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Biofouling in membrane devices treating water with different salinities: a modeling study

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ABSTRACT

The impact of biofilms on reverse osmosis (RO) membrane performance loss was studied using a two-dimensional mathematical model that couples fluid dynamics, salt and substrate mass transport and biofilm development. Decline in the permeate flux was simulated at different salt concentrations in the feed assuming: (i) the same feed pressure and (ii) pressures adjusted for constant initial flux. The pattern of biofilm development in the spacer-filled membrane channel was similar for all cases. Numerical results indicated that the detrimental effect of a biofilm is more pronounced for higher salinity of the feed, effect mainly due to the biofilm-enhanced concentration polarization. When pressure is increased to compensate for the osmotic pressure created by higher salt in feed, the local flux under the biofilm strongly deteriorates while a slight flux enhancement is observed in biofilm-free areas. Parametric variation within commonly measured range of biofilm permeability did not affect strongly the flux. Smaller effective diffusion coefficients of salt in the biofilm slightly decreased the permeate flux.

Keywords: Biofouling; Model; Reverse Osmosis; Brackish water; Salinity; Flux Decline

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