CFD parametrical study of the spacer geometry for Membrane Distillation

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Membrane Distillation (MD) is a thermal process that separates water from aqueous solutions containing non-volatile components such as salt. Water vapor from the hot feed channel permeates through a hydrophobic membrane thanks to a partial pressure gradient, and condenses in the cool channel. One of the main advantages of MD is the easy coupling with renewable resources, as the solar thermal energy. In the various MD configurations developed, net spacers are used in order to support the membrane, thus creating the channels; moreover, they can counteract the side effects of temperature polarization by promoting mixing. However, the presence of the spacer involves an increase of pressure drops and thus of pumping costs. In the design of MD modules, therefore, the choice of the spacer is crucial for the process efficiency.

In this work, flow and heat transfer in spacer-filled channels were predicted by computational fluid dynamics simulation. A parametrical study of net spacers made of two layers of overlapped filaments at 90° was performed; several values of (i) pitch to channel height ratio *p/h* (1-6), (ii) flow attack angle (0°-45°) and Reynolds numbers (20-350) were examined. The periodic domain of the hot channel was simulated under the hypothesis of fully developed conditions (Unit Cell approach). A very complex influence of the parameters on the heat transfer and pressure drop was found; nevertheless, better compromises between high Nusselt numbers and low friction factors were reached for *p/h* larger than 3. Simulation results provided directions for an optimal spacer features and are part of a large database that can be used for the process design and optimization.

Keywords: CFD, Membrane Distillation, Spacer-filled channel, Heat transfer, Temperature polarization, Pressure drop.

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