CFD study of the effect of perforated spacer on pressure loss and mass transfer in spacer-filled membrane channels

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ABSTRACT

One way to reduce pressure loss in spiral wound membrane modules is via creating holes within the feed spacer matrix, leading to increased channel porosity and reduced flow resistance. This study modifies conventional spacer geometry (i.e., dual-layer non-woven spacer) by perforating spacer filament and analyses the effect of different perforation aspects of spacers on the membrane performance via CFD. The results show that spacers with perforations near the membrane surface demonstrate similar mass transfer and pressure loss to the case where the perforation is in the middle of the channel (i.e., bulk flow) and the case that considers spacers without perforation, for a Re_h range of 50 – 200. Moreover, a large perforation size decreases mass transfer by over 10% through weakening of the flow velocity or suppression of vortex shedding. The main finding is that spacer perforation does not improve mass transfer for the cases simulated using conventional spacers.

KEYWORDS

CFD; Reverse osmosis (RO); Spiral wound module; Perforated spacer; Membrane performance

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