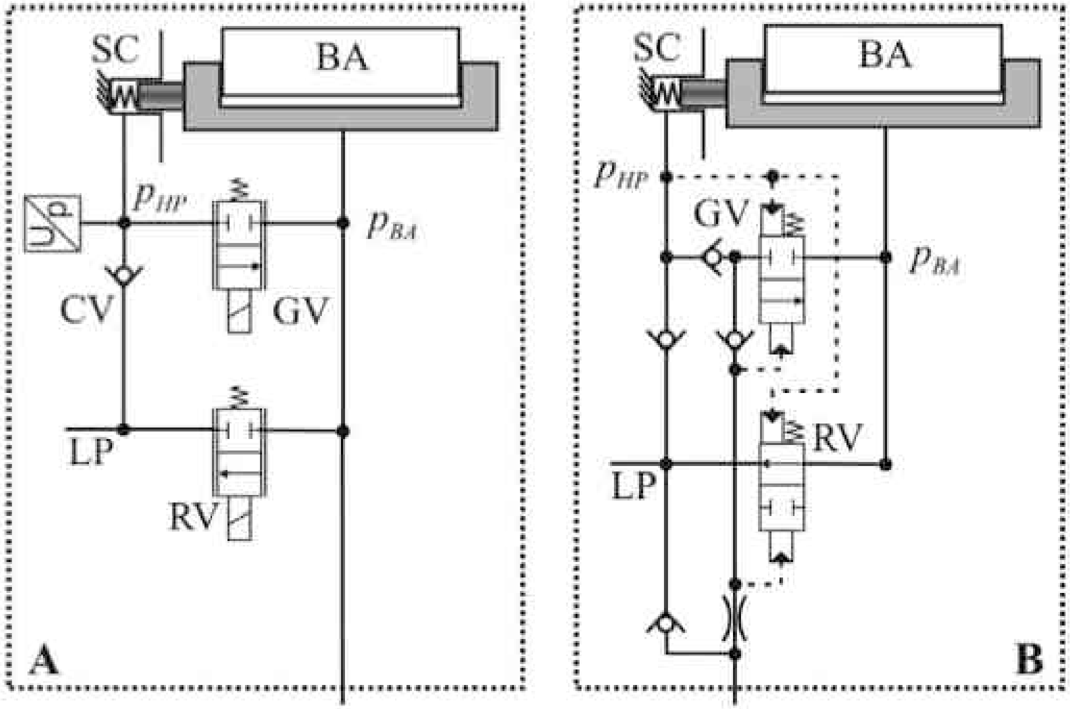
Hydro-Mechanical Control

- Closed loop control of brake torque (shown for one wheel)



- Electric control (A)
  - Pressure sensor
  - Electric valve actuation located near wheel
- Hydraulic control (B)
  - Hydraulic feedback
  - Mechanic force balance at the valves
  - Demand signal by brake pedal
- Benefits of hydraulic control
  - No electronics near caliper
  - No safe electric power supply needed

Theissen: Developments at IFAS
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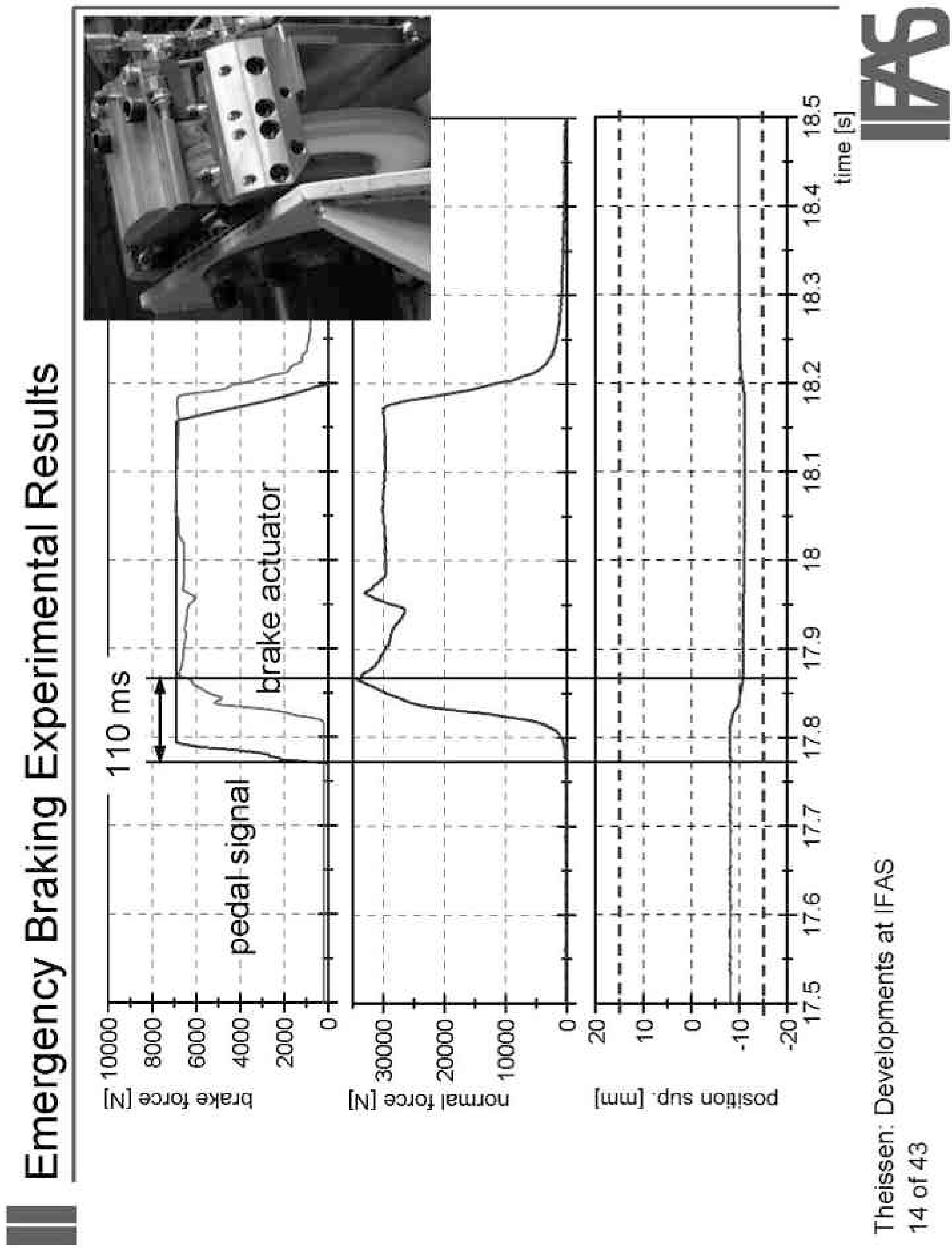

Emergency Braking Experimental Results
110 ms
pedal signal
brake actuator
brake force [N]
normal force [N]
position sup. [mm]
time [s]
17.5 17.6 17.7 17.8 17.9 18 18.1 18.2 18.3 18.4 18.5
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Outline

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- Wave Energy
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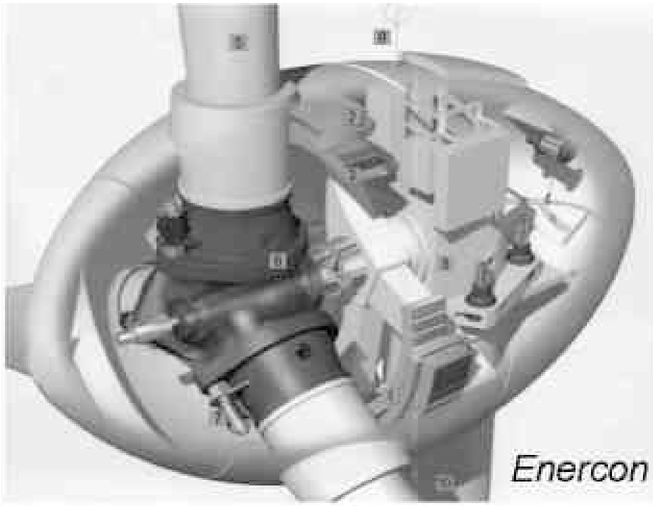
Wind Turbines – State of the Art

RE power

Mechanical

- Fixed transmission ratio
- Frequency converter

1

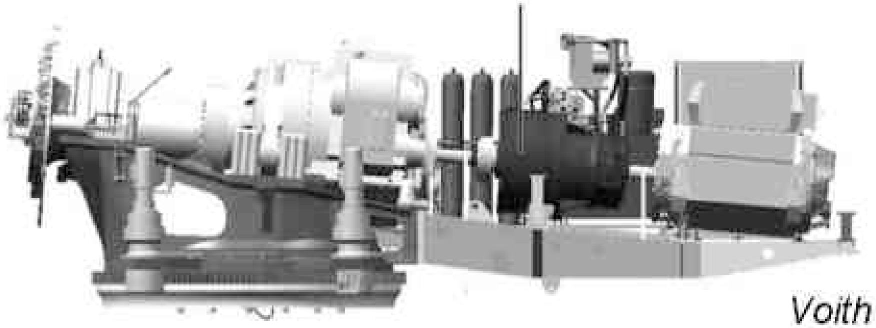


Enercon

Low-speed generator

- Generator on rotor hub
- Frequency converter

2



Voith Turbo

WinDrive

- Hydrodynamic converter
- No frequency converter

3

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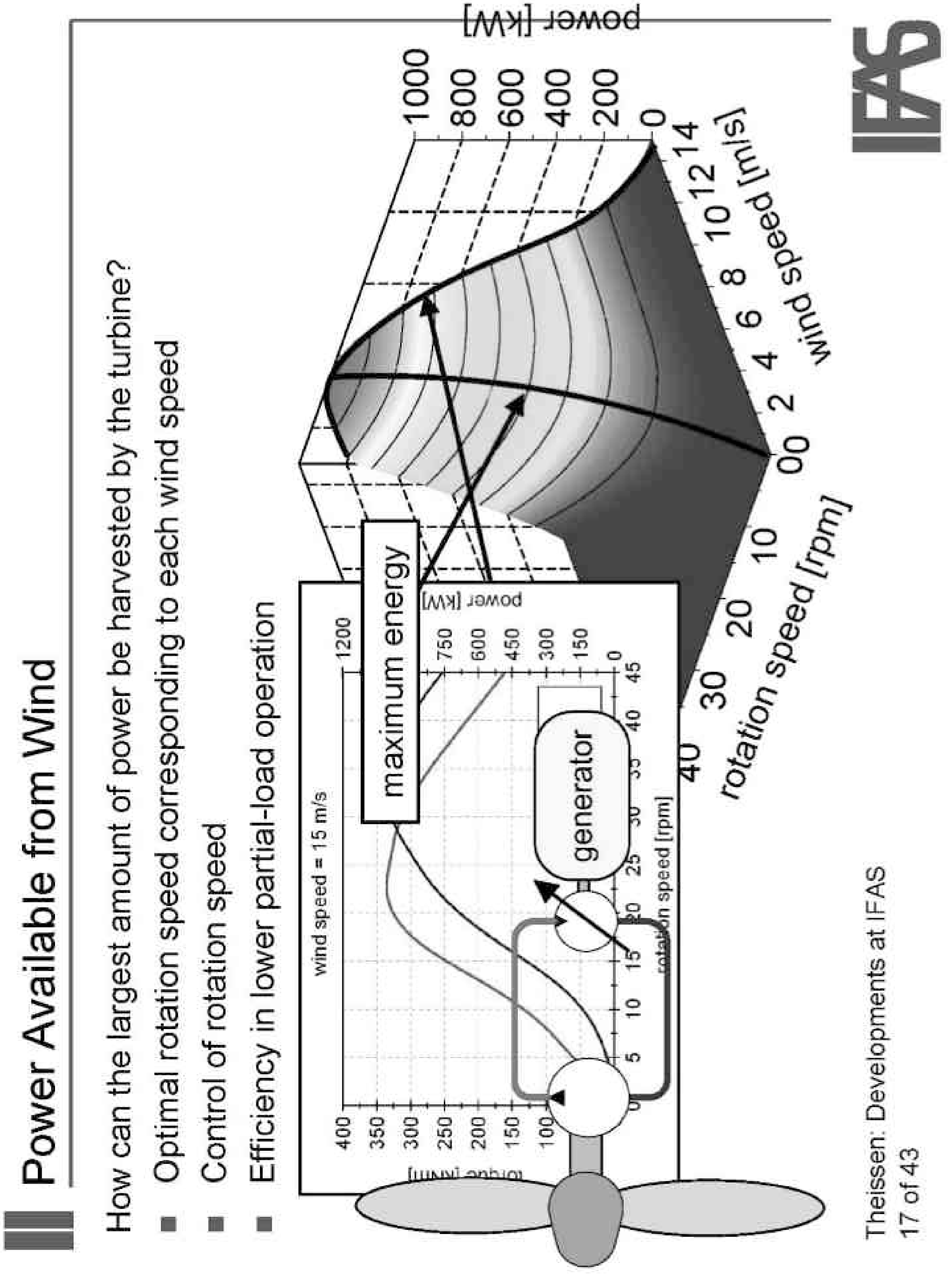
Power Available from Wind
How can the largest amount of power be harvested by the turbine?
Optimal rotation speed corresponding to each wind speed
Control of rotation speed
Efficiency in lower partial-load operation
power [kW]
1000
800
600
400
200
0
wind speed [m/s]
0 2 4 6 8 10 12 14
rotation speed [rpm]
0 10 20 30 40
maximum energy
wind speed = 15 m/s
torque [kNm]
400 350 300 250 200 150 100
power [kW]
1200 750 600 450 300 150 0
rotation speed [rpm]
0 5 10 15 20 25 30 35 40 45
generator
IFAS
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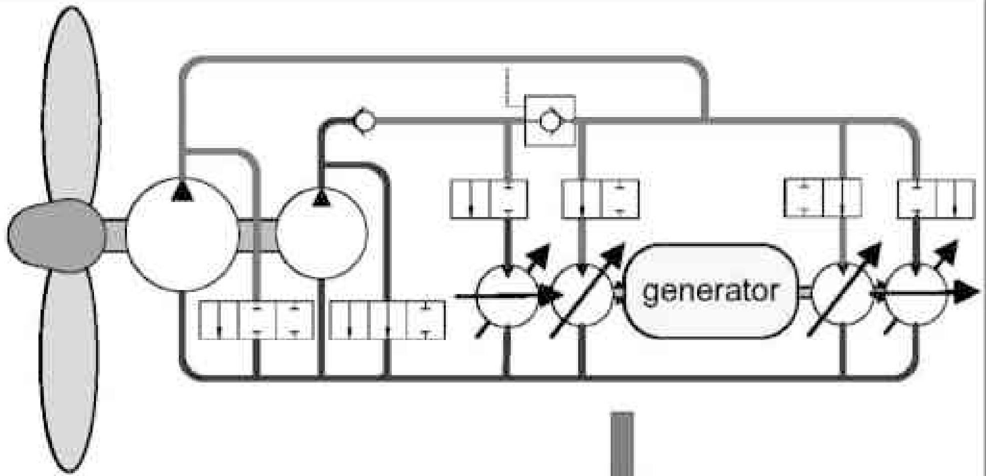
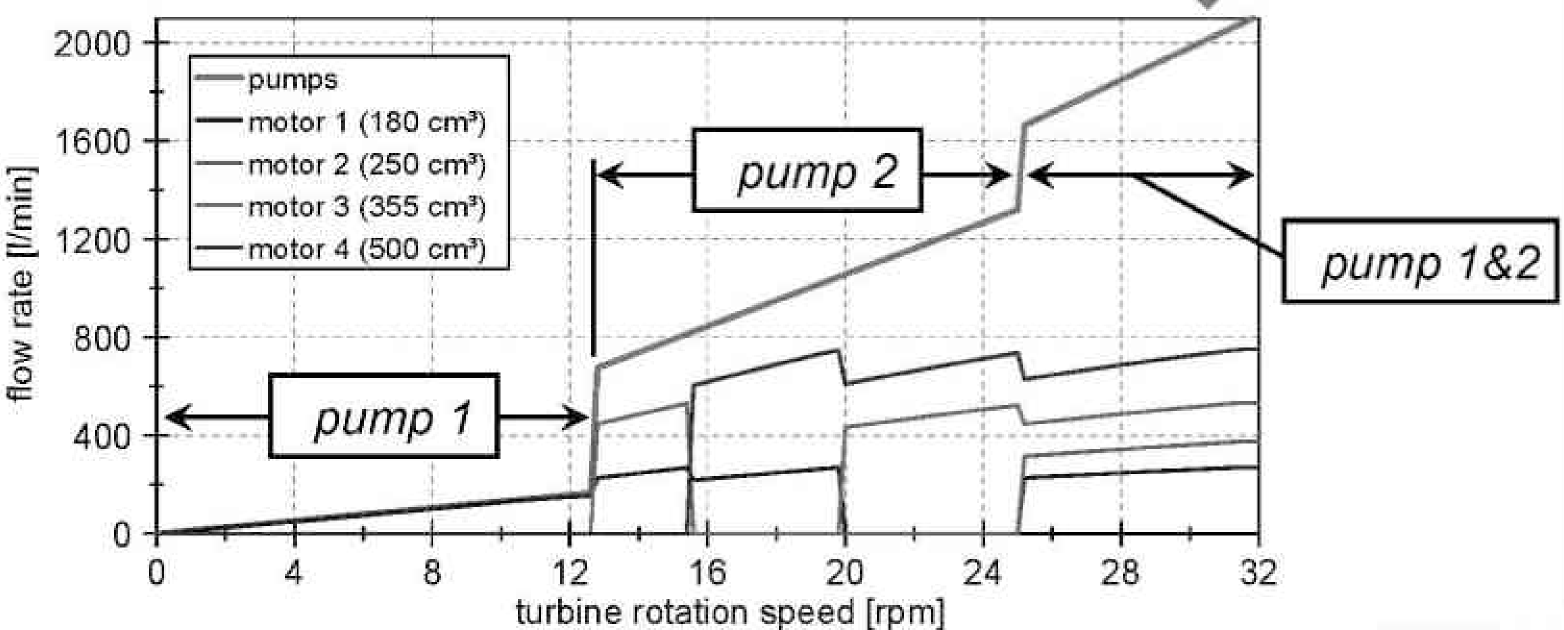
Operating Modes

