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Estimation of liquid entry pressure in hydrophobic membranes using CFD tools

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Abstract:

A two-dimensional computational fluid dynamics (CFD) model was developed and validated to estimate the liquid entry pressure (LEP) of hydrophobic membranes used for membrane distillation (MD). The volume of fluid (VOF) approach was employed to model the pore wetting process at pore-scale. As a result, the water/air interface could be identified at the pore entrance and then monitored through the pore in the course of gradually increased liquid water pressure at the feed side of the membrane. The contact angle (θ), pore length (L), pore entrance sharpness (r_s) and pore throat geometry were studied for their effects on wetting using the CFD model. Additionally, the impact of applying permeate-side vacuum on the LEP was assessed, in comparison to feed-side-only trans-membrane pressure.

An accurate LEP estimation with a high-resolution capillary effect monitoring strategy was achieved using the CFD tool. Pore throat geometry variation, θ, r_s and L were all found to have a