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Relative importance of geometrical and intrinsic water transport properties of active layers in the water permeability of polyamide thin-film composite membranes

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Abstract

Analytical and numerical modeling studies in the literature have shown that the water permeability of reverse osmosis (RO) membranes is a function of geometrical (thickness, pore structure, surface roughness) and intrinsic water transport (water partition and diffusion coefficients) properties of their active layers. Nevertheless, no study has evaluated the relative importance of these properties with respect to the substantial differences (i.e., >10-fold) observed in water permeability among commercial RO membranes with active layers made of the same base material (e.g., crosslinked aromatic polyamide). Thus, we evaluated which active layer properties account for the differences observed in water permeability among five commercial RO membranes having crosslinked aromatic active layers and a wide water permeability range. We determined experimentally membrane water permeability and surface roughness, as well as active layer thickness, pore volume fraction, pore size, and water partition coefficient. We determined water diffusion coefficients in the active layers via macroscale modeling (i.e.,

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