Result of evaluation

- 2 switchable radial piston pumps
- 4 variable displacement motors
- 2 main circuits





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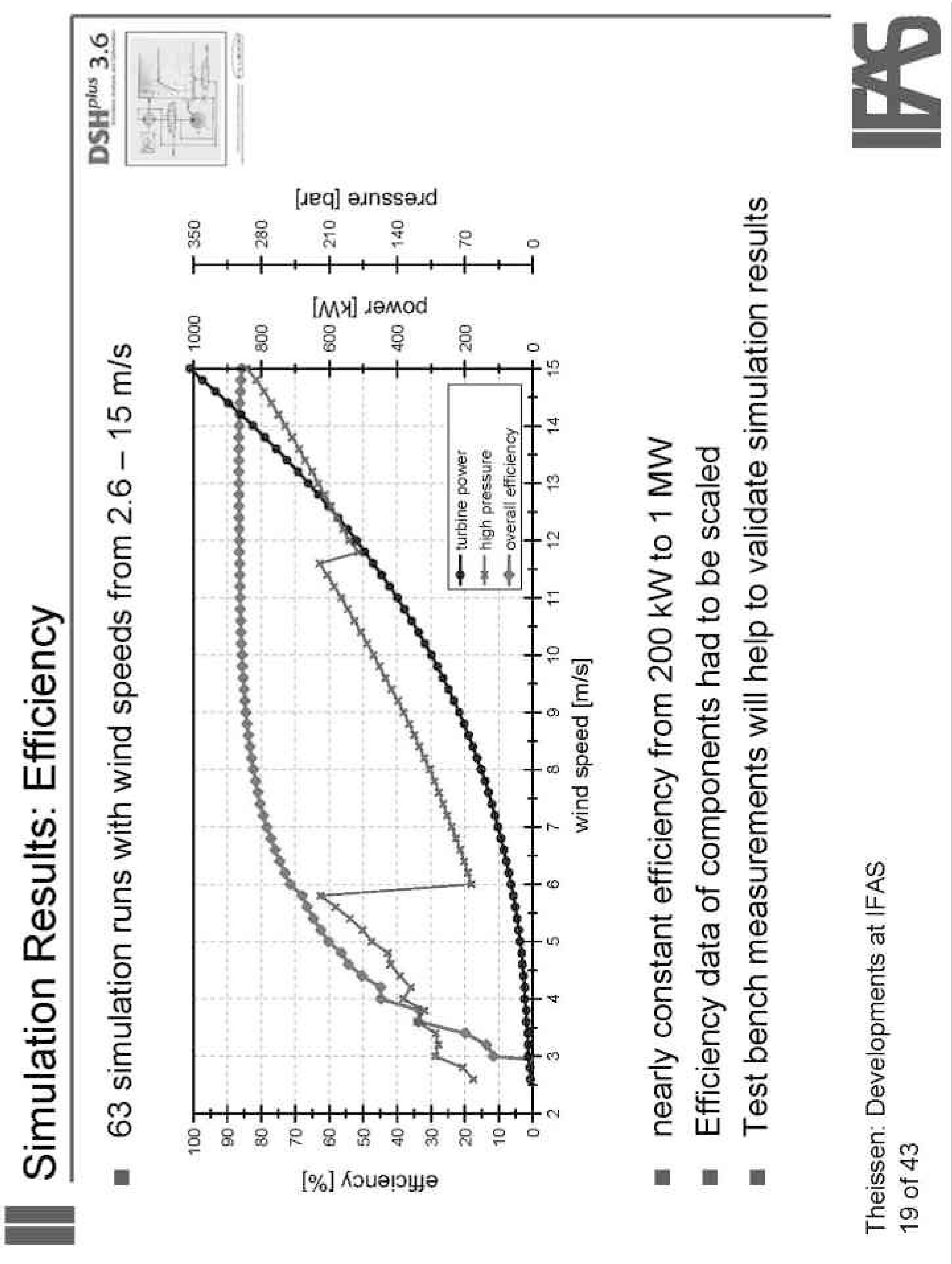
Simulation Results: Efficiency
63 simulation runs with wind speeds from 2.6 – 15 m/s
efficiency [%]
power [kW]
pressure [bar]
wind speed [m/s]
turbine power
high pressure
overall efficiency
nearly constant efficiency from 200 kW to 1 MW
Efficiency data of components had to be scaled
Test bench measurements will help to validate simulation results
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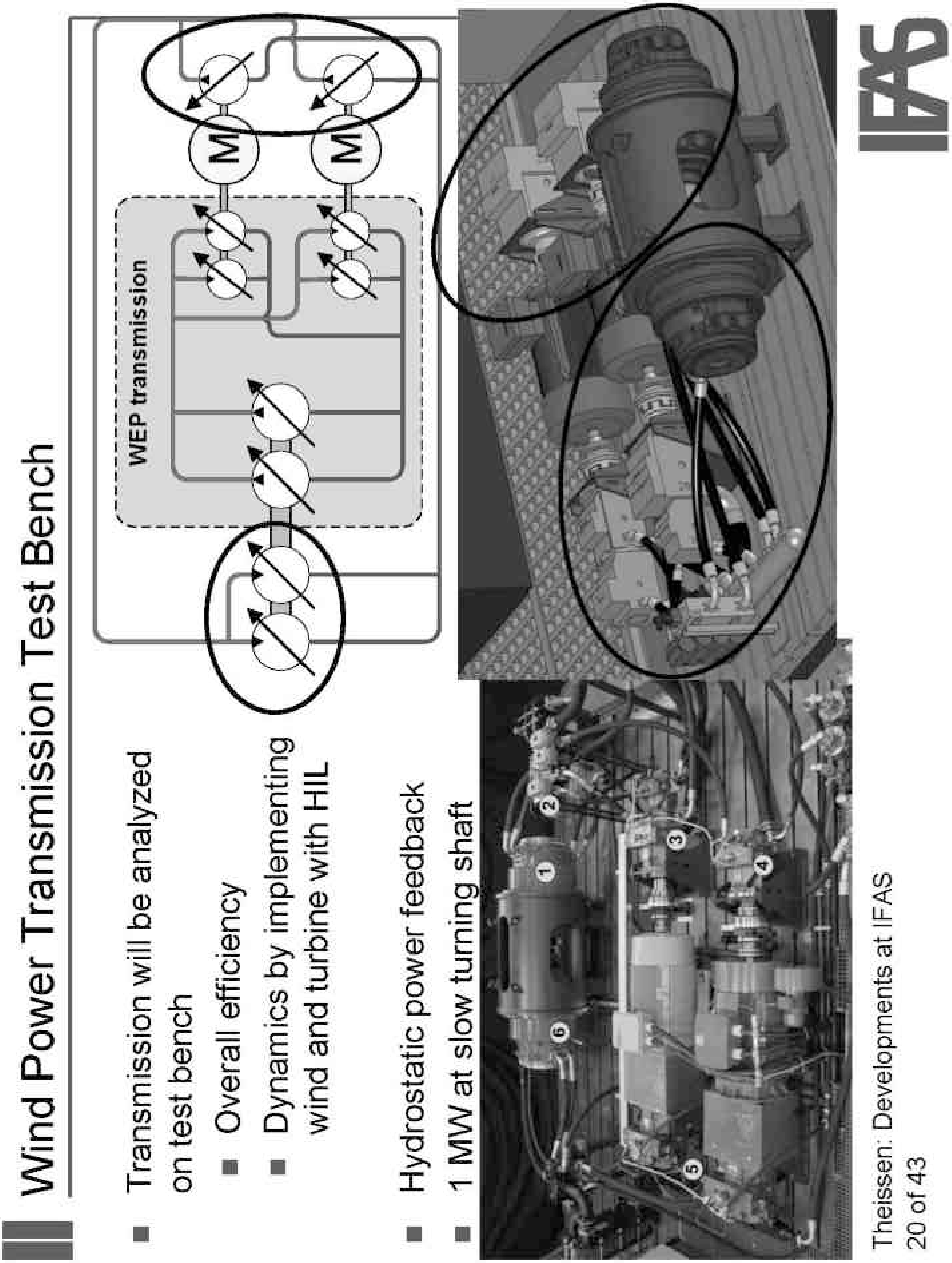
DSH plus 3.6


Wind Power Transmission Test Bench
Transmission will be analyzed on test bench
Overall efficiency
Dynamics by implementing wind and turbine with HIL
Hydrostatic power feedback
1 MW at slow turning shaft
WEP transmission
M
M
1
2
3
4
5
6
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Outline

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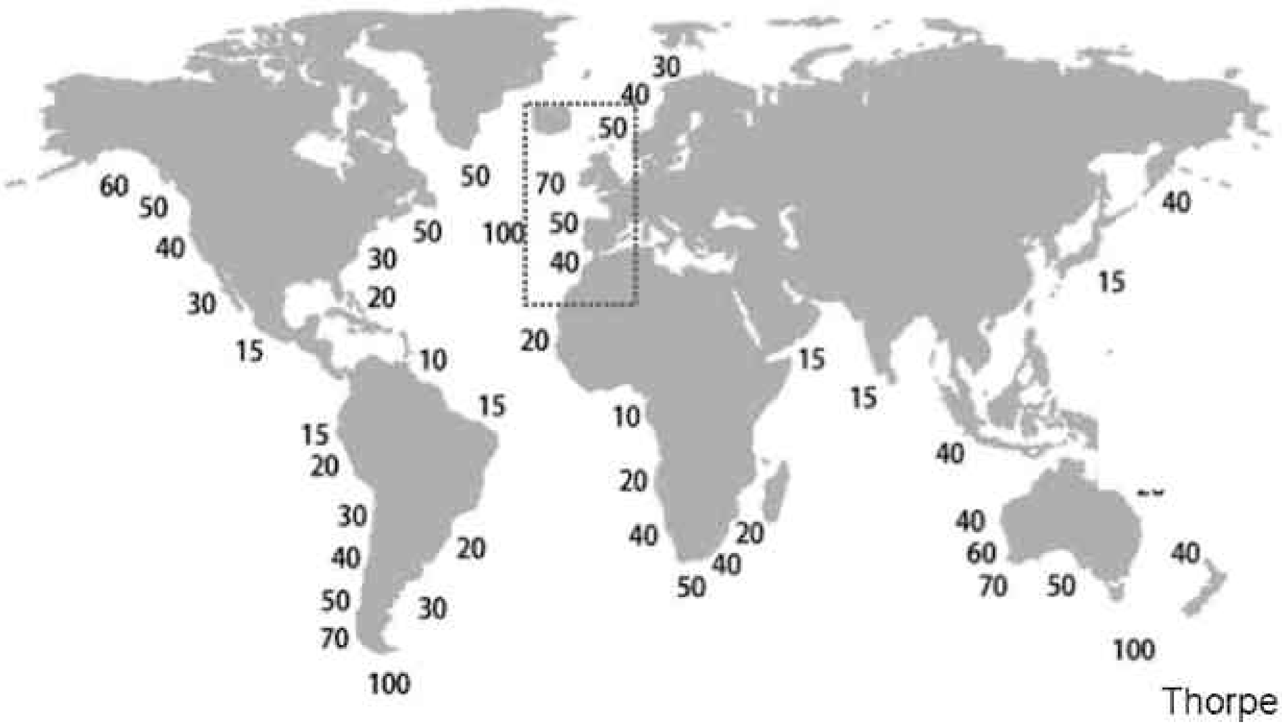
Ocean Wave Energy

- Power of wave energy in kW per meter wave front [kW/m]



- World wide wave power <u>potential</u> ≈ 200 – 400 GW (source: Cruz)
- Compare: World wide wind power <u>capacity</u> 2009 ≈ 160 GW
  (World Wind Energy Association)

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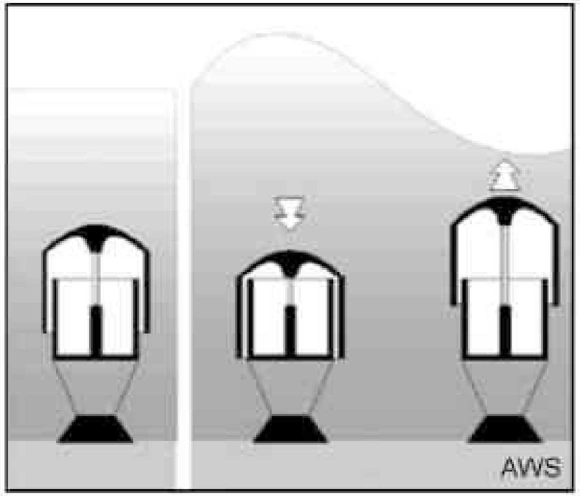
Archimedes Wave Swing – AWS Ocean Energy (Scotland)

