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Performance assessment of synthesized CNT/polypropylene composite membrane distillation for oil field produced water desalination

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ABSTRACT

Multi-walled carbon nanotubes (MWCNTs)/polypropylene (PP) blend membranes were synthesized by phase inversion process, using xylene as a solvent and methyl isobutyl ketone (MIBK) as a dispersion medium for MWCNTs. The prepared MWCNTs/PP membranes were characterized using several analytical techniques such as: attenuated total reflections Fourier transform infrared spectroscopy, contact angle measurement, atomic force microscope (AFM), and scanning electron microscope (SEM). Performance of the synthesized membranes in vacuum-enhanced direct contact membrane distillation (VEDCMD) process was evaluated using 55˚C feed synthetic water and/or oil field produced water samples with salinities up to 230,000 ppm. Effect of membrane preparation conditions, including polymer concentration, polymer thickness, and CNT concentrations as well as operating temperatures and streams flow rates on the flux were studied. The results showed an improvement in membranes characteristics and trans-membrane flux by MWCNTs addition. Contact angle measurements indicate that the hydrophobicity of MWCNT/PP membrane was significantly increased compared to the pure PP membrane. The SEM images showed a well dispersion of MWCNTs in the PP matrix. By analyzing AFM images, the roughness parameters and mean pore size increase by either using MIBK or decreasing PP polymer concentration. On the other hand, by blending MWCNTs, the roughness parameters increase with decreasing of mean pore size. The salt rejection of the synthesized membranes was greater than 99.9%. The results show that MWCNTs enhanced the performance of VEDCMD with 58% at the same operating conditions. The obtained flux ranged from 45.95 to 19.66 L/m^2 h, using 10,000 ppm and brine oil field produced water, respectively, by MWCNT/PP nano-composite membrane with 5 mg/g of MWCNTs and thickness 50 μm.

Keywords: PP/MWCNTs; Composite membrane distillation; Water desalination

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