
STUDY OF THE VELOCITY OF THE FLOW IN WASTEWATER TREATMENT PLANT

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Abstract: *The paper presents a study that was carried out on the velocity of the wastewater flow through the pumping well in the wastewater treatment plant in the primary stage where the pollutants removal processes such as large particles and solid particles in suspension or sedimentation are carried out. The study of flow rates in the pumping well has been done to obtain results in carrying out works to reconfigure the pumping well invert or to mount a water agitator. There are presented the obtained results, using the Fluent-ANSYS-PC software, at the pumping well, the velocity distribution in a plane parallel to the bottom of the basin at a distance of 10 mm from it. In conclusions, the paper presents the importance of mechanical purging, regarding the results discussed in the paper.*

Keywords: *Waste water, CFD, flow characteristics.*

1. Introduction

Waste water treatment is the set of physical, chemical, biological and bacteriological processes, which reduces the loading of organic and inorganic pollutants and bacteria, in order to protect the environment (air, soil, emissary, etc.). It results obtaining clean water, in different degrees of purification, depending on the technologies and the equipment used, as well as a mixture of bodies and substances which are called, generically, sludges. [1]

The paper presents a study that was carried out on the velocity of the wastewater flow through the pumping well in the wastewater treatment plant in the primary stage where the pollutants removal processes such as large particles and solid particles in suspension or sedimentation are carried out. The concern of conducting this waste water flow study through the pumping well at the treatment plant is to eliminate the deposition of solid particles on the well. The study of flow rates in the pumping well has been done to obtain results in carrying out works to reconfigure the pumping well invert or to mount a water agitator.

Due to the fact that a water treatment system operates continuously, it involves the analysis of its reliability at the conception stage, like pre-condition and to ensure water purification according to the water quality standards. The studies focused mainly on structural investigations of the wastewater treatment plant and the pumping well, where the experimental researches were carried out in order to establish possible effects of the action. [1], [2], [3]

2. Problem identification and approach

The Târgu Lăpuș Treatment Plant is located in Târgu Lăpuș, Maramureș County, 300 m from Târgu Lăpuș-Gâlgău Road, in the river basin Târgu Lăpuș River which is the emissary. It was commissioned in 1975 and was designed for a maximum purge rate of 9 [L/s] with a 82% yield for CBO5 and 74% for suspensions. The new Wastewater Treatment Plant is designed at a rate of 19 [L/s].

The technological flow includes: [1]

1. Mechanical treatment;
2. The biological treatment process;
3. Treatment of sludge.

In the mechanical treatment stage wastewater are removed the large bodies, the impurities that are deposited and the floating ones. Thin and fine suspensions are retained at this stage. For their retention are used the rare grills, screens, grease separator, sand decanter and decanters. [1]