- Class: Point absorber (submerged)
  - Axis symmetric (heave axis)
  - Small compared to wavelength
- Prototype:
  - $P = 2$ MW, $m_{total} = 6{,}760$ tons
  - Electric linear generator
- Characteristics:
  - \+ Fully submerged → invisible
  - \+ Good controllability
  - – Durable gas spring necessary
  - – Complex power electronics
  - – Fully submerged → maintenance?
- Prototype sank during start-up



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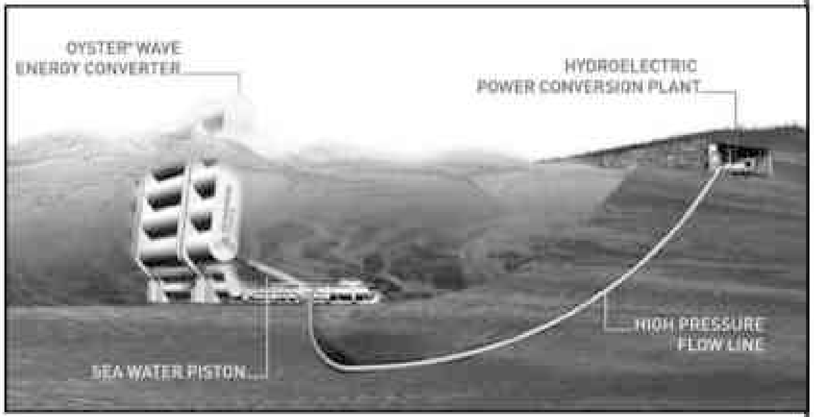
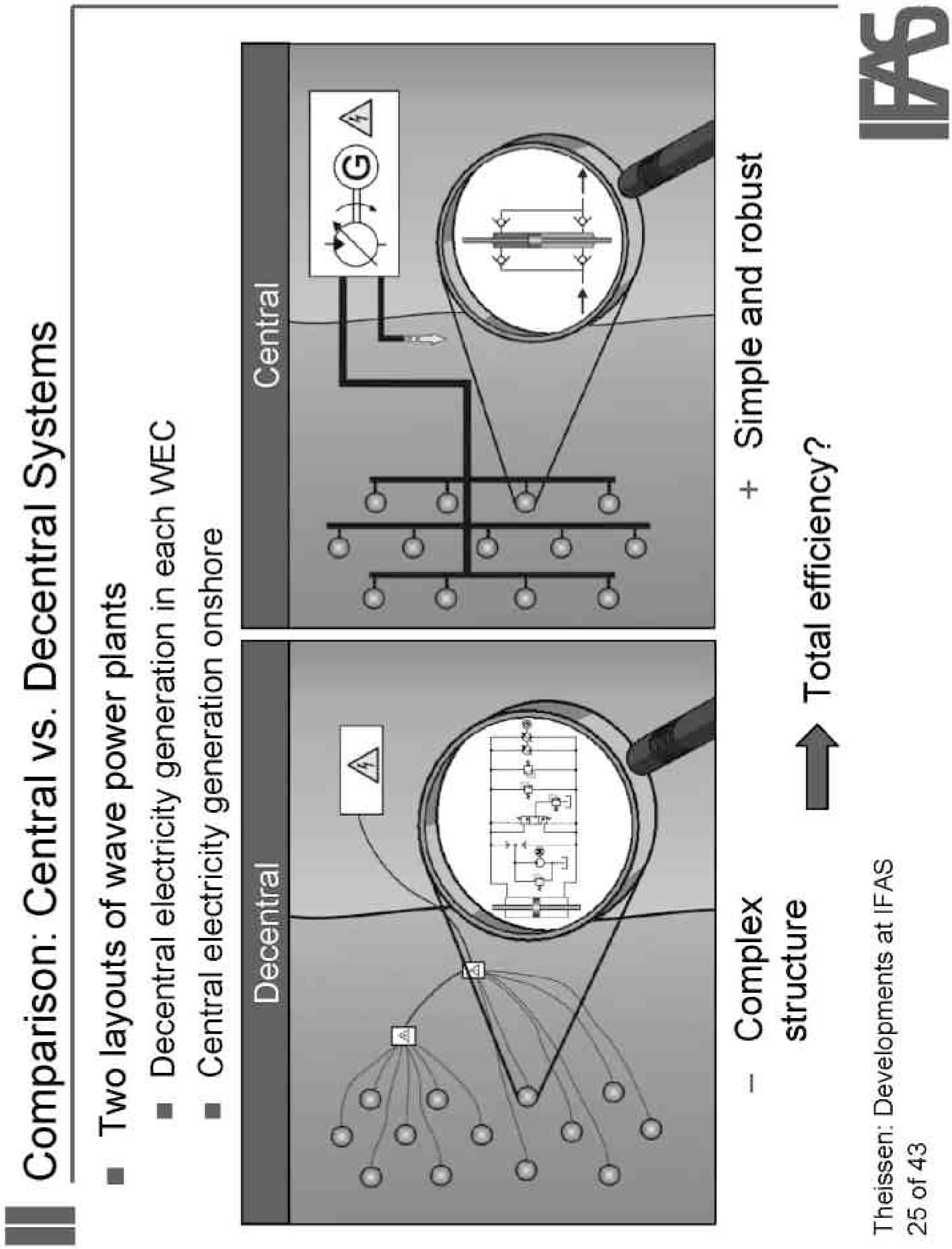
IFAS

Oyster – Aquamarine Power (Scotland)

- Class: Terminator
  - Aligned orthogonal to wave propagation
- Prototype:
  - P = 750 kW
  - Hydrostatic transmission Waterhydraulics, Pelton turbine
- Characteristics:
  + \+ Vulnerable components onshore
  + \+ Simple structure
  + – Exposed to sediment transportation




Comparison: Central vs. Decentral Systems
Two layouts of wave power plants
Decentral electricity generation in each WEC
Central electricity generation onshore
Decentral
Central
G
– Complex structure
+ Simple and robust
Total efficiency?
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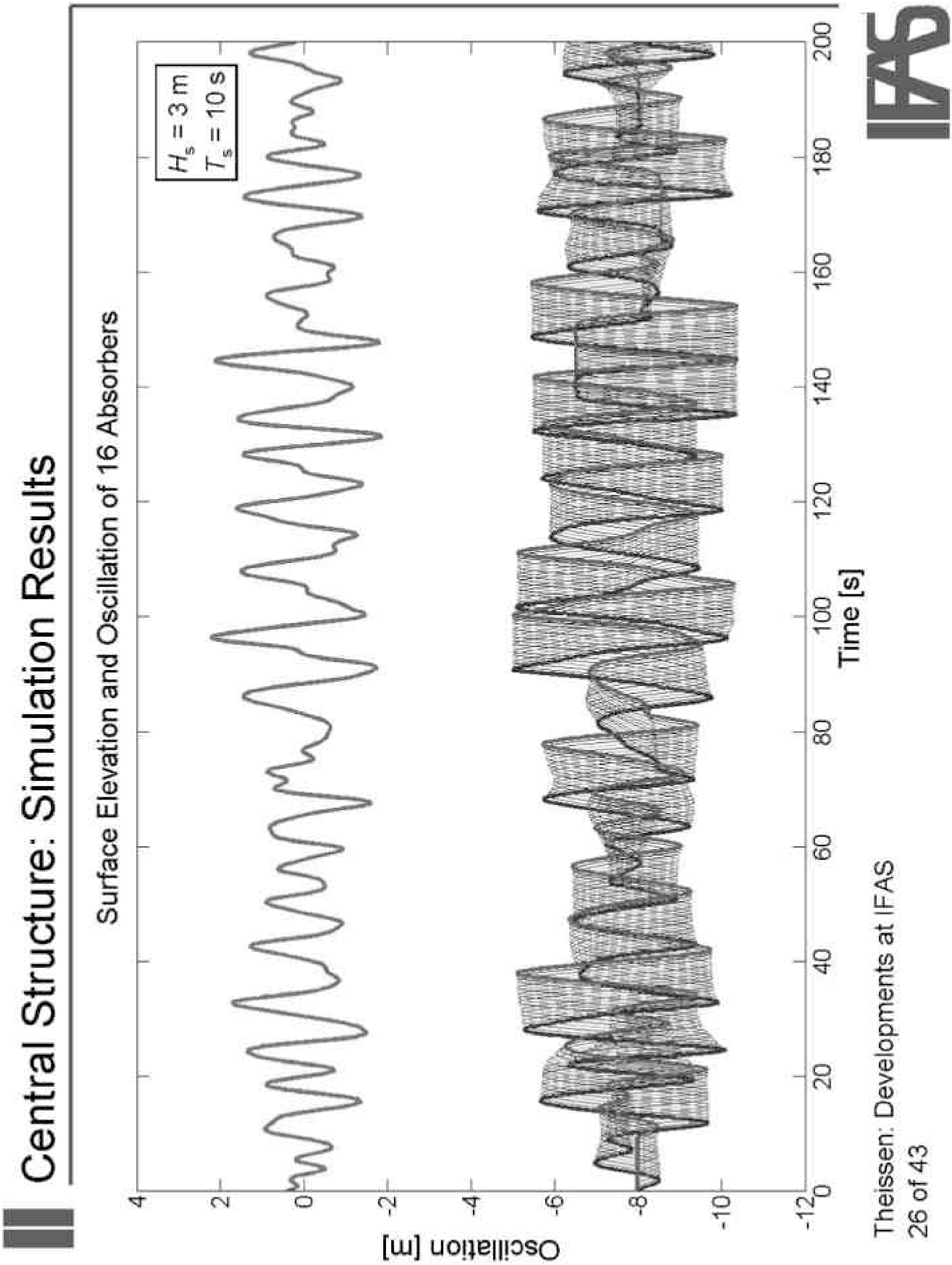
IFAS


Central Structure: Simulation Results
Surface Elevation and Oscillation of 16 Absorbers
H_s = 3 m
T_s = 10 s
Oscillation [m]
4
2
0
-2
-4
-6
-8
-10
-12
0
20
40
60
80
100
120
140
160
180
200
Time [s]
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IFAS

Outline

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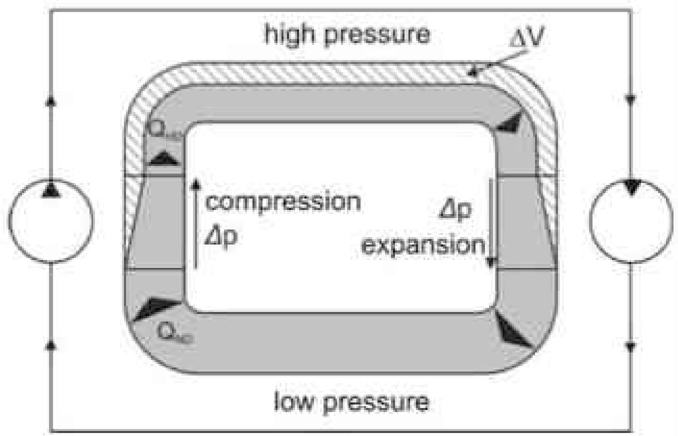
- **Simulation of Hydraulic Systems**
- Digital Pumps



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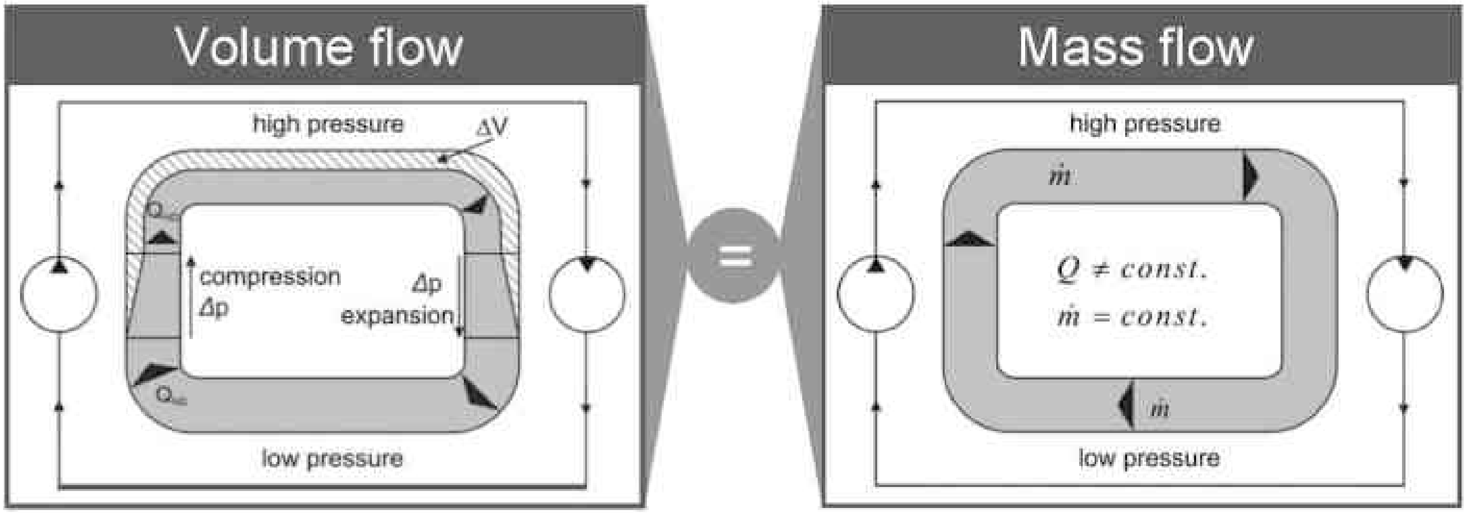
Mass flow vs. volume flow



