Abstract

The purification of water by membrane distillation (MD) is a thermally driven process operating at low pressure employing a low-grade heat source or renewable heat energy. For the multi-effect MD (MEMD) configuration, a two-dimensional computational fluid dynamics (CFD) model was proposed and verified using experimental data. The effect of increasing the number of effects while maintaining a fixed recovery ratio (RR = 15%) was investigated, and the findings revealed that as the number of effects grows, the permeate flux decreases and the energy efficiency (GOR) increases. Parametric analysis was used to investigate the impacts of module length, gap thermal conductivity and thickness, membrane permeability coefficient, wall and cold plate temperatures, and inlet velocity on GOR, permeate flow, and RR. The impact of adding fins in the feed channels was evaluated through a separate heat conduction analysis. At the same channel porosity, adding a larger number of thinner fins helps approach the upper-bound conductance value, thereby improving overall system performance.

Keywords: Simulation; Parametric analysis; Constant heat flux; fins