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OPERATION OF THE PUMPS SERVING THE FLOW RATE COMPENSATION BASIN OF A WASTEWATER TREATMENT PLANT

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Abstract: This paper shows the importance of which ensures the correct functioning pumps water out damage or special weather. Also shows the operation of these pumps within compensation tank ok flow. It also shows the characteristic curve of the pump used, pumping height –flow rate, so that the automatic control system can switch to the flow demanded by the processor of the wastewater treatment system.

Keywords: pumps, optimization, wastewater treatment plant

1. INTRODUCTION

The wastewater treatment plant is located on the left bank of Mureş River, at the south of the E 79 national road, and is bounded by the Fruit Tree Farm no. 4 - Deva.

The waste waters from the lower areas of Hunedoara are sent through a sewage *manifold* system to 6 pumping stations, from where they are pumped into the gravitational collectors.

The plant is connected to the two main collectors: an ovoid-type of 70/105 cm and a bell-type of 165/260 cm, both collecting the domestic and industrial waste water from Hunedoara and its neighbouring townships. The role of the plant is to mechanically and biologically clean the waste water, as well as the stabilization of the sludge resulting from the wastewater treatment processes.

Upstream of the treatment plant, there is a basin for flow rate compensation during the periods of heavy rainfalls. The waste water is flowing into the main collector and taken over in the treatment plant. To compensate the lack of capacity ($Q > 2200$ l/s) and to prevent the accidental pollution, downstream of the treatment plant there are biological ponds ~ 20 Ha, from where the water is discharged into Mureş River in a controlled manner and with the approval of the Environmental Inspectorate and Romanian Waters Directorate.

The wastewater treatment plant has the role to take over and clean the domestic and industrial waste water from Hunedoara and some neighbouring areas.

The type of the wastewater treatment plant is a mechanical-biological one, and the effluent of the plant is discharged into Mureş River.

The wastewater treatment plant includes the following items:

- » flow rate compensation basin;
- » mechanical stage;
- » biological stage;
- » biological ponds.

This new wastewater treatment plant cost about €10 million and was built to the latest European standards, using the state-of-the-art equipment and technologies in the field, as specified in the Apa Prod officials' report.

Besides the stages of mechanical and biological treatment, the plant has also a third stage: the sludge collection. Only in Hunedoara, in just one hour, the sewer system gathers 4 cubic meters of sludge, which is collected and allowed to ferment.



The resultant biogas is then used in the production of electric energy, by means of a special engine. Then, the sludge is dried to a moisture content of 21%, stored and delivered to the farmers who are interested in using it as fertilizer.

For farmers, the sludge transport is free, the cost of this operation being included into the general costs generated by the sewerage system operation.

2. ELEMENTS OF CALCULATION AND DESIGN OF THE PUMPS USED FOR THE COMPENSATION BASIN

For sizing and checking the pumps that serve the flow rate compensation basin of the analysed wastewater treatment plant, the following calculation hypotheses have been made, depending on weather conditions and daytime, shown schematically in Table 1.

Table 1. The amount of water circulated through the system

Sr. no.	Sizing case	Symbol	Water quantity [l/s]
1.	Failure	Q_{SA}	845
2.	Rainy weather	Q_{RW}	845
3.	Dry weather	Q_{TW}	503.4
4.	Night flow	Q_{NZ}	277.8

The pumping station has a number of 4 pumps whose operation is automated (the pumps are started one by one, as needed), providing an average flow rate of 700 m³/h and a pumping height of 9.6 meters.

