

Microplastics (MPs) pose one of the most complex environmental problems. The current increase in the number of cars all over the world causes an increased transmission to the environment of microplastics resulting from tire abrasion (TMP, Fig. 1a). Tire material particles (TMPs) are common MPs in aquatic environments and contain toxic additives that pose a threat to organisms when released. A critical point in the MP spreading in the environment are wastewater treatment plants (WWTPs). WWTPs receive MPs, including TMPs, and can act as a barrier as well as the main entrance path for MPs into the environment.

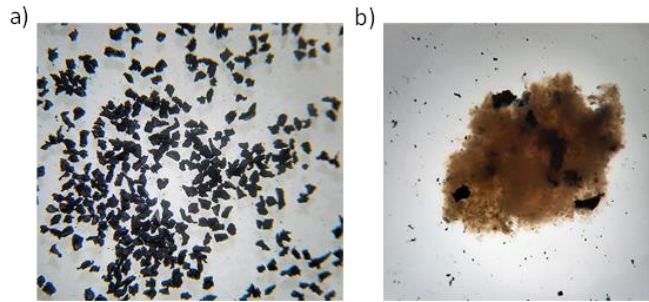


Fig. 1 Photographs of a) TMP, b) TMP in aerobic granule

For treating TMP-containing wastewater, aerobic granular sludge (AGS) technology shows promise because it is resistant to toxic compounds. Polishing biologically treated wastewater with membrane filtration may further reduce transmission of TMPs and TMP-derived compounds to the environment.

Thus, the aim of this project is to determine the efficiency of removal of TMPs and their derivatives in an integrated aerobic-granular-sludge – membrane-module system and the effect of those compounds on sludge properties, including methane potential, and the species composition and activity of biomass.

Municipal wastewater with various TMP loads will be treated in an aerobic-granular-sludge – membrane-module system operated with different aeration regimes in a batch reactor cycle and at different membrane *cut-offs*. To determine the efficiency of TMP and TMP-derivative removal at various stages of the treatment, their concentrations will be measured in biologically treated wastewater, AGS, permeate and retentate. The chemical and morphological changes on TMP surfaces will be analyzed after biological treatment. Nutrient conversion efficiency and kinetics in GSBs and permeate quality at various aeration regimes and membrane *cut-offs* will be determined. High-throughput sequencing will reveal the species composition of microorganisms in AGS. Metatranscriptome analysis and respiration and enzymatic tests will indicate how TMPs and TMP derivatives affect biomass activity. The morphology and chemical composition of AGS will be investigated (Fig. 1b). The effect of TMPs in waste sludge and retentates on methane potential and methane formation kinetics will be examined. Multidirectional analysis of molecular and technological results will determine the mechanisms of TMP and TMP-derivative removal from wastewater and indicate the groups of microorganisms engaged in the process.

In summary, the project will develop a technological solution for the effective removal of TMPs and their derivatives from wastewater. The knowledge regarding the transformations of TMPs and their derivatives in wastewater treatment system can be used in environmental research aimed at developing effective strategies for the elimination of MP from the environment.