USE OF STATISTICAL ANALYSIS FOR FABRICATION OF PVDF/PVP/TiO_2 MEMBRANES TO TREAT OIL-IN-WATER EMULSION

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ABSTRACT

Highly effective treatment of oily wastewater is becoming an urgent necessity due to its harmful effect on the environment. Membrane filtration can be used to remove finely dispersed, emulsified, and dissolved oil. Polymeric membranes are usually fabricated with phase-inversion method and can be modified to generate membranes with defined characteristics; for this, different polymers and additives are often used, such as photocatalytic nanoparticles, which became an interesting approach since they can decompose the organic matter on the membrane, reducing the fouling and increasing the flux. The use of statistical analysis is important for membrane fabrication since it shows how different variables affect the formation and performance of membranes simultaneously.

In this study, the effects of different contents (0.0, 0.5, 1.0, and 1.5%) of polyvinylpyrrolidone (PVP) and titanium dioxide (TiO_2) on polyvinylidene fluoride (PVDF) membranes were investigated, generating response surfaces that show how the additives affect the pure water flux, flux, and rejection rate of an oil-in-water emulsion (100 mg L^{-1}), flux recovery ratio after cleaning, and decomposition rate of methyl orange.

TiO_2 had a significant effect on the photocatalytic activity of the membranes ($p=0.00196$) and every TiO_2-membranes decolorized more than 95% of dye in the studied interval; 1.5% of TiO_2 did not show the greatest decomposition, therefore, the optimum content of nanoparticle is within 0.5 and 1.0%. TiO_2 and PVP did not significantly affect the filtration performance of the membranes ($p>0.05$). However, higher contents of PVP reduced oil rejection rates ($p=0.000521$), but min. 90% was observed in all cases. PVP had a positive effect on the flux recovery ratio as well ($p=0.000143$). Therefore, the chosen content of PVP was 1.0%. The presented data show details of how PVP and TiO_2 affect the membrane fabrication and performance and can be used for better understanding for the membrane filtration enhancement.

Keywords: membrane filtration, photocatalytic membrane, TiO_2 nanoparticles, statistical analysis

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