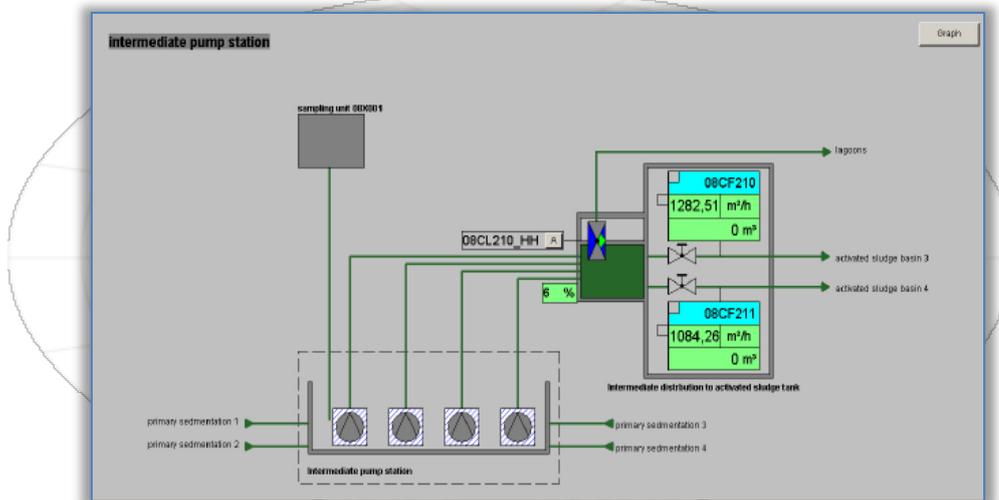


Figure 1. Control interface of the pump used for the compensation basin



Figure 2. Pump designed for domestic waste water discharge

The pumps ensure the flow rate required to discharge the waste water mainly in case of failure, i.e. in rainy weather, aiming to protect the domestic water supply system. For this, it is very important to plot and analyze the characteristic curve of these pumps, in order to optimize their operation.





Drawing this curve enables a better dosing of the amount of domestic water already treated mechanically that goes to the new biological stage.



Figure 3. Taking the waste water out of sewers – the water enters into the mechanical stage



Figure 4. Waste water discharge, mechanically cleaned

The waste water is taken from sewage through the inlet chamber, which is provided with two valves (Figure 3):

- » water entering into the mechanical stage;
- » by-pass to the biological ponds (in case of failure or additional flows).

This inlet chamber is bell-type and has the following dimensions: 2.6 / 1.65 m. After the inlet chamber, the domestic water goes through the next route in the mechanical treatment area:

- » loose and dense wire meshes;
- » desander;
- » grease separator;
- » primary decanters;
- » primary sludge pumping station;;
- » decanted water pumping station.

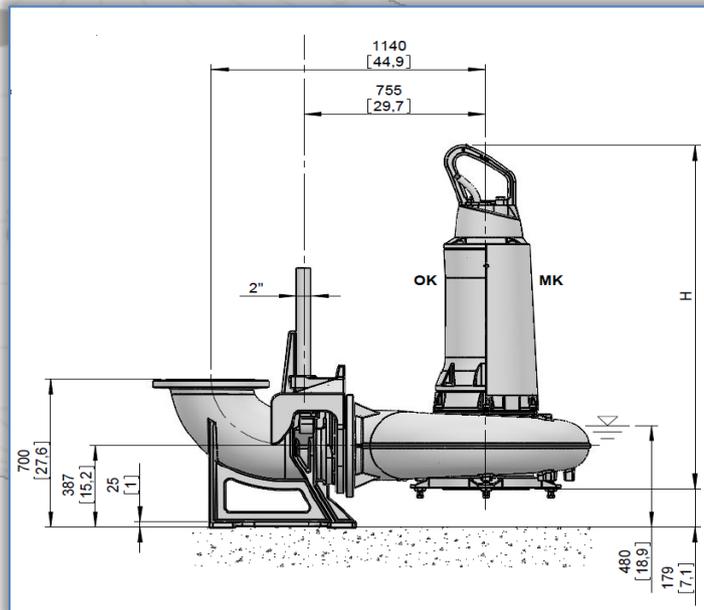


Figure 5. Pump dimensions

Table 2. The characteristic curve of the four pumps used

Pumping height [m]	1.83	1.93	2.22	2.7	3.38	4.25	5.32	6.58	8.04
Flow rate [m ³ /h]	250	500	900	1250	1650	2000	2400	2800	3200

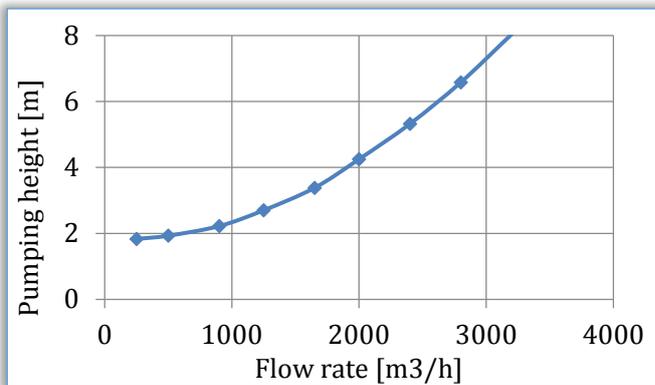


Figure 6. The characteristic curve of the four domestic sewage pumps

The characteristic curve of the four pumps for domestic water discharge from the compensation basin is shown in Figure 6. When plotting the curve, the following data has been taken into account:

