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SEDIMENTATION TANKS USED IN WATER TREATMENT: MODIFICATIONS, TESTS AND FUTURE DIRECTIONS OF SCIENTIFIC RESEARCH

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INTRODUCTION

The processes of treating industrial and domestic sewage that comes from the chemical and food industries are one of the most important problems today. Due to the important role that water plays in everyday life and in many industries, issues related to the thickening and purification processes of water are becoming more and more popular. Environmental aspects also play an important role regarding this issue. This mainly applies to developing and industrialized countries, in which the amount of pollution caused by human activity, which enters the water, is constantly increasing. The solution to this is to develop more effective and cheaper methods of water purification. Regarding the above, there has been a significant increase of sedimentation research in the field of sedimentation engineering, which can be found in the subject literature. Purification processes require multi-stage and thorough analysis. It is necessary to identify a problem, plan its solution, conduct analyzes and appropriate research, and finally carry out reclamation and treatment, or the removal of undesirable effects of sedimentation in order to improve the process.

THE AIM OF THE RESEARCH AND THE RESEARCH METHODOLOGY

The purpose of this research was to design and construct modified swirl sedimentation tanks, perform efficiency tests, and analyze hydrodynamics. The following geometric elements were subjected to modifications: inlet pipe, outlet pipe, internal partition (baffle). Figure 1 shows the constructions of the sedimentation tanks that were used for the tests. The separation process was analyzed for a water-heavy solid system, with the diameter of the solid particles being equal to 125 μm.

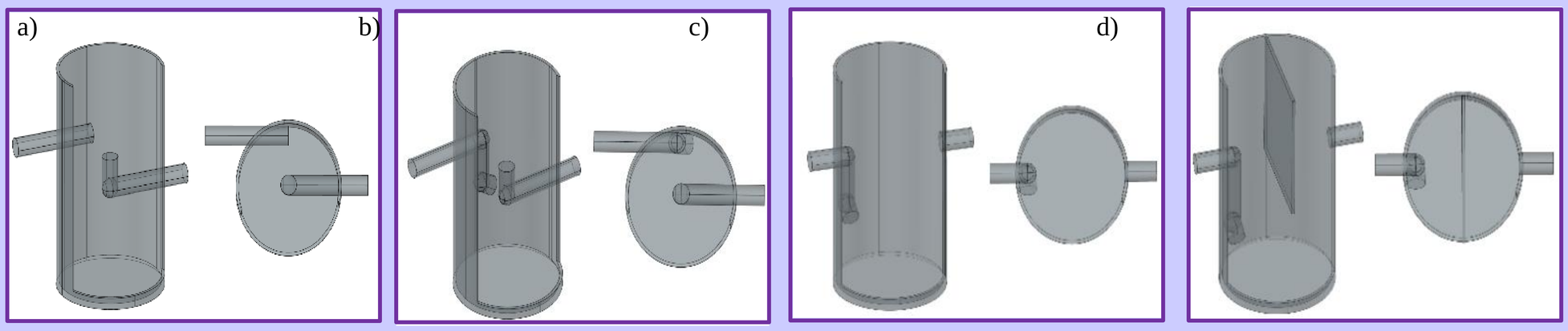

Fig. 1. Swirl sedimentation tank: a) standard (S), b) with an inlet pipe arranged tangentially (ZW), c) with an inlet pipe arranged radially (ZM), d) with a profiled inlet pipe and longitudinal partition (ZMP).

EXPERIMENTAL RESULTS

On the basis of Figure 2, it was concluded that the use of a partition in the swirl sedimentation tank significantly increases the flow resistance. The value of the resistance coefficient increased approximately twice in relation to the structures in which there is no longitudinal partition. Based on the obtained data, it was found that the modification of the inlet pipe and the use of a partition increased the separation efficiency of the swirl sedimentation tank when compared to standard constructions of separators (Figure 3). The use of a longitudinal partition in swirl sedimentation tanks is justified by the fact that it may increase the efficiency of the apparatus, or allow for the separation of light fractions (liquid/petroleum derivatives).