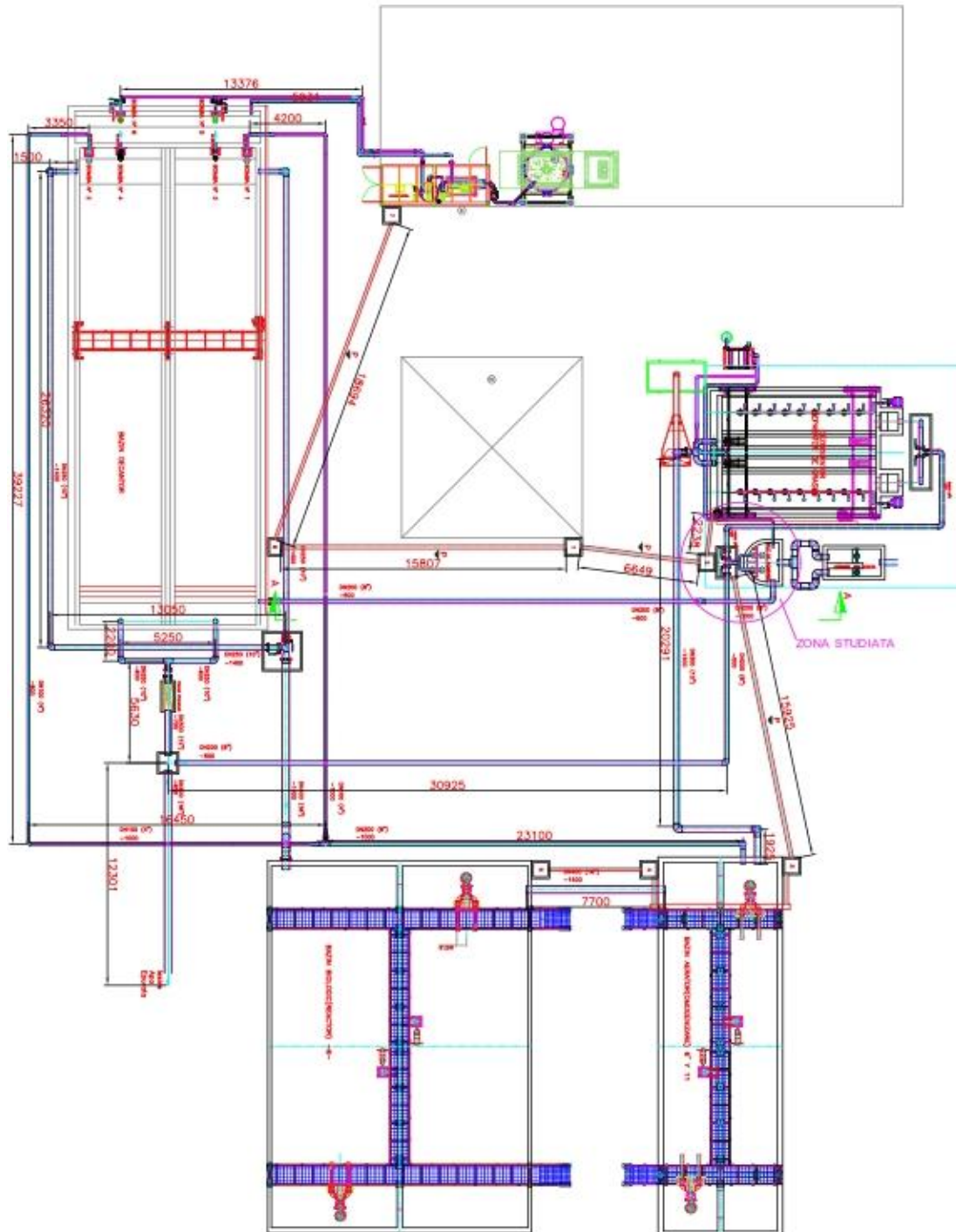


Fig. 1. Scheme of WWTP Targu Lapus

In a sewage treatment plant, water transport and constant flow and homogeneous flow are among the most important steps. Domestic water comes out of the screens basin and enters the pumping

well through two 400 mm diameter pipes and is discharged by means of two submersible pumps connected to 3" diameter metal pipes in the desiccator and the grease separator. The submersible pumps carry water and sludge between the technological stages of the treatment plant as well as to and from the treatment plant.

