

The subject of wastewater treatment and water recovery is still facing new challenges. Development of analytical methods allowed people to see new threats arising from the presence of trace amounts of hazardous substances in the environment caused by human activity. Such substances include pharmaceuticals and hormones.

The authors propose the application of an integrated method for removing these compounds from water by means of advanced oxidation with the use of ozonation,  $\text{H}_2\text{O}_2/\text{UV}$  and  $\text{O}_3/\text{H}_2\text{O}_2$  as well as nanofiltration/reverse osmosis. At the stage of chemical oxidation compounds decompose to products which do not pose a threat to the environment and at the same time do not recontaminate the environment by resulting sludge or spent reagents. On the other hand, due to membrane processes such as nanofiltration and reverse osmosis various substances are removed even in 99.9%. Integration of chemical oxidation and membrane filtration creates a possibility of comprehensive and complete removal of organic compounds, including pharmaceuticals, which pose a threat to the environment.

Phenomena accompanying the removal of organic compounds by means of an integrated method of chemical oxidation and membrane filtration, and the mechanism of interactions between the applied methods have been scarcely tested. The scientific goal of the project is to understand the mechanisms of phenomena occurring during the process of advanced oxidation, and membrane filtration of selected pharmaceuticals on polymeric membranes, as well as to explain the mechanisms of interaction between the two processes. Within the project it is planned to perform basic research in the field of reaction kinetics of pharmaceuticals decomposition and the type of resulting products of oxidation with the use of ozone,  $\text{UV}/\text{H}_2\text{O}_2$  and  $\text{O}_3/\text{H}_2\text{O}_2$  which would allow us to understand the process mechanism.

Due to the fact that some oxidizing agents (ozone, hydrogen peroxide) may damage the structure of polymer membranes, their durability will be tested. Groups of compounds whose oxidation products may adversely affect the performance of membrane filtration will be identified. Phenomena occurring on the membrane surfaces and in pores during the filtration of pure solutions of selected pharmaceuticals and their oxidation products will be analyzed. It will be determined which parameters and in what way will affect the final reduction degree of the pharmaceuticals in the integrated process of oxidation and membrane filtration.

The research will be carried out for two variants: (1) solutions of selected pharmaceutical compounds will be subjected to pre-oxidation and then membrane filtration to determine the effect of the oxidation stage on filtration parameters. (2) solutions of the selected pharmaceutical compounds will be subjected to membrane filtration (nanofiltration or reverse osmosis), while both the filtrate and the concentrate will be subjected to chemical oxidation by means of selected oxidizing agents.

Membrane blocking agents which reduce the efficiency of membrane processes will be determined. The reasons and mechanisms of these phenomena will be determined, which will contribute to solving important problems related to the disposal of hazardous substances such as pharmaceuticals and improving the efficiency of water treatment.