→ Increase of accuracy especially in closed hydraulic systems

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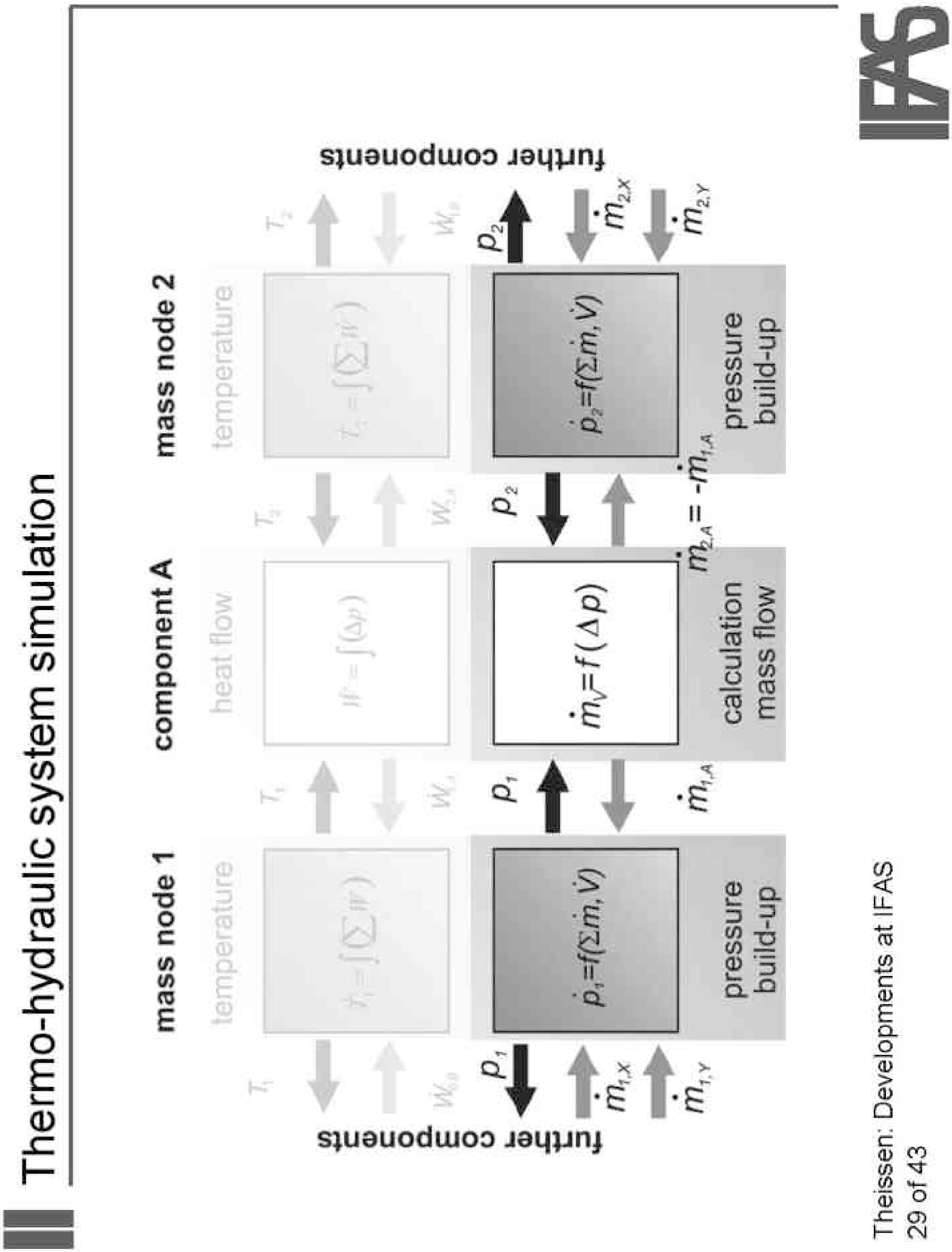
Thermo-hydraulic system simulation
mass node 1
component A
mass node 2
temperature
heat flow
temperature
$\dot{p}_1=f(\Sigma\dot{m},\dot{V})$
$\dot{m}_V=f(\Delta p)$
$\dot{p}_2=f(\Sigma\dot{m},\dot{V})$
pressure build-up
calculation mass flow
pressure build-up
p_1
p_2
$\dot{m}_{1,X}$
$\dot{m}_{1,Y}$
$\dot{m}_{1,A}$
$\dot{m}_{2,A} = -\dot{m}_{1,A}$
$\dot{m}_{2,X}$
$\dot{m}_{2,Y}$
further components
further components
IFAS
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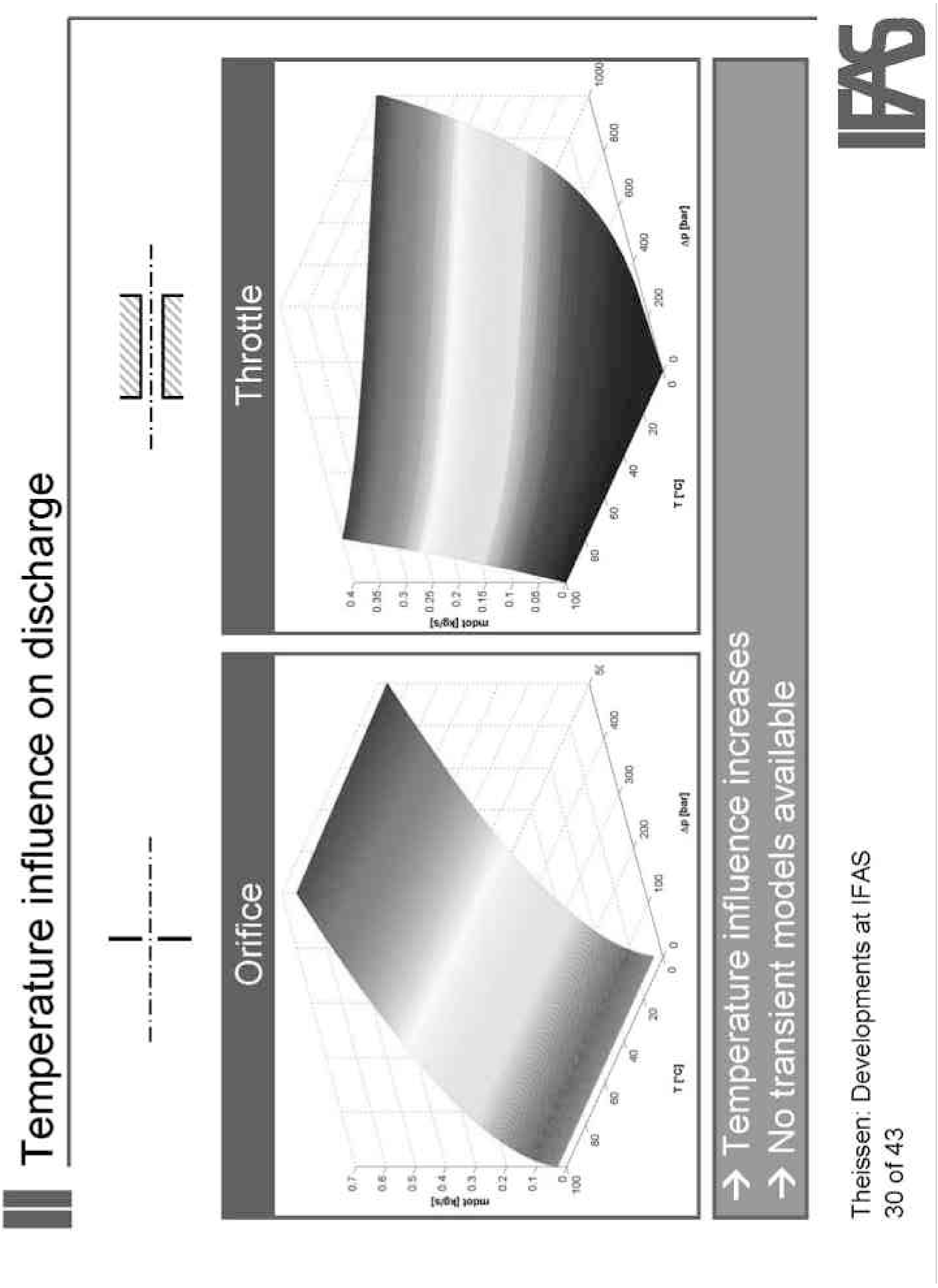
Temperature influence on discharge
Orifice
mdot [kg/s]
T [°C]
Δp [bar]
Throttle
mdot [kg/s]
T [°C]
Δp [bar]
→ Temperature influence increases
→ No transient models available
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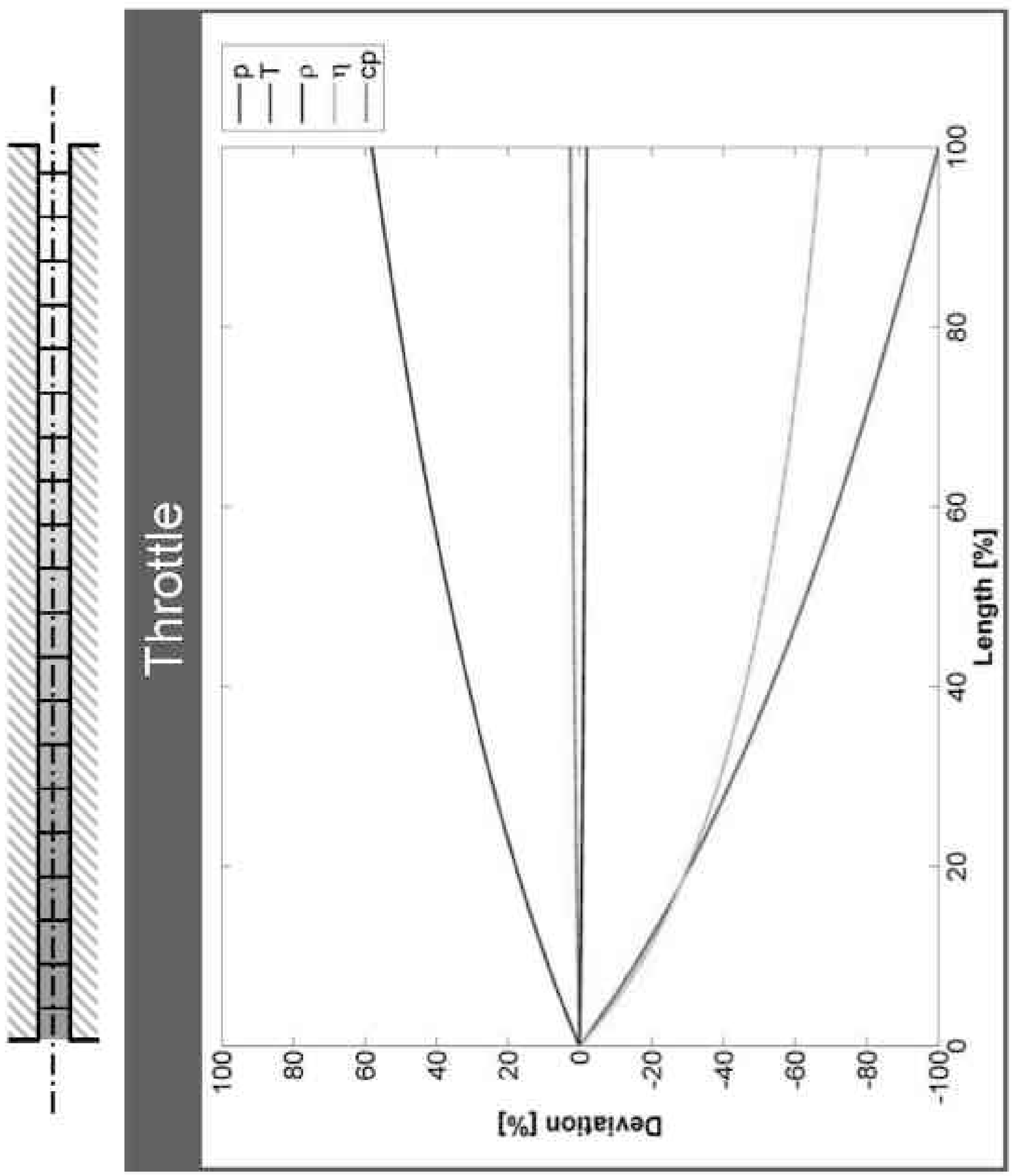
Change of physical parameters over length



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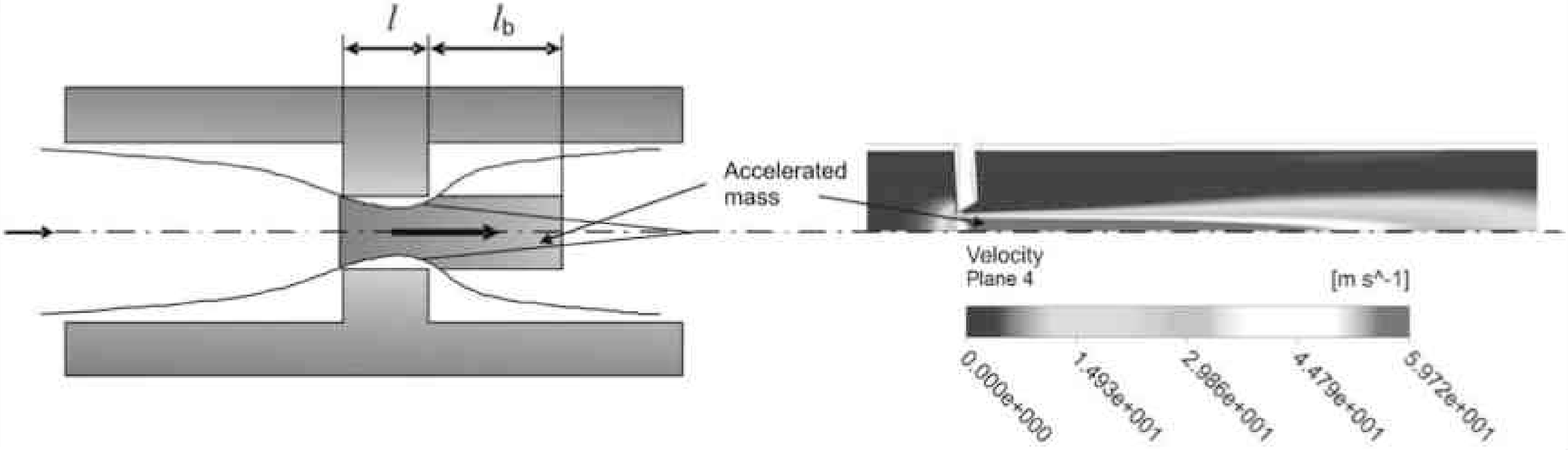
Description of transient behaviour

Inductivity of accelerated mass

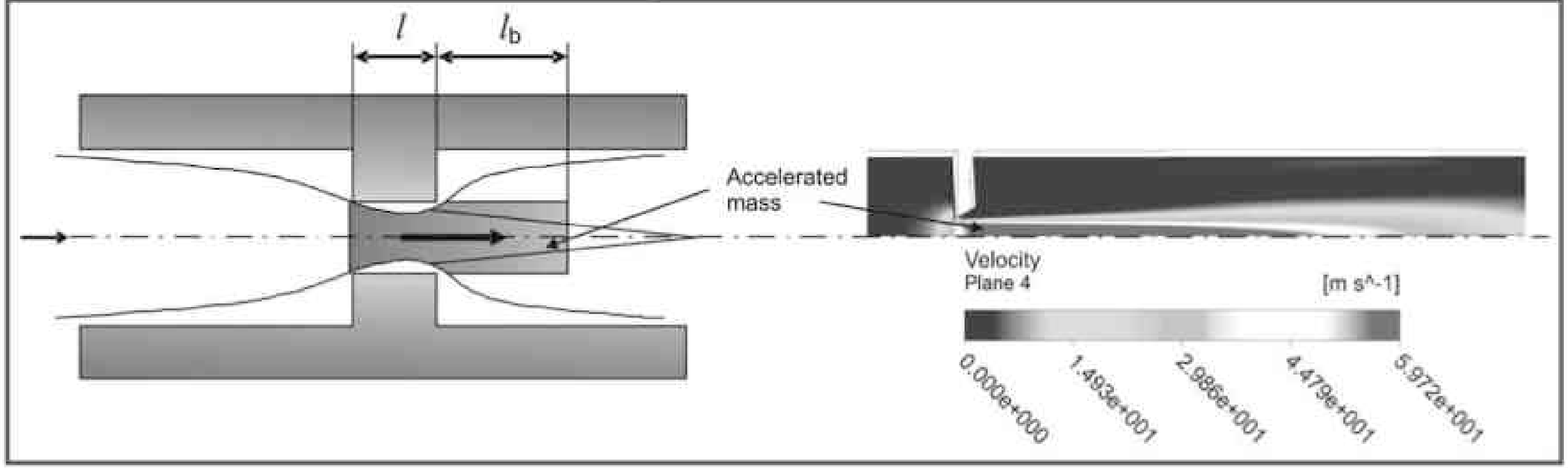


Source: Tsung (1991)

