TIO_2/CNT COMPOSITE MODIFIED MEMBRANES FOR ADVANCED MEMBRANE SEPARATION OF OIL-IN-WATER EMULSION

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ABSTRACT

Oily wastewaters are produced all over the world by several activities, which contain several toxic and carcinogenic components, and mean serious risk both on the natural environment and human health. Beyond environmental protection reasons, economic concerns also lead the industries to use advanced wastewater treatment methods which ensure higher purification efficiency. The augmentation of conventional techniques is expected to be compulsory in the near future Membrane filtration has several advantages, like high purification efficiency, no chemical addition, and easy integration, but oily contaminants quickly form a hydrophobic layer which reduces the water flux, decreases the membrane lifespan and increases the energy consumption which leads high operational costs.

In the present study titanium dioxide (TiO_2) and carbon nanotube (CNT) were used for the modification of PVDF membranes to reduce the membrane fouling via the inhibition of oil droplet adhesion on the membrane surface. Titanium dioxide (TiO_2) coating can increase the membrane hydrophilicity, while carbon nanotube (CNT) can be used to reduce the significant electron/hole recombination of TiO_2 during the photocatalytic cleaning of the fouled membrane.

In the present study, the beneficial concentration of the used carbon nanotubes in TiO_2/CNT nanocomposites was investigated (in an interval of 1-10 w/w%) to achieve advantageous filtration properties. Within the studied range, TiO_2/CNT nanocomposite containing 2 w/w% of CNT – which was physically immobilized onto the membrane surface – was the most beneficial. That composition increased the flux and reduced the filtration resistance with the highest efficiency, and it also proved to be beneficial in terms of purification efficiency during the filtration of 100 mg/L^{-1} oil-in-water emulsions (prepared from natural crude oil). It has also been shown that the advantageous properties of the nanocomposite-modified membrane surface are enhanced by increasing the transmembrane pressure.

Keywords: crude oil, emulsion, membrane separation, titanium dioxide, carbon nanotube

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