3D CFD study on hydrodynamics and mass transferphenomena for SWM feed spacer with different floating characteristics

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ABSTRACT

Enhancing the efficiency of reverse osmosis (RO) applications through the design andmodification of spacer geometries for spiral wound membrane (SWM) modules remainsa challenging task. In this work, four 3D feed spacer geometries with different degrees of"floating" characteristics are studied using computational fluid dynamics (CFD) simulationsto investigate the mechanisms that result in shear stress and mass transfer enhancement.The modelled data reveal that the floating ratio (Rf) is not a determining factor for masstransfer enhancement, as the transport mechanism is more strongly dependent on othergeometric characteristics, such as a 2- or 3-layer design. The analysis confirms our hypothesis, as the middle filament in a 3-layer design disrupts the formation of the large streamwisevortex located downstream of the intersection between the top and bottom filaments at Reh200. This explains why 3-layer spacers (both woven and non-woven) show lower Sherwoodnumber (Sh) than a 2-layer woven (2LW) spacer at Reh200. However, at a smaller Reh(<100),the vortical flow for 2LW is rather weak as a result of reduced membrane region with fluidmixing caused by creeping flow. This has led to the smaller Sh of 2LW compared to the3-layer spacer.

KEYWORDS: CFD; spiral wound module floating spacer; mass transfer

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