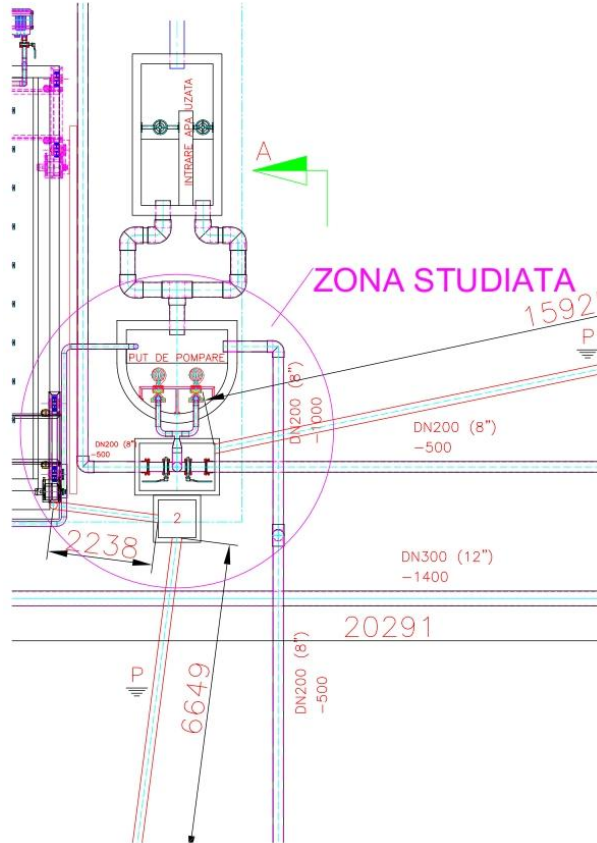


Fig. 2. The well for pumping station

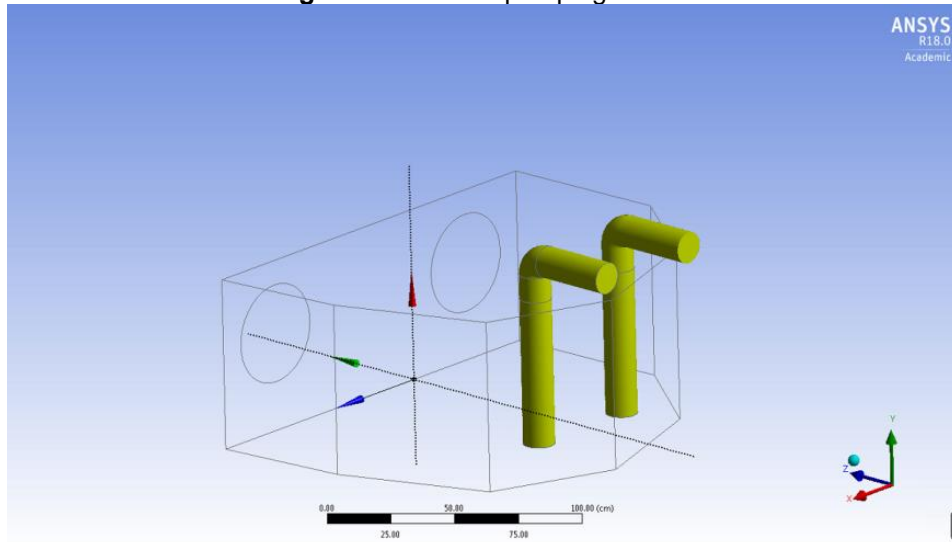


Fig. 3. Axonometry pumping station

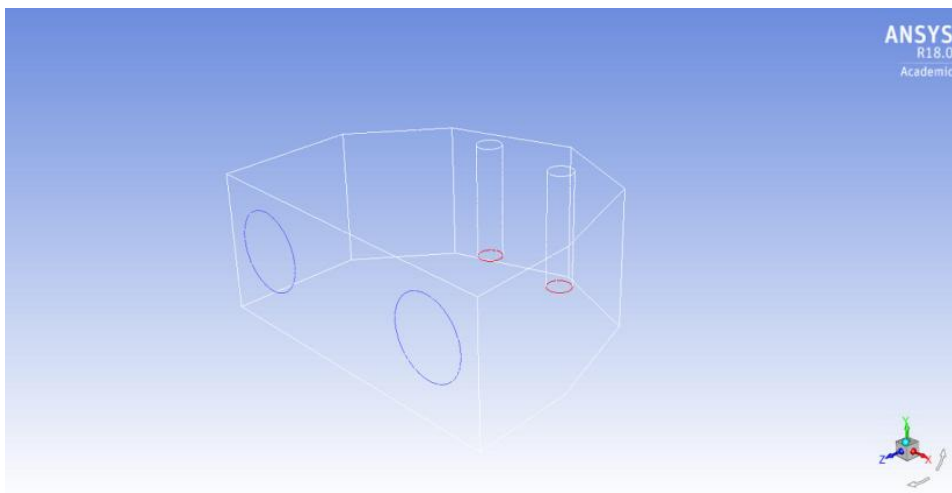


Fig. 4. The well for pumping station - CAD model

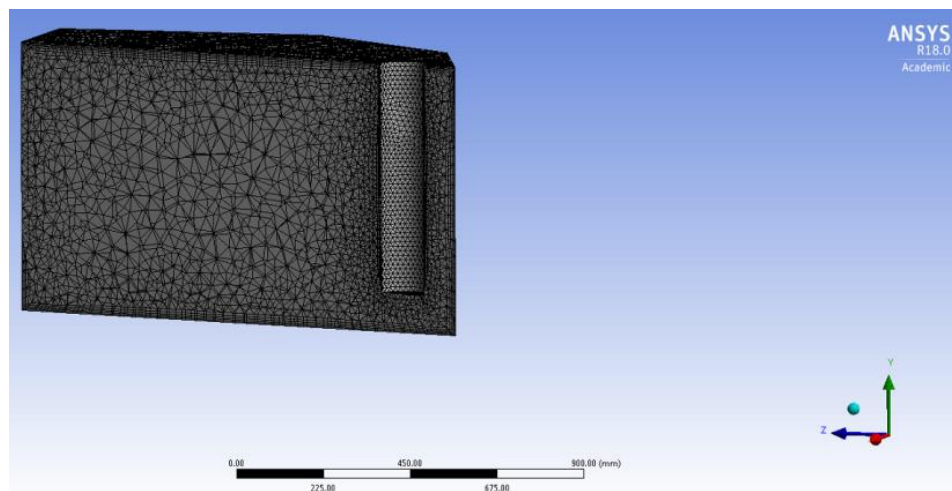


