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ABSTRACTS

SPIN-COATED THIN-FILM NANOCOMPOSITE MEMBRANES WITH MULTI-WALLED CARBON NANOTUBES FOR ENHANCED WATER DESALINATION AT REDUCED PRESSURE FLUX

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Pressure-driven membranes are widely used for water desalination, but their reliance on high-pressure flux poses significant energy and operational challenges. As a result, the development of energy-efficient membranes has become a key area of research. Thin-film nanocomposite (TFN) membranes, which incorporate multiwalled carbon nanotubes (MWCNTs) into the polyamide (PA) selective layer via interfacial polymerization (IP), exhibit improved structural integrity, water permeability, and contaminant rejection compared to conventional thin-film composite (TFC) membranes. However, conventional IP techniques offer limited control over the uniformity and morphology of the PA layer. This study introduces a novel fabrication approach that integrates spin coating with the IP process to produce TFN membranes. By applying varying spin accelerations, the centrifugal force helps regulate membrane formation at the nanoscale. A polyether sulfone (PES) substrate was used to support the formation of an ultrathin PA layer, synthesized through the reaction between m-phenylenediamine (MPD) and trimesoyl chloride (TMC). Spin acceleration assisted in uniformly removing excess amine solution, resulting in a defect-free and thinner PA layer. These membranes exhibited water flux values ranging from 11.16±0.56 to 18.41±0.92 L/m^2 h, with the highest flux at 60 rpm/s but lower salt rejection. Higher water flux is often associated with larger pores in the selective layer, which can compromise the salt rejection. As a result, these membranes exhibited relatively low salt rejection and water flux stability. Higher spin rates altered porosity and thickness of the PA layer, affecting both flux and salt rejection. Salt rejection was evaluated using Na_2SO_4, $MgSO_4$, $MgCl_2$, and NaCl. Membranes spun at 40 and 80 rpm/s demonstrated better salt rejection, indicating improved PA layer formation. At 40 rpm/s and 0.004% MWCNT loading, the membrane achieved over 61.36±3.07% rejection for $MgSO_4$ and 59.15±2.96% for Na_2SO_4 with a water flux of 14.45±0.72 L/m^2 h at 600 kPa. Iron nanoparticles present in the MWCNTs, synthesized via the floating catalyst method, may obstruct nanotube pores, reducing overall performance. Ongoing work focuses on nanoparticle removal and surface functionalization to further enhance membrane efficiency.

Keywords: *Desalination, Carbon nanotubes, Interfacial polymerization, Nanocomposite, Spin coating method*