Optimization of fabrication parameters for nanofibrous composite membrane using response surface methodology

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\begin{abstract}
In this study, response surface methodology (RSM) is introduced as an efficient method for investigating and optimizing important parameters for the synthesis of an active layer on the surface of a nanofibrous midlayer. The nanofibrous composite membranes fabricated in this study comprised a polyethylenimine (PEI)/trimesoyl chloride (TMC)-active layer, electrospun polysulfone (PSf)/polyethylene glycol (PEG) midlayer, and commercial polyethylene terephthalate (PET) nonwoven mechanical support layer. The PEI/TMC-active layer was fabricated under the following conditions: 2–4 w/v\% PEI, 1–3 w/v\% camphor sulfonic acid (CSA), and 0.5–1.5 w/v\% TMC. The effect of the three parameters on the membrane performance (i.e. permeate flux and salt rejection) in aqueous solutions containing 2,000 mg/L NaCl at 7 bar was investigated. The Box–Behnken design was used to elucidate the effects of the concentrations of PEI, CSA, and TMC on the membrane performance and optimize these parameters. The results demonstrated that PEI concentration had the most significant influence on both permeate flux and salt rejection. The highest permeate flux and ion rejection values obtained from the polynomial model were 26.83 L/m\textsuperscript{2} h and 74.90\%, respectively. Confirmation runs revealed that the predicted and experimentally obtained data were within 4.0\%, indicating acceptable accuracy of the predicted model attained from the RSM study. Although further research is necessary for confirmation, our results reveal that the RSM used in this experiment could be a useful tool for optimizing parameters for cross-linking reactions and quantitatively evaluating the effect of experimental conditions on nanofiltration properties.

\textbf{Keywords:} Nanofiber; Nanofiltration; Response surface methodology; Optimization; Polyethylenimine
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