Description for the general public

In recent years, the development of industry and excessive consumption of the modern population resulted in a significant increase in the emission of hazardous organic substances, mostly of anthropogenic origin, to the environment. Their highest concentration is observed, among others, in water systems. That is why, research on effective water treatment technologies are of key importance in many scientific centres worldwide. Among many different techniques used to purify wastewaters, adsorption, membrane separation, advanced oxidation or biological processes can be considered. In order to effectively remove pollutants from wastewaters, combination of mentioned methods into one complex process is of growing interest nowadays. Such a situation is observed in case of typical biological treatment combined with membrane technology, which can be implemented by designing of a proper membrane biological reactor (MBR). Solutions concerning bioreactor selection and construction, having regard in particular membrane type and its building material seem to be crucial ones when considering high efficiency of wastewaters purification. Nevertheless, a serious limitation of the widespread use of MBR is the phenomenon of membrane contamination during the filtration of sewage with suspended activated sludge, which contributes to a significant reduction in the efficiency of the process. That is why, research on improving the functional properties of membranes by means of their structural or surface modification is the subject of research by many renowned research centres worldwide.

Hence the main goal of the project will focus on research on a new group of membranes as components of bioreactors intended for the purification of water systems from organic pollutants. The research will focus on the selection and preparation of a new group of components for the production and modification of membranes including hybrid/composite oxide materials as well as their combinations with polymer-based compounds (e.g. biopolymers). Additional aspect will concern direct modification of membranes by surface grafting. An important stage will include effective incorporation of mentioned additives during membrane preparation which should result in enhanced membrane stability, operational parameters and also on the mechanism of its performance in the MBR system. Estimation of the mechanism of interactions between the individual components of the membrane will be crucial part of the research which will enable selection of the best additive as well membrane type for the verification tests under model and real wastewater treatment technology using MBR. It is assumed to use two types of bioreactors for this purpose: bioreactor with activated sludge and enzymatic bioreactor. Comprehensive analysis of reaction mixtures before and after the conversion process will enable to evaluate the effectiveness of bioreactors and membrane module in the conversion of selected organic pollutants. What is more, proposing the mechanism and pathways of the transformation of harmful substances during their microbiological and enzymatic conversion will be additional and significant part of planned research. Based on the comprehensive research realized within the project, the relationship between the biological treatment of hazardous pollutants and the mechanism of their separation on additives-based polymer membranes, considering the physicochemical phenomena occurring on the membrane surface, will be solved. Based on project results we will propose novel concept for wastewater treatment, which will translate into reducing the amount of organic pollutants in wastewaters.

The project fits perfectly with the principles of sustainable development and environmentally friendly technologies. The cooperation undertaken between the Faculty of Chemical Technology (Poznan University of Technology) - project leader, Lukasiewicz Research Network - Textile Research Institute and Faculty of Process and Environmental Engineering (Lodz University of Technology) - project partners, and the complementary nature of those institutions' experimental resources, provide an undoubted guarantee that the research goals of the project will be completed to high practical and theoretical standards. A measurable result of the project will be the completion of interdisciplinary research leading to a significant expansion of knowledge and development of the scientific field in question, as well as highly ranked scientific publications indexed by Thomson Reuters JCR.