→ Inductivity relevant at high frequencies

Description of transient behaviour

Inductivity of accelerated mass



Source: Tsung (1991)

→ Inductivity relevant at high frequencies

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Outline

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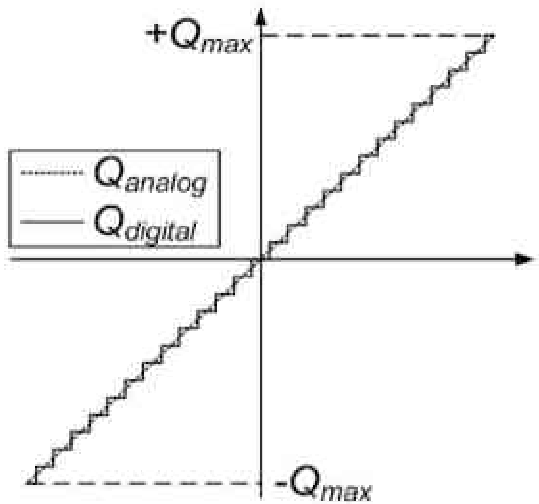

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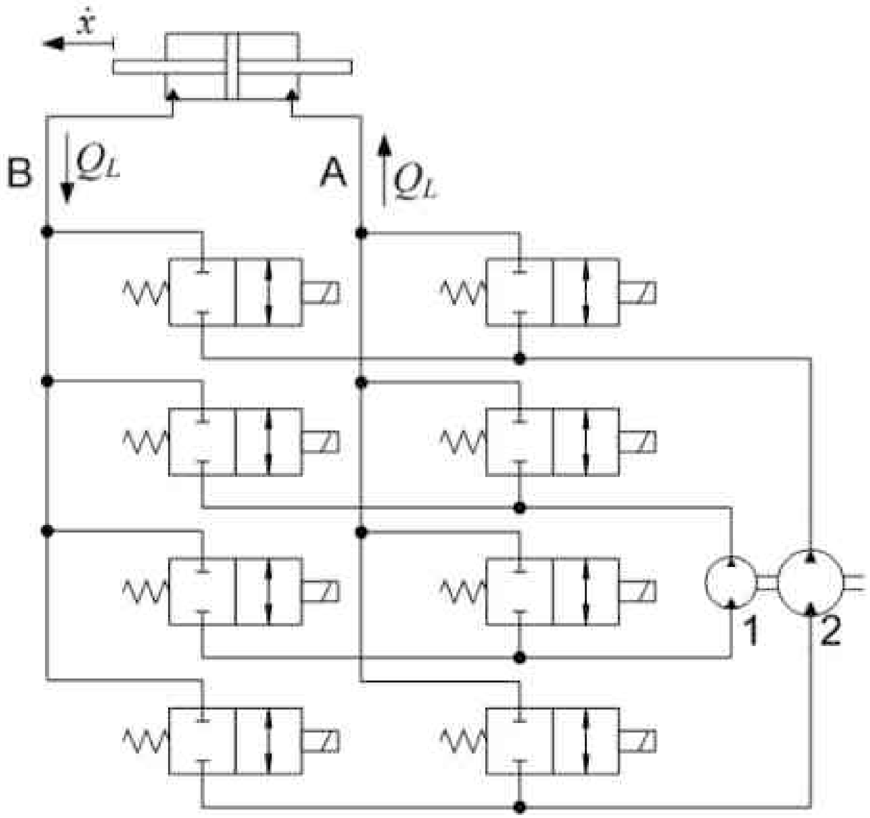
Digital Pump made of Constant Pumps and Valves



- Flow Q_L is realized by adding or subtracting individual pump flows Q_1 and Q_2

- Advantages:
  - simple components
  - good partial load efficiency
  - multiple use of pumps

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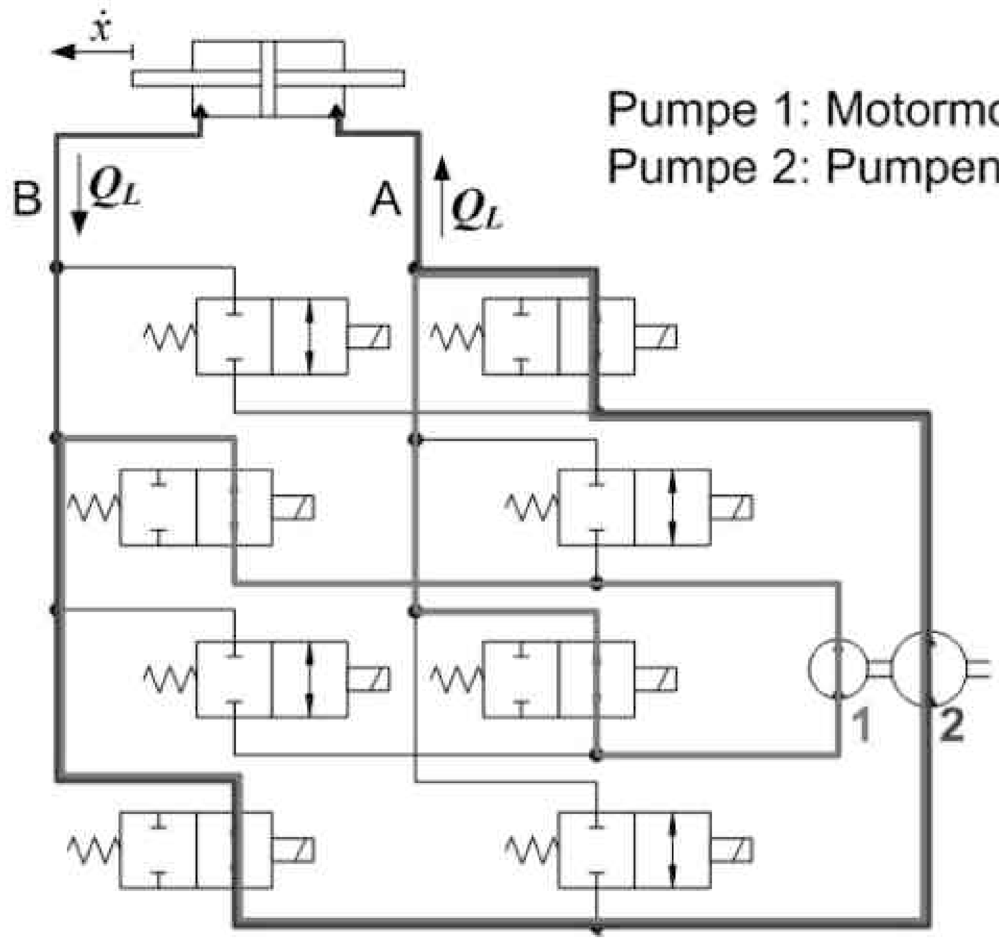
Binary Gradation (1, 2, 4, 8, ...)

"Leerlauf" = idle



Pumpe 1: Motormodus
Pumpe 2: Pumpenmodus

Q_1	Q_2	Q_L
-1	-2	-3
0	-2	-2
~~1~~	~~-2~~	~~-1~~
-1	0	-1
0	0	0
1	0	1
~~-1~~	~~2~~	~~1~~
0	2	2
1	2	3

pump and idle modes

Theissen: Developments at IFAS
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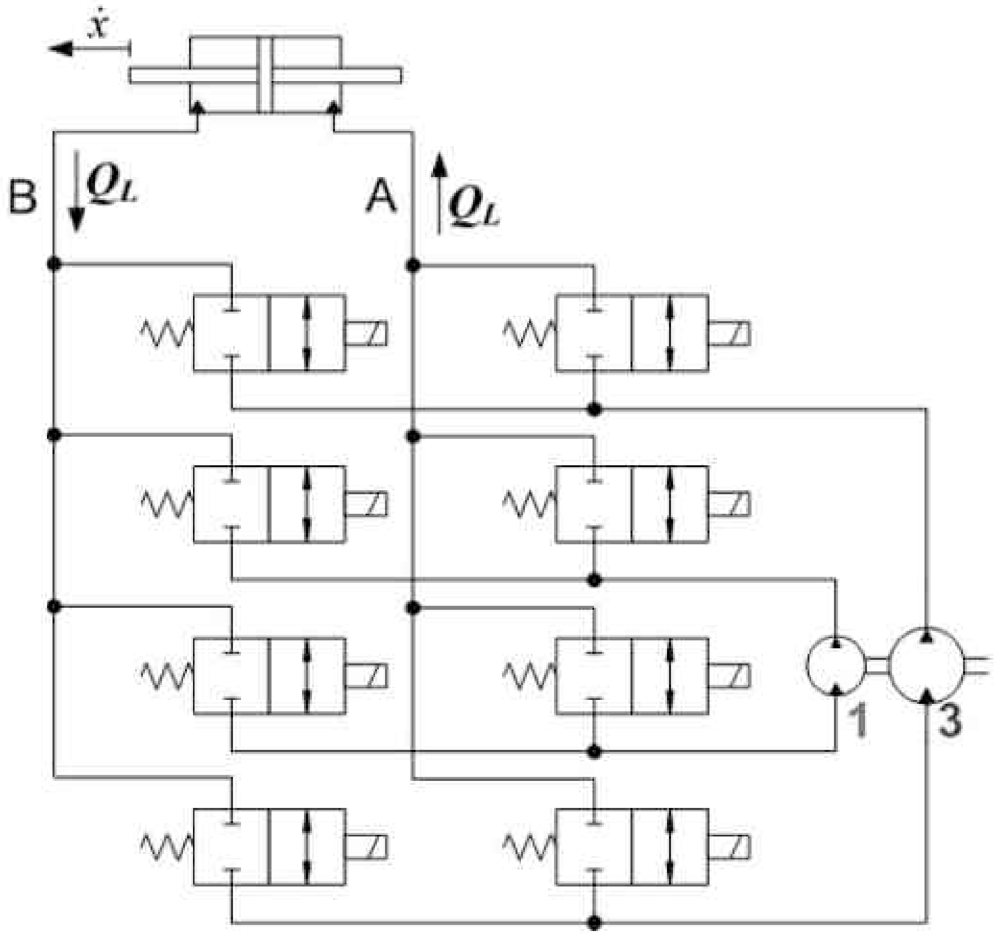
Ternary Gradation (1, 3, 9, 27, ...)



Q_1	Q_2	Q_L
-1	-3	-4
0	-3	-3
1	-3	-2
-1	0	-1
0	0	0
1	0	1
-1	3	2
0	3	3
1	3	4

pump, idle, and motor modes

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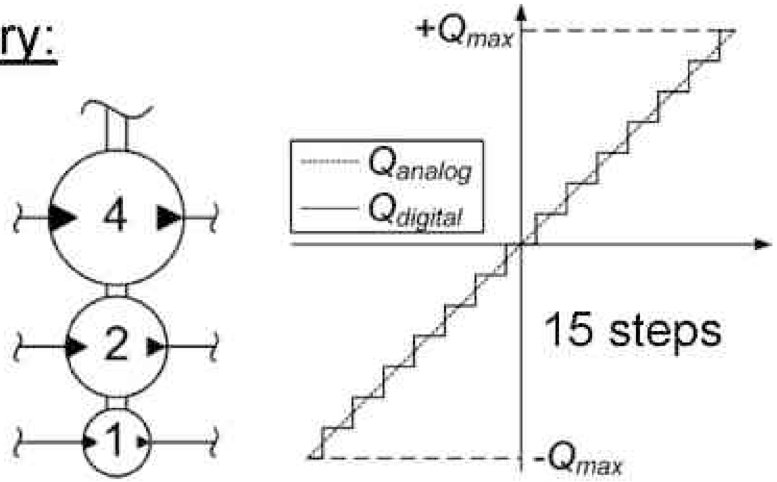
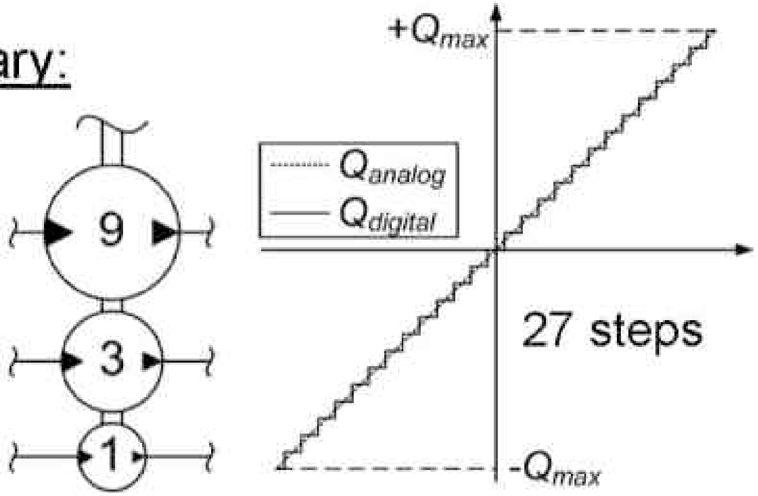
Resolutions of Binary and Ternary Gradation

Binary:



# of pumps	resolution[1]
2	16,7 %
3	7,1 %
4	3,3 %
5	1,6 %
6	0,8 %

Ternary:



