Breaking through permeability-selectivity trade-off of thin-film composite membranes assisted with crown ethers

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May 8, 2020

Abstract

In this study, we deployed a modified interfacial polymerization process to incorporate multifunctional crown ethers (CEs) into thin-film composite (TFC) polyamide membranes. These CE additives acted as both the phase-transfer catalyst and co-solvent to facilitate the diffusion of amine monomers into the organic phase and also enhanced the free volume content of the selective layer, facilitating water transport and inhibiting the diffusion of draw solutes. Various characterization techniques were employed to elucidate the modification mechanism as a function of CE chemical and physical properties on the microstructure of resultant TFC membranes and consequently separation performances. Compared to TFC membranes produced from traditional interfacial polymerization method, CE-modified membranes exhibited a 146% water flux enhancement and 59% lower reverse salt fluxes with a suitable draw solution. CE-modified membranes also exhibited improved antifouling performance with a lower flux drop (34% decline) and a higher flux recovery ratio (38% improvement).

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Graphical Abstract
for
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