

Membrane distillation heat transfer enhancement by CFD analysis of internal module geometry

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ABSTRACT

Module geometry optimisation can be a crucial matter in all separation processes using selective or hydrophobic membranes, e.g. reverse osmosis (RO) and membrane distillation (MD). In fact the choice of suitable channel shape and size can dramatically affect the performance of the process. With reference to the membrane distillation process, temperature polarization phenomena and pressure drops along the channels largely affect the process efficiency (i.e. the efficient use of temperature driving force for the passage of vapour through the membrane) as well as pressure distribution, module mechanical resistance and pumping costs. Several works have been presented so far in literature on the fluid flow characterization of spacer-filled channels for the case of reverse osmosis modules, but only few works deal with the problem of MD modules optimization. The present work aims at the CFD simulation of the fluid flow and temperature fields within spacer-filled MD module channels for a variety of spacer geometries. Both commercial and custom made geometries have been simulated in order to identify the most important parameters affecting process efficiency. The commercial CFD code ANSYS CFX11.0 has been adopted to perform simulations. Results provide valuable information to identify the main features which an optimised spacer should possess in order to minimise T-polarization and pressure drops along the channel.

Keywords: Computational fluid dynamics; Membrane distillation; Spacer geometry; Design optimisation; Simulation; Temperature polarization

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