Fig. 5. Section shaft pumping station purification

3. Results

The obtained results using the Fluent @ ANSYS-PC application at the pumping well the velocity distribution in a plane parallel to the bottom of the basin at a distance of 10 mm from it. The mathematical model is based on solving a set of differential conservation equations, supplemented with numerous additional equations, often semicircular models, to handle the turbulence.

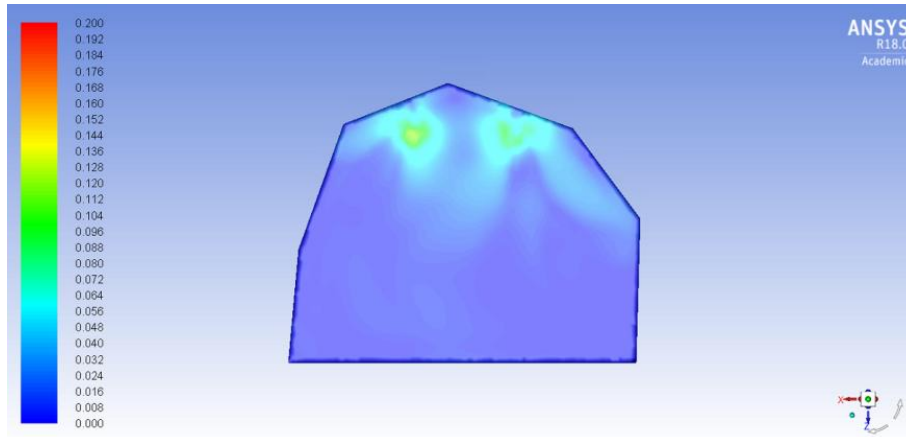
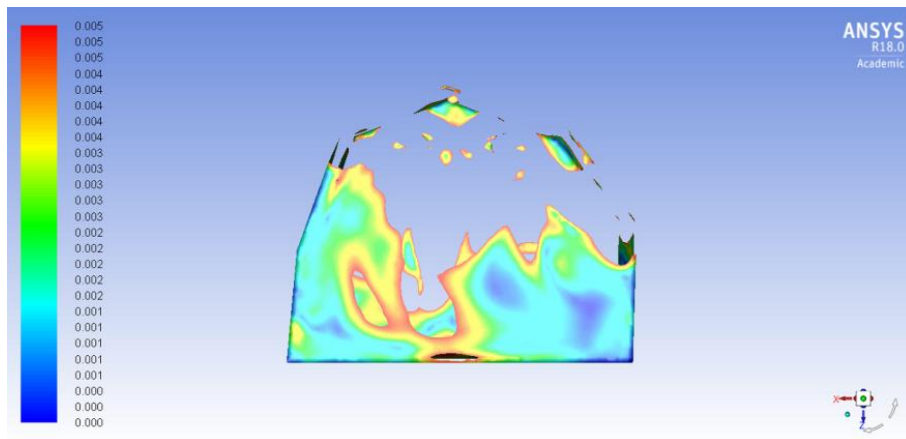
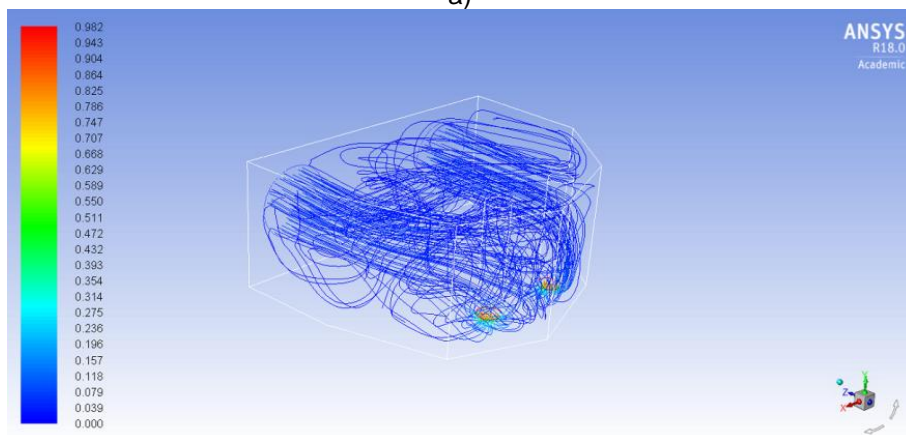