# of pumps	resolution[1]
2	12,5 %
3	3,8 %
4	1,3 %
5	0,4 %
6	0,1 %

1: refers to maximum flow

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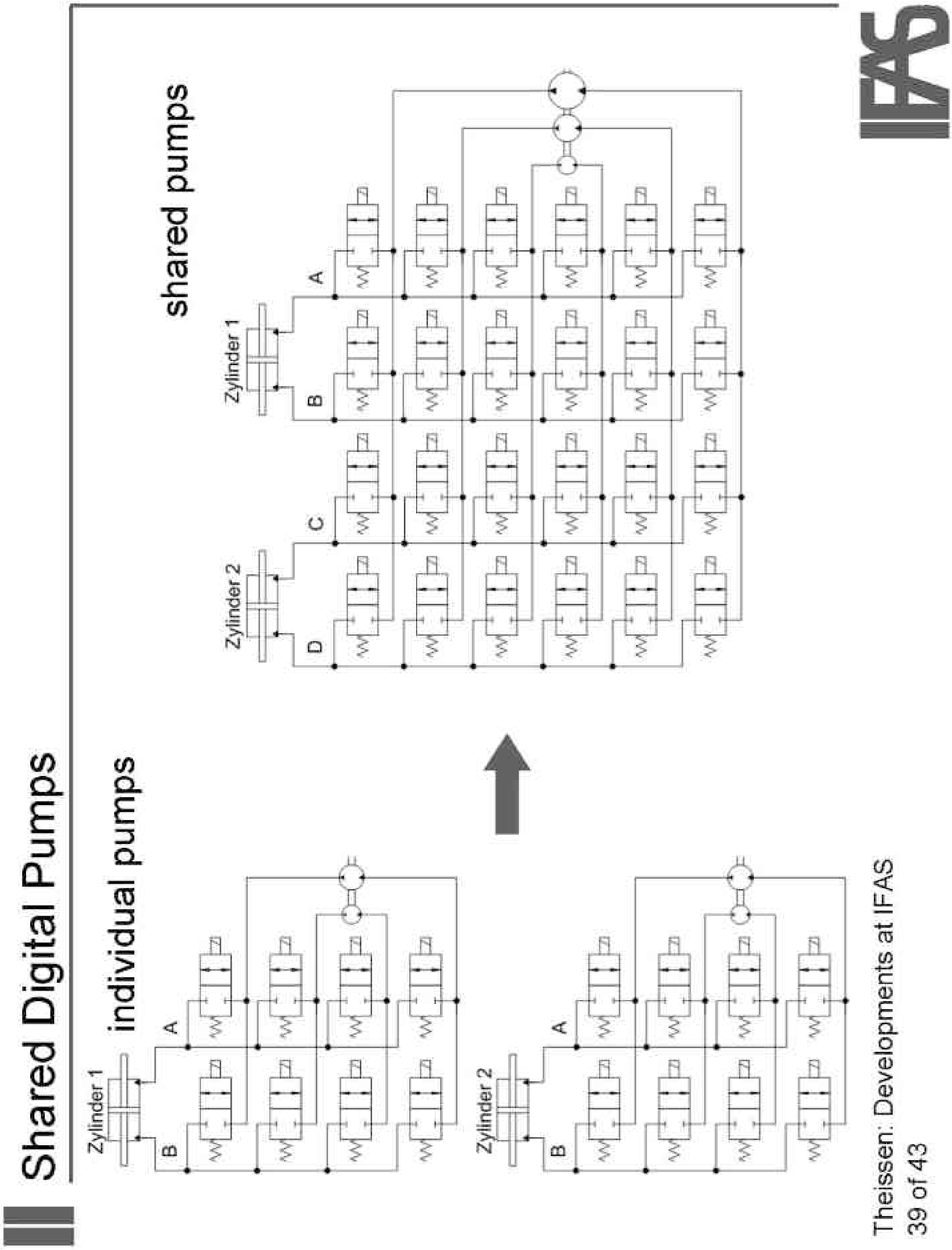
IFAS


Shared Digital Pumps
individual pumps
Zylinder 1
A
B
Zylinder 2
A
B
shared pumps
Zylinder 1
A
B
Zylinder 2
C
D
Theissen: Developments at IFAS
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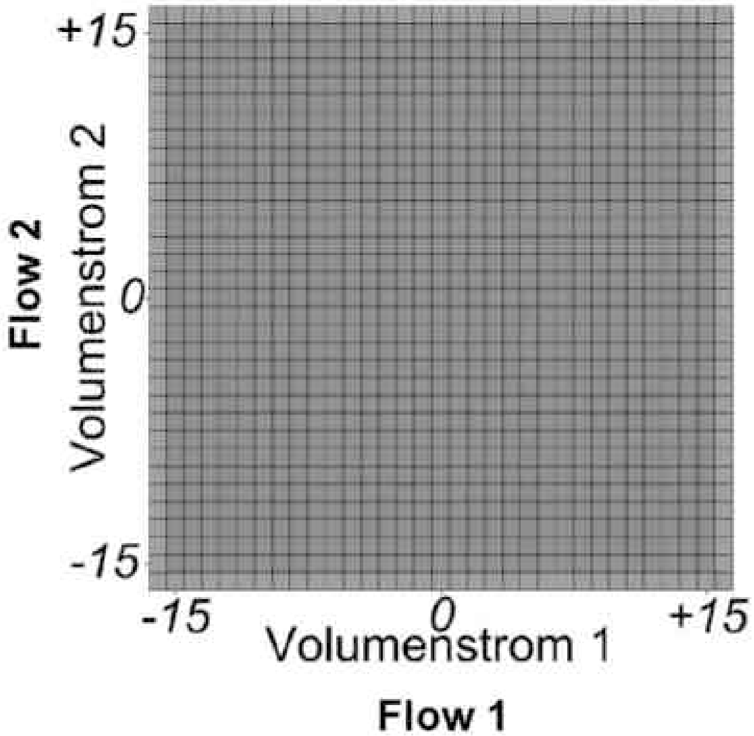
IFAS

Operating Ranges

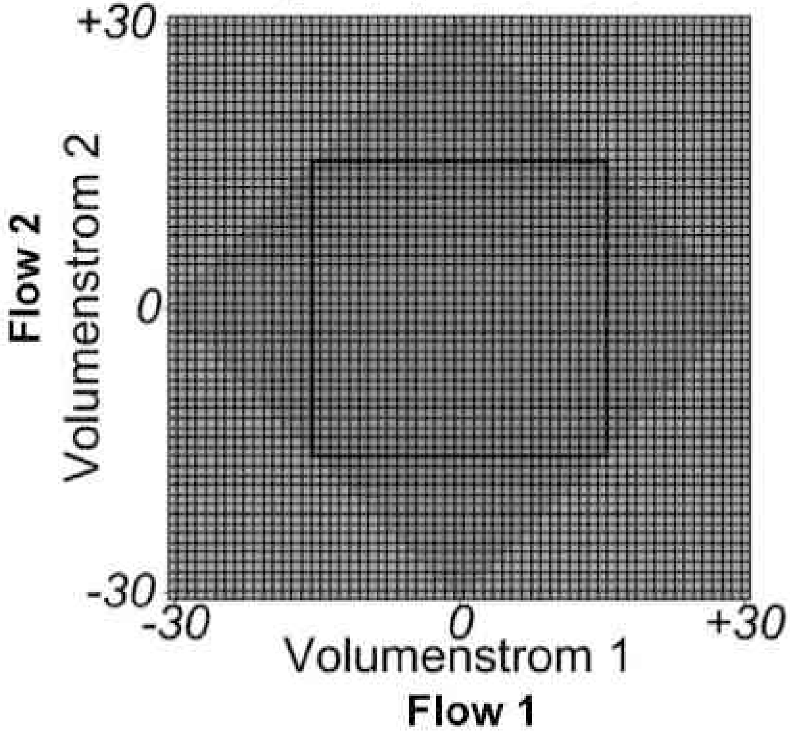
Individual pumps

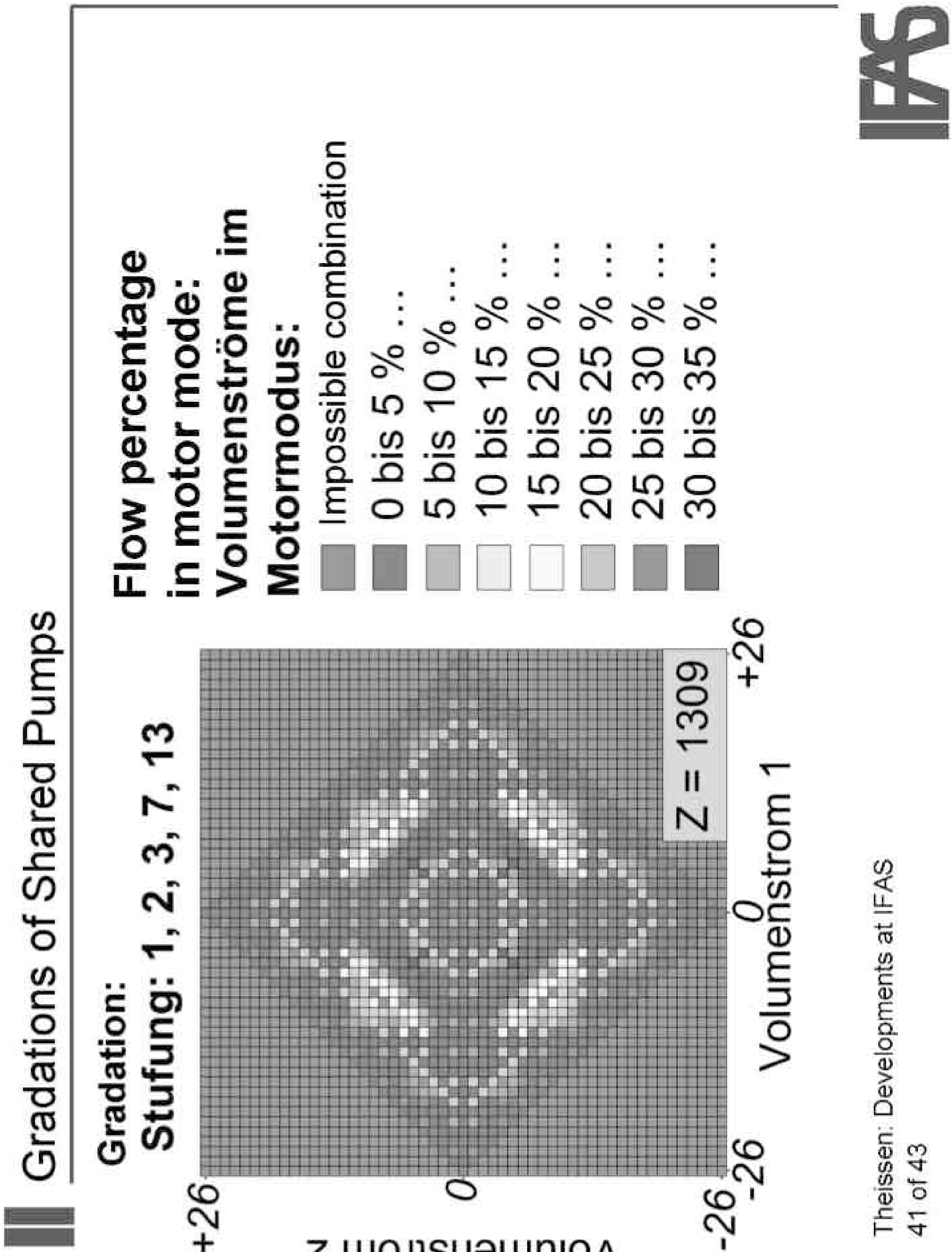
Gradation:
Stufung: 1, 2, 4, 8 + 1, 2, 4, 8

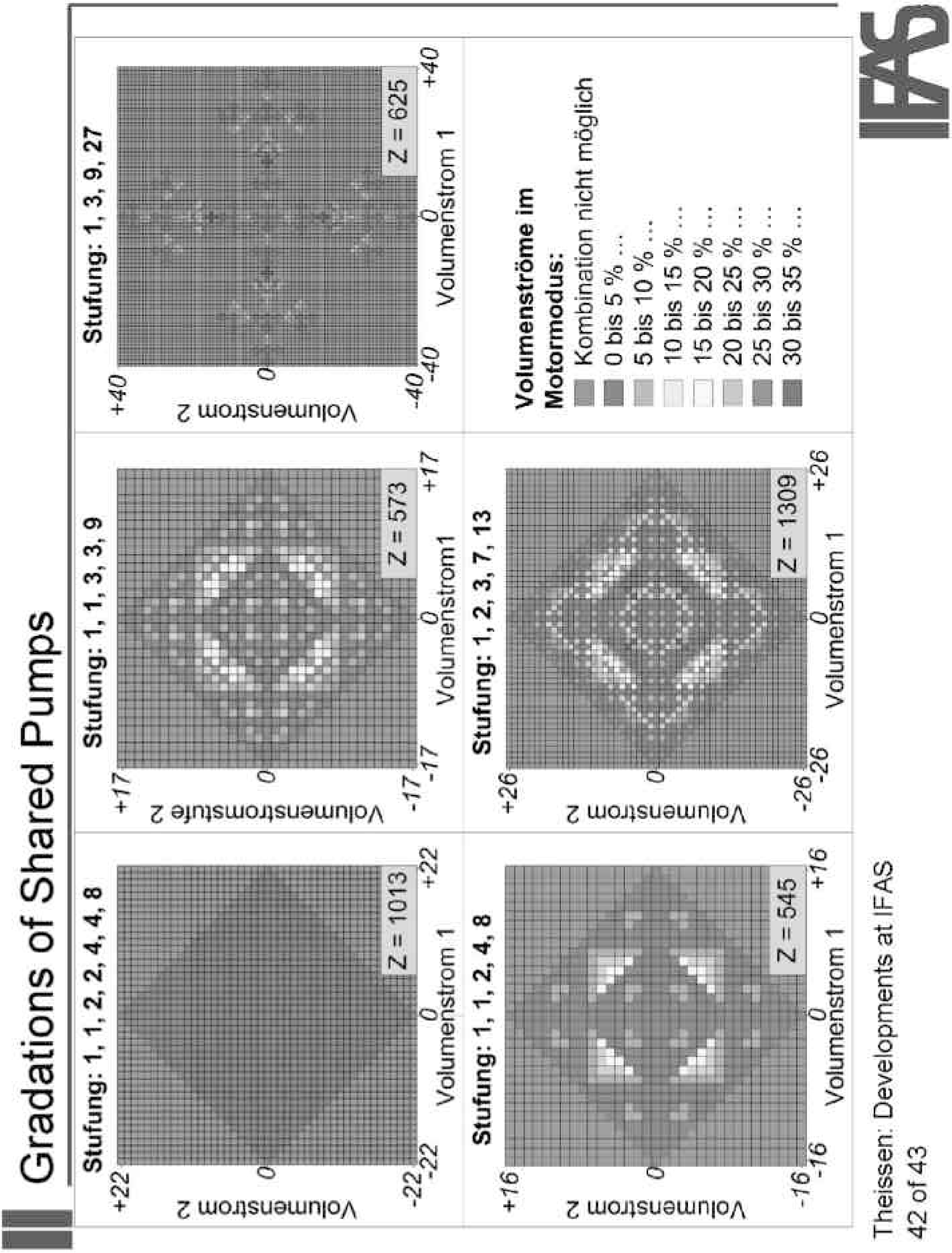


Shared pumps

Gradation:
Stufung: 1, 1, 2, 2, 4, 4, 8, 8




Gradations of Shared Pumps
Gradation:
Stufung: 1, 2, 3, 7, 13
Flow percentage
in motor mode:
Volumenströme im
Motormodus:
Impossible combination
0 bis 5 % ...
5 bis 10 % ...
10 bis 15 % ...
15 bis 20 % ...
20 bis 25 % ...
25 bis 30 % ...
30 bis 35 % ...
Z = 1309
Volumenstrom 1
Volumenstrom 2
+26
0
-26
Theissen: Developments at IFAS
41 of 43
IFAS


Gradations of Shared Pumps
Stufung: 1, 1, 2, 2, 4, 4, 8
Z = 1013
Stufung: 1, 1, 3, 3, 9
Z = 573
Stufung: 1, 3, 9, 27
Z = 625
Stufung: 1, 1, 2, 4, 8
Z = 545
Stufung: 1, 2, 3, 7, 13
Z = 1309
Volumenstrom 1
Volumenstrom 2
Volumenstromstufe 2
Volumenstrom1
Volumenströme im Motormodus:
Kombination nicht möglich
0 bis 5 % ...
5 bis 10 % ...
10 bis 15 % ...
15 bis 20 % ...
20 bis 25 % ...
25 bis 30 % ...
30 bis 35 % ...
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EXPERIMENTAL PROCEDURE FOR ACTUATIO N SYSTEMS WITH HIGH AND MEDIUM PRESSURES

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INOE 2000 - IHP Bucureşti

Abstract
This paper has the propos to make a dissemination of the information regarding the experimental methodologies of complex pneumatic device, in the main broadly, of an actu ation servo-system, in particularly, synthesizing and peculiarity of the theoretical bases and the latest information from this field (pneumatic actuations and automatic of the complex systems) and combine it with 20 years of experience in IHP Bucharest, has be established the experimental procedures of the pneumatic and mecatronic systems. Also will be made a short presentation of the main elements that must be take in consideration when a testing procedure is elaborated do draw the characteristics of a pneumatic servo-system with actuators.

