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President of Redox Technologies, Inc.
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ABSTRACTS

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Effects of blended and grafted TiO₂ and TiO₂/CNT on the membrane separation of oily wastewaters with photocatalytic PVDF-nanocomposite membranes

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Membrane separation can be a promising solution for the final treatment of oily wastewaters containing finely dispersed, emulsified oil droplets. By producing semiconductor-nanoparticle-modified membranes it is possible to create photocatalytically active, antifouling, and self-cleaning surfaces. Titanium-dioxide (TiO₂) is one of the best-known photocatalytically active nanoparticles, and its hydrophilic property is also beneficial in membrane modification. Carbon nanotube (CNT) can increase the efficiency of TiO₂, as CNT has good electrical conductivity properties, making it possible to capture the electrons of the conduction band of the excited titanium dioxide, resulting in extended lifetime of the electron-hole pairs and enhanced photocatalytic activity [¹⁻³].

In this study, four types of TiO₂ and TiO₂/CNT_{2%} nanocomposite blended and grafted (phase-inversion produced) PVDF membranes were prepared for the membrane separation of an oily wastewater. In the first part of the study the production parameters were optimized: the benefits of different modifications were investigated in terms of fluxes, fouling (filtration resistances) purification efficiencies and flux recovery ratios (FRRs). The nanomaterials were effective in hydrophilizing the membrane surface (even the CNT is a hydrophobic material) by reducing the contact angle by up to ~85%, and thus the FRRs were significantly (up to 50-fold) higher compared to the reference PVDF membrane (without nanoparticle modification). The multiple use of the membranes was also investigated. In addition, the photocatalytic properties of the surface were also examined. After repeated filtration processes (with oily emulsion) the effects of UV (20h) and VIS (72h) irradiations on the membrane surfaces were investigated. The results proved that the initial flux was totally recovered, and SEM-EDX measurements also showed the photocatalytic purification of the membrane surfaces.

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Keywords:

membrane filtration, oil emulsion, titanium dioxide, carbon nanotube, surface modification, photocatalytic regeneration.