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Thin-film composite forward osmosis membranes based on polysulfone supports blended with nanostructured carbon materials

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Abstract

Polysulfone (PSf) membrane supports were blended with pristine multi-walled carbon nanotubes (MWCTNs), functionalized MWCNTs (MWf), graphene oxide (GO) and their corresponding carbon-TiO_2 composites. The surface hydrophilicity and the porous structure of the supports depended markedly on loading, type and surface chemistry of the nanostructured material, as well as on the addition or not of polyvinylpyrrolidone (PVP). These PSf supports were used to develop polyamide thin-film composite (TFC) membranes, whose performance was evaluated in forward osmosis using distilled water and 0.6 M NaCl solutions. TFC membranes prepared on PSf supports containing MWf and GO showed higher water permeation and draw solute rejection than those with hydrophobic MWCNTs or neat PSf only. An improved performance was observed when both carbon-TiO_2 composites and PVP were used, due to a porous structure of more elongated and straight finger-like pores and enhanced hydrophilicity. Among them, the most permeable membrane was that containing 0.5 wt.% of a GO-TiO_2 composite and PVP (12.5 L m^{-2} h^{-1} of water flux; ca. 60% higher than a TFC membrane on a commercial PSf support). However, the best performing membrane with the lowest specific solute flux (0.41 g L^{-1}) was that obtained when replacing GO by MWf.

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