Utilization of Photocatalytic Nanomaterials for the Development of Advanced Membrane Surfaces Used for the Purification of Oil Emulsions

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Water protection has become one of the biggest challenges of the 21st century, and over the environmental protection reasons, economic concerns - derived from increasing costs for processing water and wastewater discharge - also lead industries to the utilization of advanced wastewater treatment methods, which ensure excellent purification efficiency.

Membrane filtration has several advantages, like high purification efficiency, facile operation, and no chemical addition, but the effective mitigation of membrane fouling needs to be developed, especially in case of oily wastewaters, since the formation of hydrophobic layer results in quick and significant flux reduction, which reduce the productivity and the life span of the membrane.

Titanium dioxide (TiO_2) nanoparticles proved to be useful to enhance the membrane hydrophilicity – therefore to achieve higher fluxes – during the filtration of oily wastewaters. Moreover, TiO_2 – as a photocatalytic semiconductor – also provides the possibility of the photocatalytic degradation of any organic foulant without any chemical addition, but applying simple UV-, visible- or solar-light activation.

TiO_2 has several beneficial properties – such as low cost, chemical stability, etc. –, but it is not free from drawbacks, as the significant electron/hole recombination limits the photocatalytic activity, and pure TiO_2 can be activated only by UV photons. For the suppression of electron/hole recombination, carbon nanotubes (CNTs) can be used as composite component, due to their high conductivity, and the presence of CNT also proved to be beneficial on the membrane surface in case of oil-in-water emulsion separation. The utilization of bismuth vanadate ($BiVO_4$) as nanocomposite component also proved to be beneficial for membrane surface modification.

Acknowledgments:
This project was supported by the Hungarian Science and Research Foundation (NKFI_FK_20_135202; 2017-2.3.7-TÉT-IN-2017-00016) and by the Ministry of Science and Technology of the Government of India (DST/INT/HUN/P17/2017). G.V. is thankful for the support provided by the Ministry of Human Capacities of the Hungarian Government in the framework of the NTP-NFTÖ scholarship program (National Talent Program - Scholarship for Young Talents of the Nation; NTP-NFTÖ-20-B-0254).