Fig. 6. Pressure-based pumping well

From the above picture we can see that in the pump suction area, the colour is blue and greenish-yellow, making it a scale-grading, the maximum fluid velocity of 0.128 m/s.



a)



b)

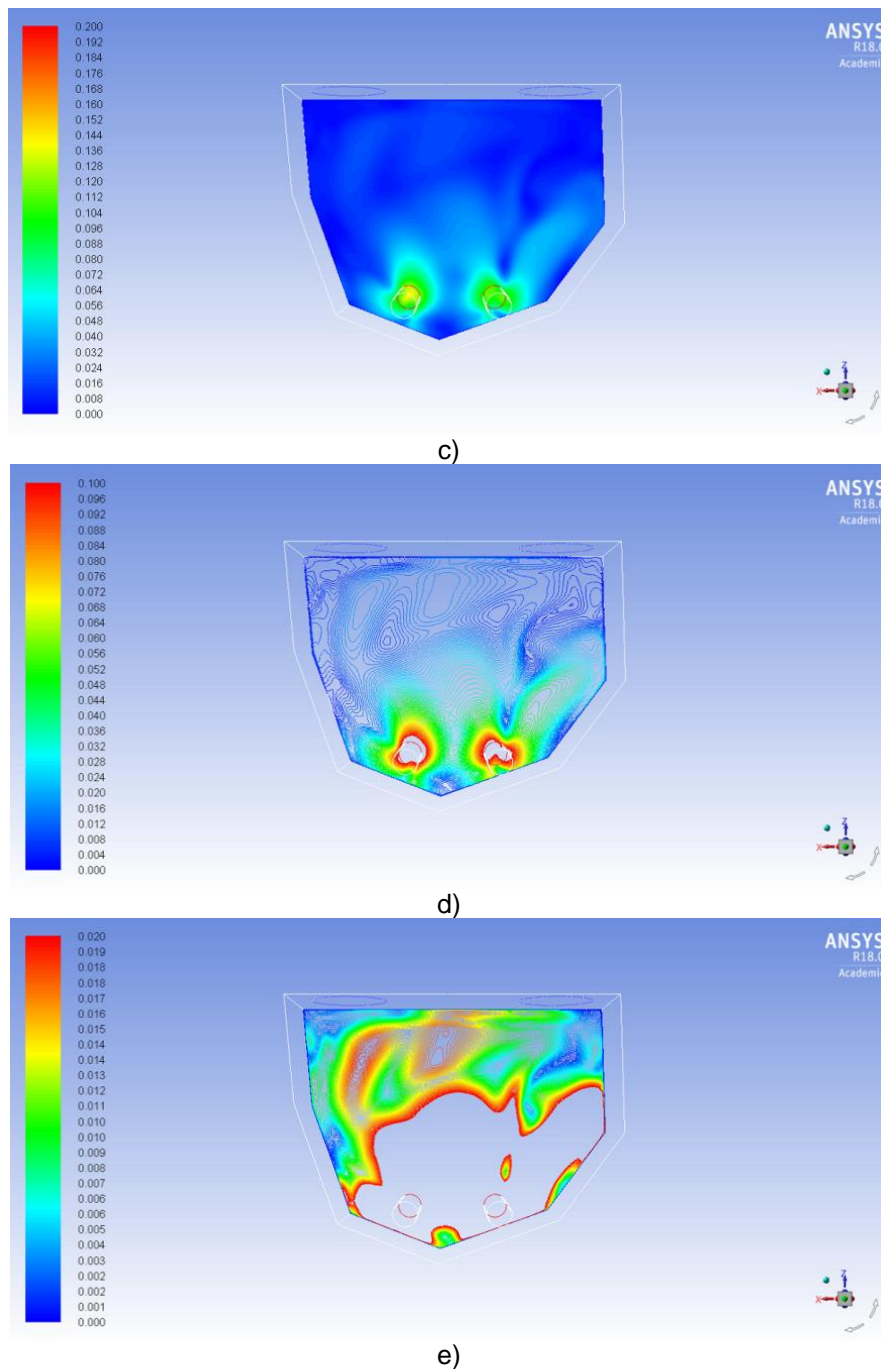


Fig. 7. Pressure distribution in a plane parallel to the bottom of the basin at a distance of 10mm

The K-epsilon (k- ϵ) turbulence model used in this study is the most widely used model used in Dynamics Fluid Computational (CFD) to simulate average flow characteristics for turbulent flow conditions. It is a two-equation model that provides a general description of the turbulence through two transport equations (PDEs). The initial impetus for the K-epsilon model was to improve the mixing length model, as well as to find an alternative to algebraic turbulence balances in moderate-to-high complexity flow. The first variable determines the energy transported in turbulence and is called turbulent kinetic energy (k). The second variable carried is the turbulent dissipation (ϵ) which determines the rate of dissipation of the turbulent kinetic energy. In fluid mechanics, turbulence or turbulent flow is a flow regime characterized by stochastic fluctuations in properties. These relate

to the diffusion and transport (convection) time, rapid variations of pressure and speed in space and time. [3], [4]

The theoretical studies must be verified by experimental measurements, as in [5] and [6] thus developing useful models for design process.

4. Conclusions

The Târgu Lăpuș Purification Station fails to fully realize the purpose for which it was built, namely the removal of polluting substances from the wastewater and the discharge of relatively clean waters into the emissary, according to the legislation and the agreement with the Apele Romane.

This is due to the following: repetitive failures of various machines that make the process technologically difficult, reduction of deburring due to deposits, loss of station efficiency. It is important that the WWTP discharge the water into the river Târgu Lăpuș a high quality effluent.

The importance of mechanical purging results from the following aspects, discussed in this paper:

- Thick and fine suspensions are retained in the mechanical treatment stage;
- The importance of screens in removing large floating bodies is felt by the entire purification process;
- Fat removal is very important for the mechanical purification of industrial waters and especially for mechano-biological or mechano-chemical treatment to prevent imbalances caused by increased fat content;
- Mechanical cleaning is an effective way of combating pollution by retaining coarse particles and suspended particles from wastewater.

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