Introducere

Elaborarea procedurilor de experimentale în cazul sistemelor pneumatice în care sunt implementaţi actuatori, respectă în linii mari metodologia subsistemelor pneumatice de bază şi a componentelor din structura unei scheme pneumatice. Cum însă sistemele cu actuatori moderne sunt în general servosisteme, care se deosebesc din punct de vedere funcţional de sistemele standard (clasice), vor apărea câteva elemente noi în privinţa elaborării proceduri sau protocolului de experimentare, care trebuie s ă reunească următoarele aspecte:

- Modalităţi de analiză funcţională a sistemul pneumatic de probat cu actuatori ce este considerat ca un sistem automat;
- Particularităţile de abordare a parametrilor funcţionali (ipotezele de lucru) prin care se fac experimentările;
- Parametrii de performanţă şi caracteristicile de funcţionale specifice acestor sisteme pneumarice automate.

1. Modalităţi de analiză funcţională şi metodologiile de experimentale a sistemelor complexe cu actuatori

În literatura de specialitate există mai multe procedee de analiză experimentală a sistemelor, care se pot aplica şi în cazul nostru. Dintre acestea amintim:

- **Analiza statică,** ce se poate utiliza dacă se urmăreşte descrierea sistemului stabil, pentru intrări constante.
- **Analiza dinamică,** utilizată numai în cazul în care se urmăreşte determinarea regimului dinamic;
- **Analiza continuă,** prin această metodă se urmăreşte continuu evoluţia în timp a ieşirilor sistemului şi cea a intrărilor sale;
- **Analiza a unei variabile sau mai multe,** utilizată dacă sistemul are o singură intrare şi ieşire (sau mai multe);
- **Analiza folosind modele matematice liniare sau neliniare,** metodă des întâlnită atunci când modelul este liniar iar dacă nu se liniarizează pe porţiuni.

Fiecăreia din abordările enumerate îi corespunde un număr de procedee de analiză matematică evoluată din care amintim: analiza seriilor Fourier; analiza de corelaţie; procedeele de ajustare; estimare parametrilor.

Din cadrul metodologiilor de experimentale a sistemelor complexe cu actuatori, laboratorul de pneumatică din cadrul INOE 2000 - IHP are capacitatea de a realiza doar primele două metodologii de analiză.

2. Particularitățile funcționale ale sistemelor pneumatice cu actuatori de medie şi înaltă presiune şi parametrii de testare.

Pentru a elabora procedura de experimentare a sistemelor pneumatice cu actuatori de presiune medie şi înaltă, se va ţine cont în primul rând de parametri funcționali (atât în regim static cât şi dinamic).

Trebuie reamintit ca sistemele de actuatori de a caror metodologii ne vom ocupa in continuare nu sunt sisteme de actionare pneumatice „clasice", ci servosisteme complexe ce lucreaza de cele mai multe ori in regim automat. De aici putem stabili regimul de funcționare precum şi metode de comandă şi control specifice fiecărui actuator pentru a întocmi procedurile şi protocolul de experimentare.

În figura 1 şi 2 sunt prezentate două de astfel de servosisteme reprezentative.

Particularitățile sistemelor pneumatice cu actuatori la presiuni medii şi înalte sunt influențate de muți factori, cum ar fi:

a) Compresibilitatea aerului comprimat

La presiunii de lucru sub 16 bar (presiune de lucru medie), funcţionarea servo-sistemului depinde atât de variația sarcinii *F* cât şi a temperaturii de lucru *T*, cea ce reiese că agentul de lucru este compresibil.

La presiunii mai mari de 16 bar (presiune de lucru înaltă), funcționarea servosistemului depinde doar de variația sarcinii *F*, iar influenta temperaturii de lucru *T* fiind nesemnificativă. Agentul de lucru fiind practic incompresibil.

b) Procesele termodinamice ce apar în regimul de lucru pentru care se fac experimentările: la presiuni medii (sub 16 bar) se stabilesc transformări adiabate sau izoterme iar presiuni înalte (de până la 40 bar) politrope sau izoterme. La ora actuală laboratorul de pneumatica din cadrul IHP realizează experimentări numai pe baza ipotezelor izoterme.

c) Numărul parametrilor funcționali ce pot fi controlați în cadrul experimentărilor (ce depind în mare parte de gradul de automatizare a standului).

Atunci când se controlează un parametru, variația factorilor perturbatori externi este considerată nulă sau neglijabilă. Această metodă este folosită la determinarea caracteristicilor statice şi dinamice ce pot fi controlate într-un sistem de reacție cu bucla deschisă (pentru determinarea forțelor sau momentelor). În cazul în care se doreşte urmărirea mai multor parametri, atunci când variația factorilor perturbatori externi este luata în considerare, sistemele sunt comandate în bucla închisă.

Altfel spus experimentările sistemelor pneumatice cu actuatori pot fi abordate numai în unul din următoarele moduri:

- Experimentări în regim static;
- Experimentări în regim dinamic.

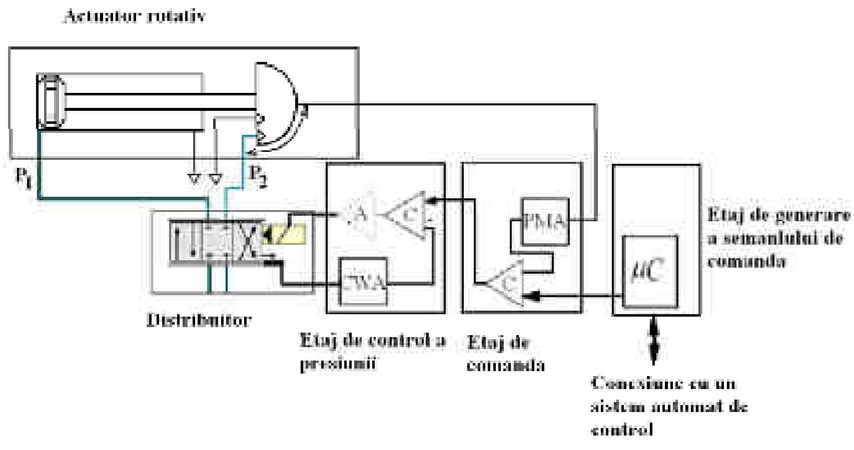

Fig.1 Servosistem de rotație pneumatic cu control al poziției

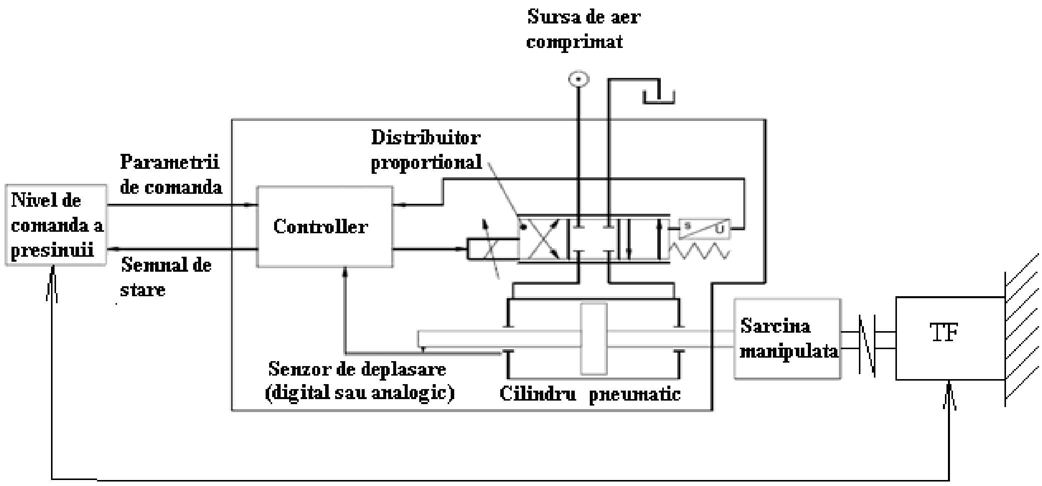

Fig.2 Servosistem liniar pneumatic cu control al forței

Având în vedere particularitățile sistemelor pneumatice ce au fost men ționate mai sus, principalii parametrii principali care sunt stabiliți în cadrul metodologiilor de testare al unui servo-echipament pneumatic sunt următorii: presiunea de lucru și de comandă (p si p_c); debit masic Q_m sau volumic Q_v de aer (debitul masic, apare în principal la măsurători în domeniul presiunilor mai mici de 16 bar); cursa actuatorului c sau α (liniară sau unghiulară a servomotorului pneumatic); viteza actuatorului v sau ω(liniară sau unghiular); curentul de comanda I (amplitudinea A sau frecventa ν); temperatura agentului de lucru T, (întrucât $\rho_{aer}=f(T)$ şi de aici se determină variația lui p și Q). Acești parametrii se stabilesc atât în regim static cât şi în regim dinamic.

Pentru a verifica funcționarea sistemului în ***regim static*** a unui servo-sistem cu actuatori se determină următoarele caracteristici:

a) Caracteristica de reglare a servo-echipamentului (în frecvență): caracteristica curent-frecvență de comandă $I=f(\nu)$ şi caracteristica curent de comandă – forță actuator $I=f(F)$. Pentru care determinările se fac în domeniile: $I=0\text{-}I_{max}$ curent comanda, pentru $Q=Q_{max}$ şi $p=p_{max}$ aer comprimat;

b) Caracteristica statică a servo-echipamentului (în frecvență): caracteristica cursă-forță actuator: $s=f(F)$ şi caracteristica forță-frecvență de comand ă $F=f(\nu)$. Aceşti parametrii se verifică numai în regim static.

Verificarea func ționării în regim dinamic a unui servosistem cu actuatori se trasează în funcție de răspunsul acestuia atunci când asupra lui acționează factorii perturbatori. Astfel sunt determinate următoarele caracteristici:

a*) Caracteristicii de răspuns la semnal treaptă.* Domeniul de lucru al sistemului este: $I=0\text{-}I_{max}$ şi $F=F_{max}$, iar parametrii ce sunt determinați cu ajutorul acestei caracteristici sunt: t_i=timpul de întârziere [ms]; t_s=timpul de suprareglare [ms] şi σ=suprareglarea, pentru $s=1/2\ c$ şi $s=1/1\ c$;

b) Caracteristica de răspuns la semnal rampă (numai în anumite situații). Domeniul de lucru al sistemului este: $I=0\text{-}I_{max}$ și $F=F_{max}$, iar parametrii ce sunt determinați sunt: t_i=timpul de întârziere [ms]; t_s=timpul de suprareglare [ms] şi σ=suprareglarea, pentru $s=1/2\ c$ şi $s=1/1\ c$;

c)Caracteristica de răspuns la semnal sinosoidal (în amplitudine situații). Domeniul de lucru al sistemului este: $I=-0{,}05I_{max}$ - $+0{,}05I_{max}$ pentru domeniul de frecvente 0...100Hz şi astfel se trasează diagrama Bode;

3. Elaborarea procedurilor de experimentare sisteme de actionare cu actuatori

Plecând de la cele menționate înainte procedurile de experimentare sunt grupate pe două categorii: proceduri (protocoale) de experimentare a sistemelor cu actuatori în regim static cât și proceduri (protocoale) de experimentare a sistemelor cu actuatori-în regim dinamic. La rândul lor acestea pot avea ca obiect de studiu: sisteme de actuatori cu controlul deplasării liniare sau de radiale şi sisteme de actuatori cu controlul forței sau momentului;

În prima categorie de sisteme intră majoritatea instalaţiilor cinematice (sisteme sau servosisteme monoaxiale sau multiaxiale cu diferite grade de libertate), iar în a doua categorie se încadrează dispozitive de manipulatoarele sau roboţi

Complexitate funcţională a sistemelor pneumatice determină structura unei proceduri, care este cuprinsă din:

- Schema bloc de de verificare a performanţelor statice şi dinamice a unui servoechipament pneumatic (de deplasare sau de forţă);
- Schema bloc de proces a sistemului de verificat;
- Schema cinematica de de principiu a sistemului;
- Schema funţc ională a sistemului – simbolizare şi structură
- Schemele de testare pneumatice a servo-echipamentelor;
- Schema de proces a sistemului de experimentare a unui servo-echipament pneumatic din punct de vedere static sau dinamic;

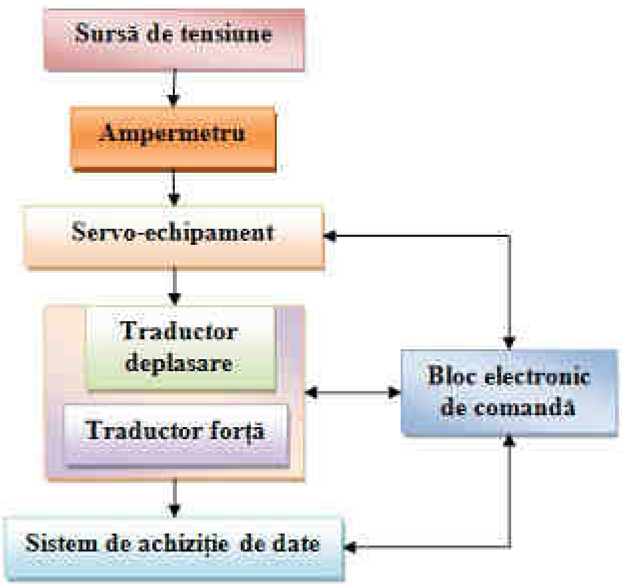

Fig.3. Schema bloc de verificare a performanţelor statice şi dinamice a unui servo-echipament pneumatic

- Nomenclatorul probelor conţinând: verificări de parametrii funcţionali şi verificarea funcţionării sistemului;
- Modul de realizare a încercărilor funcţionale;
- Criterii de validare a rezultatelor experimentale în scopul validării schemei.

În continuare se vor trata şi dezvolta aceste procesuri sub aspect tehnic.

a) Schema de verificare a performanţelor sistemului de acţionare

Schema bloc de de verificare a performantelor statice şi dinamice a unui servoechipament pneumatic (de deplasare sau de forţă) este prezentata în figura 3, din care se poate distinge următoarele sisteme: sistemul pneumatic de acţionare, servo-echipamentul; sistemul mecatronic de comandă şi control, cu traductorii si blocul electronic de control precum şi din sistemul de achiziţie date.

Această schemă este, de regulă, comună tuturor protocoalelor de experimentare a sistemelor pneumatice cu actuatori.

b) Schemele bloc pentru sistemul de control al poziţiei şi forţei

Schema bloc a unui sistem de control a poziţiei, are o structuă conform figurii 4. În funţc ie de particularităţile aplicaţiei în protocolul de experimentare se stabilesc blocurile componente.