- » Minimum geodetic height:
 $H_{gmin} = 1.83$ m
- » Minimum manometric height:
 $H_{Mmin} = 5.38$ m





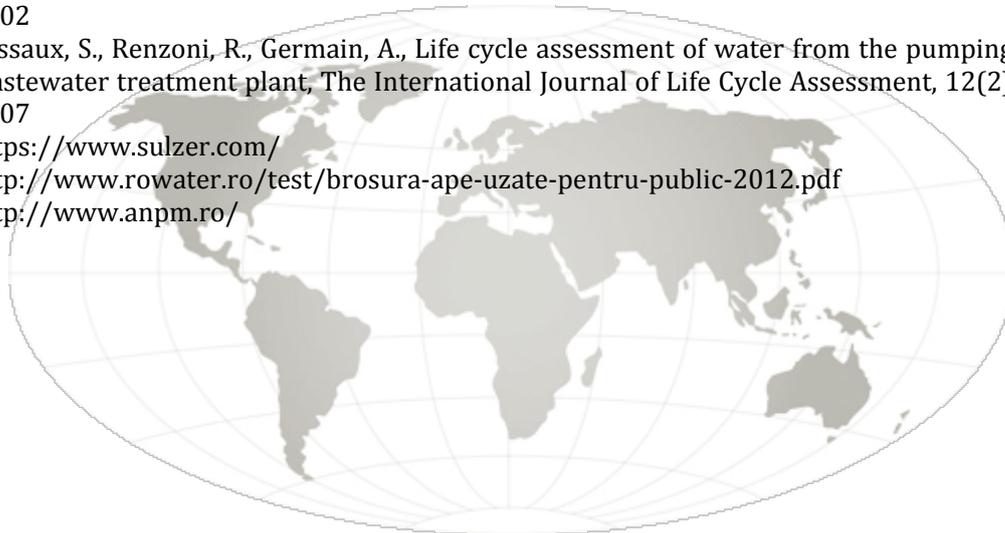
3. CONCLUSIONS

In this study, we analyzed the operating modality of the pumps used for the compensation basin of a domestic wastewater treatment plant.

The appropriate operation of the pumps in this analyzed area ensures proper and safe flow conditions, either regarding the exploitation or the environment quality protection, avoiding the waste water infiltration into the soil.

References

- [1.] Macoveanu, M., ș.a., - Epurarea avansată a apelor uzate conținând compuși organici nebiodegradabili, Editura Gheorghe Asachi, Iasi, 1997
- [2.] Nikolay Makisha, - Restoration and renovation of waste water pumping stations in case of emergency, 15th International scientific conference "Underground Urbanisation as a Prerequisite for Sustainable Development", Procedia Engineering, 165, pp.1087 - 1091, 2016
- [3.] Zaletova, N., Voronov, Y., Makisha, N., Conditions of advanced removal of phosphorus at wastewater treatment plants, International Journal of Applied Engineering Research. 10(21) (2015) pp. 42454-42455
- [4.] Ionescu, Gh. C., Sisteme de epurare a apelor uzate, Editura MatrixRom - București, 2010
- [5.] Zhang Z., Zeng Y., Kusiak, A. Minimizing pump energy in a wastewater processing plant, Energy Journal, 47(1), 2012
- [6.] Ianculescu O., Molnar A., Csaba D., Stații de epurare de capacitate mică, Editura Matrix Rom, București, 2002
- [7.] Lassaux, S., Renzoni, R., Germain, A., Life cycle assessment of water from the pumping station to the wastewater treatment plant, The International Journal of Life Cycle Assessment, 12(2), pp. 118-126, 2007
- [8.] <https://www.sulzer.com/>
- [9.] <http://www.rowater.ro/test/brosura-ape-uzate-pentru-public-2012.pdf>
- [10.] <http://www.anpm.ro/>



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