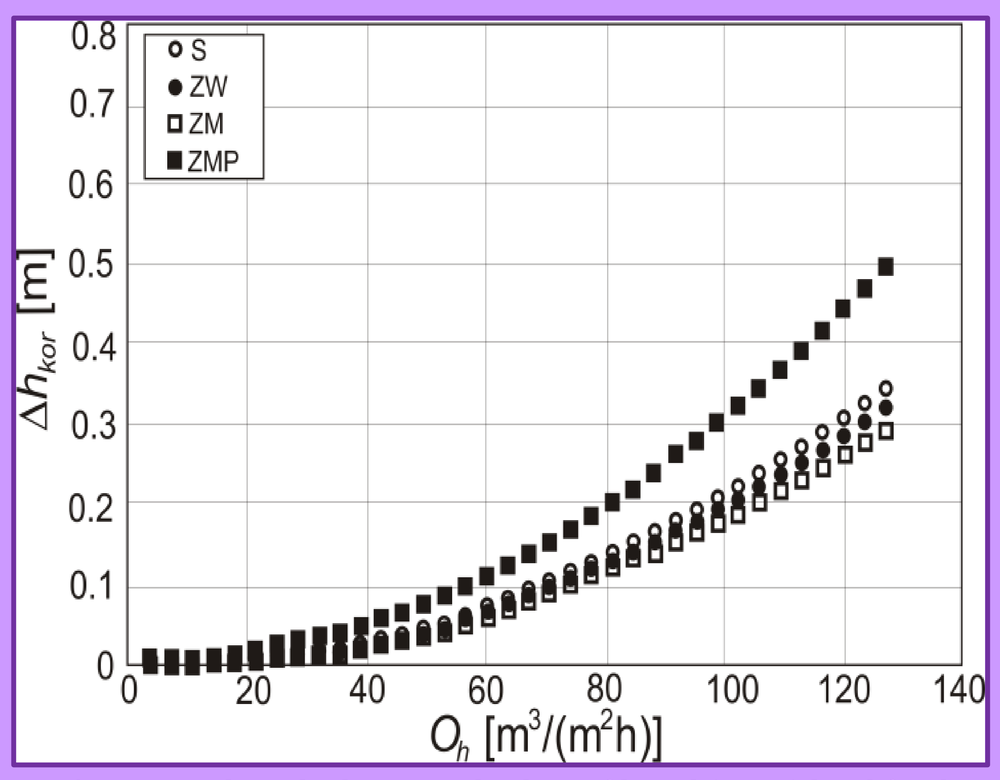

Fig. 2. Correlatively determined values of liquid (water) level for the tested structures of the swirl sedimentation tanks.

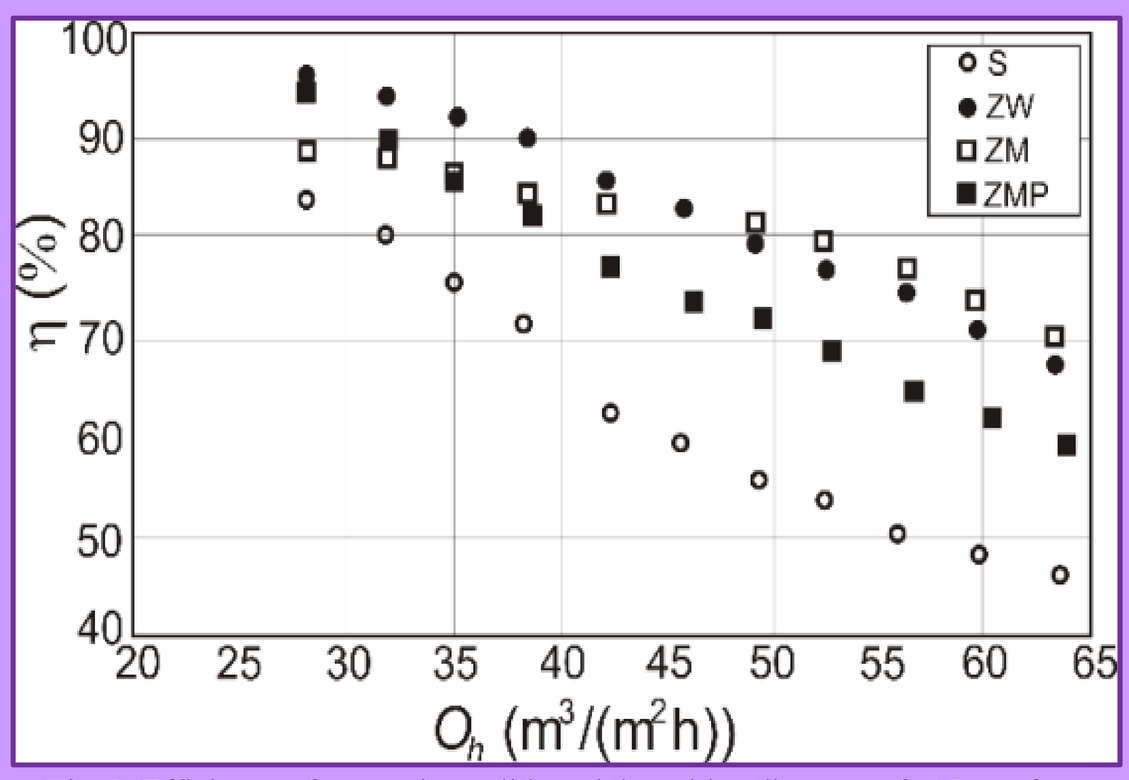

Fig. 3. Efficiency of separating solid particles with a diameter of 125 μm from liquid (water) with regards to the hydraulic load for a standard sedimentation tank (S) and its direct modifications (ZW, ZM and ZMP).

SUMMARY AND CONCLUSIONS

The obtained data allowed for the broadening of knowledge concerning the phenomenon of sedimentation, swirling motion, and the very principle of operation of rainwater separators. The achieved results motivate and justify further design and simulation research. The search for new water treatment technologies is multi-directional, but it is important that new methods and devices are efficient and do not pose a threat to the environment or human health. One of the goals for developing water treatment processes is to obtain high-efficiency devices at low cost that can be used in treatment systems and wastewater treatment plants. Due to the above, the authors have noticed an increase in the number of new construction solutions of various types of sedimentation tanks. Such sedimentation tanks are an innovative solution, or include minor modifications. Another area that can be developed involves numerical simulations and the modeling of treatment processes using e.g. neural networks and artificial intelligence. As it results from the analysis of the literature and the collected numerous experimental data, it is worth making an attempt to use neural networks that will enable their correlation. These simulations enable the obtained model data to be compared with experimental results, which in turn allows for a quick and accurate estimation of the predicted efficiency of newly design separators.