Schema bloc a unui sistem de control al forţei, poate să aibă o structură conform figuri 5. În funcţie de structura sistemului, protocolul de experimentare stabileşte diferenţa faţă de această schemă reprezentativă.

c) Schema cinematica de principiu a sistemului

Schema cinematică este specifică fiecărei aplicaţii, în care se disting două p ărţi: schema cinematică a unui sistem de control al poziţiei şi schema de principiu al unui sistem de control al forţei

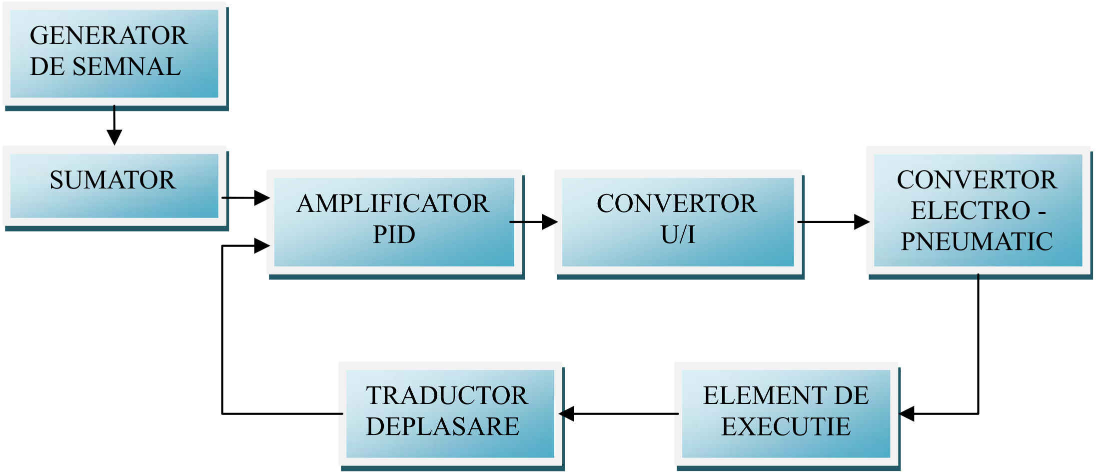

Fig.4. Schema bloc a unui sistem de control a poziției.

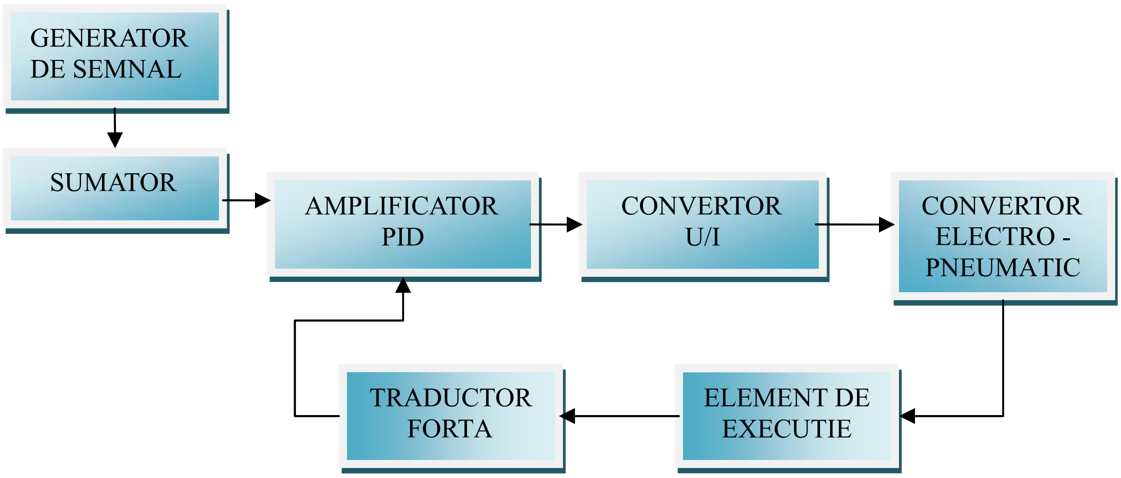

Fig. 5. Schema bloc a unui sistem de control al forței

d) Schemele pneumatice de testare servoechipamente (standuri de probare)

Aceste scheme sunt prezentate după cum urmează:

- servosistem pentru presiuni medii, figura 6;

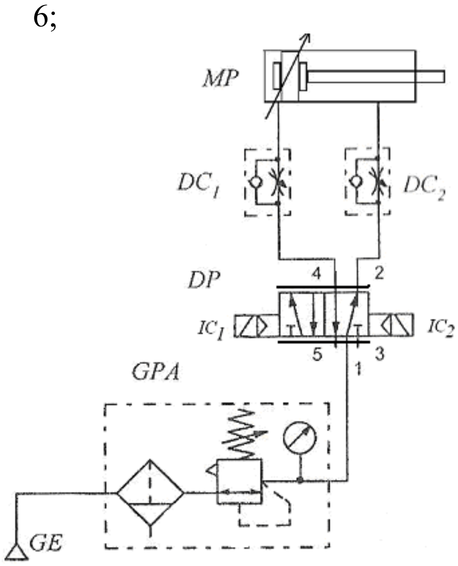

Fig.6. Servosistem pentru presiuni medii

- servosistem pentru presiuni înalte cu etaj de amplificare după cum se poate observa în figura 7;

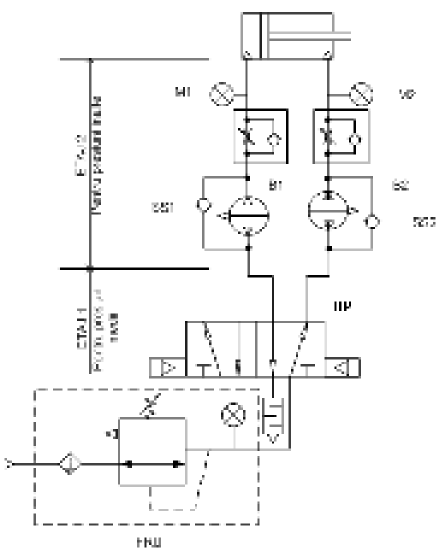

Fig.7. Servosistem pentru presiuni înalte cu etaj de amplificare

- servosistem pentru presiuni înalte fără etaj de amplificare, figura 8.
-

În toate figurile de mai sus s-a urmărit simplificarea schemelor iar echipamentul de testat este reprezentat de un actuator clasic.

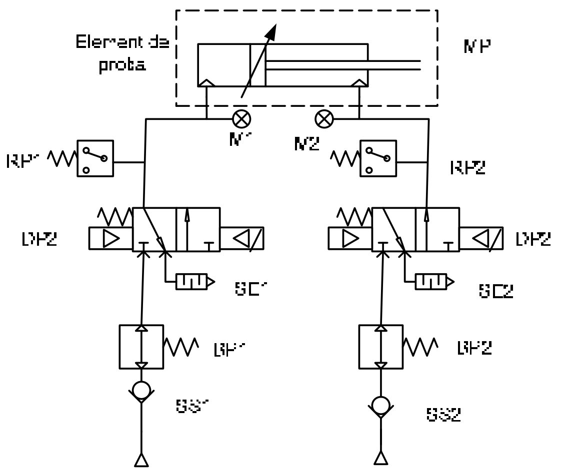

Fig.8. Servosistem pentru presiuni înalte fără etaj de amplificare

f) Schema de proces a sistemului de experimentare a unui servo-echipament pneumatic (static sau dinamic)

Aceasta e prezentata în figura 9 ce este compusă din: schema de testare pneumatică a servo-echipamentului (cu dispozitiv sarcină hidraulic); schema sistemului de comandă şi control mecatronic al parametrilor de testare; sistemul de achiziție date.

În funcție de particularitățile aplicației protocolul de experimentare stabileşte diferența față de aceasta schemă reprezentativă.

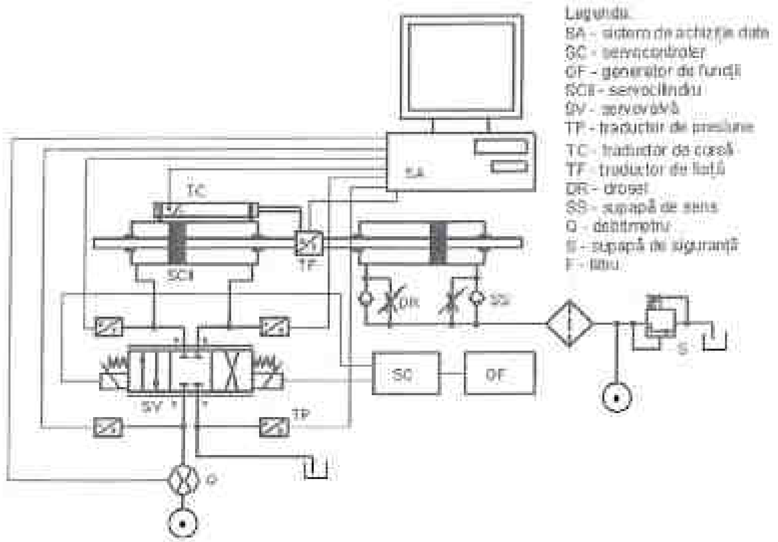

Fig.9. Schema de proces a sistemului de experimentare a unui servo-echipament pneumatic

4. Scheme pneumatice cu actuatori de medie şi înaltă presiune

4.1. Servosistem cu controlul parametrilor cinematici (deplasare, viteză). Acest echipament este compus din: actuator fără tijă şi traductor de cursă magnetostrictiv; servo-distribuitor pneumatic proporțional 5/3 normal închis, este comandat de un controller şi blocul automat de control de tip PID, ce are rolul de a realiza poziționarea, figura 10.

4.2.Servosistem cu controlul dinamic al variațiilor de sarcină (forțe). Dinamica obiectului manipulat este reprezentată ca un arc, ca şi forța realizată de sistemele pneumatice utilizate în simulări. Modelul dinamic face legătura între tensiunea de comandă a servo-valvei şi forța dezvoltată de sistem.

Servomotorul liniar (axa de translație cu traductor de cursă magnetostrictiv incorporat) ce este comandat de: distribuitor pneumatic proporțional 3/2 sau5/3 normal închis; serv-valva de presiune; traductori de forță ş i controlerul sistemului de tip PID, figura 11.

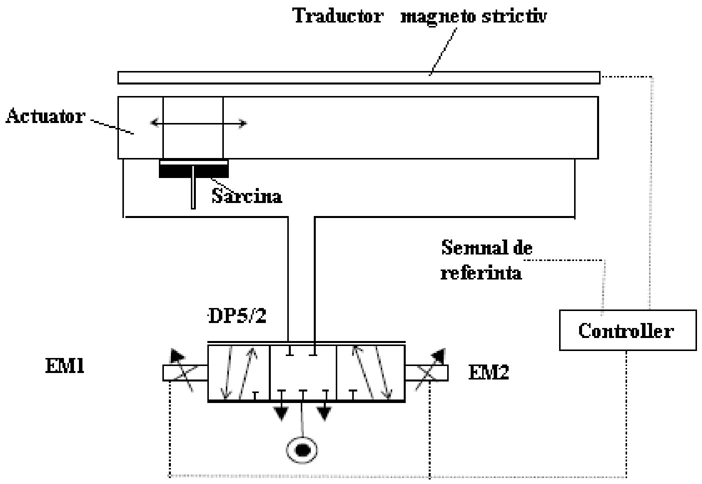

Fig.10. *Servosistem cu controlul parametrilor cinematici*

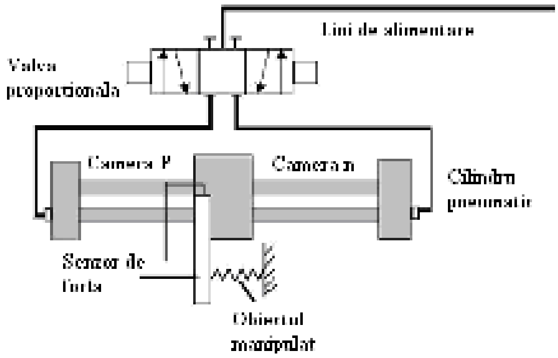

Fig. 11. *Servosistem cu controlul dinamic al variațiilor de sarcină*

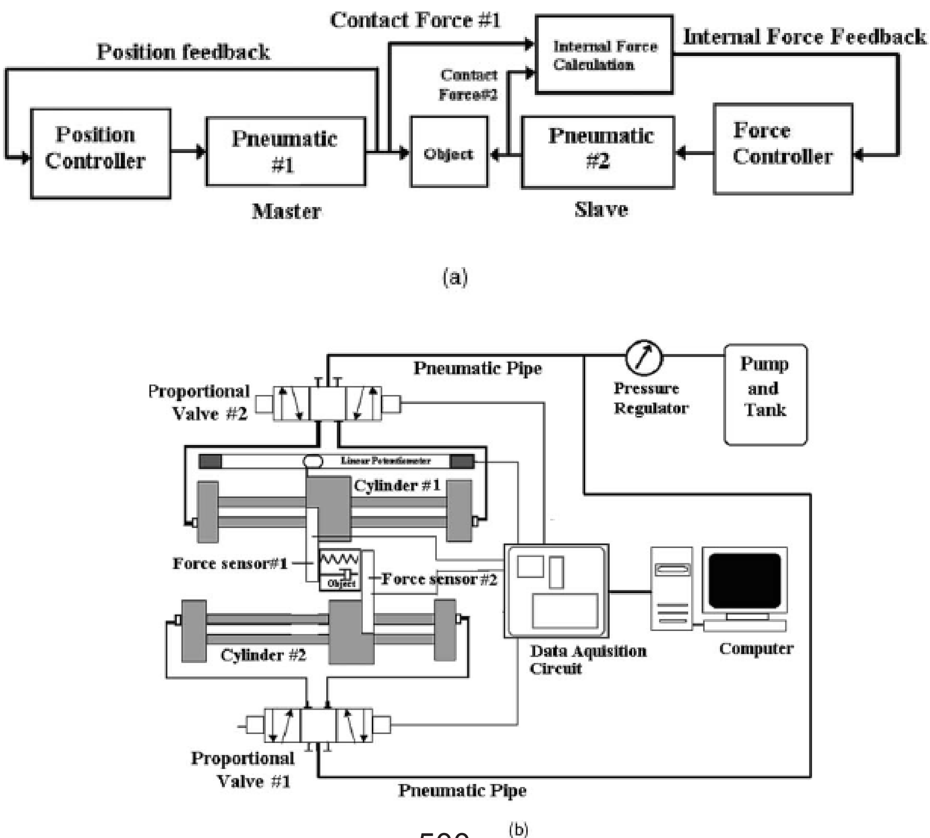

Fig.12. Sisteme pneumatice complexe a) - Sistem de interconectare master-slave şi b) - Stand experimental pentru controlul forţelor interne a unui sistem pneumatic complex

4.3.Sisteme de actuatori cu controlul simultan al deplasării şi variaţiilor de sarcină (control PID cu buclă feed-back) este compus din: servomotorul liniar (axă de translaţie cu traductor de cursă magnetostrictiv încorporat); distribuitor pneumatic proporţional 3/2 sau 5/3 schema normal închis; servo-valva de presiune; traductori de forţă şi de deplasare şi controlerul sistemului de tip PID, figura 12.

Concluzii

Prezentul articol a prezentat principalele elemente procedurale folosite de INOE 200-IHP Bucureşti în procesele de testare pentru sisteme pneumatice cu actuatori de medie şi înaltă presiune. În această lucrare se prezintă elemente de ultimă oră privind tehnica experimentării pentru sistemele de acţionare pneumatice, preluând, prelucrând şi adaptând la informaţii de la alte firme de prestigiu din lume specializate în pneumatică.

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