Desalination and Water Treatment
www.deswater.com
doi: 10.1080/19443994.2013.789234

51 (2013) 3662–3674
April

Taylor & Francis
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A CFD study of heat transfer through spacer channels of membrane distillation modules

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Received 8 September 2012; Accepted 13 March 2013

ABSTRACT

The computational fluid dynamics modeling in this paper examines transient flow and temperature patterns in spacer-filled membrane distillation channels. The instantaneous velocity profiles at various time steps show that at higher Reynolds number the vortices emerge behind spacer filaments, move along with the flow and then finally diminish. This unsteady behavior causes variation in local temperatures and heat transfer coefficients with time. The temperature polarization is usually low near the locations where high velocity region hits the top or attaches to the bottom surface. The region near the filament at the bottom is a stagnant zone and an area of higher temperature polarization at all times. The effect of filament spacing is also investigated. At low Reynolds number and a small filament spacing of 2 mm, maximum values for average shear stress and heat transfer coefficient are obtained. When Reynolds number is high, this spacer becomes unsuitable due to smaller magnitudes of these parameters. The overall analysis shows that the spacers with relatively higher spacing, such as 3 or 4 mm are more appropriate for use in membrane distillation channels.

Keywords: Computational fluid dynamics; Heat transfer coefficient; Membrane distillation; Spacer

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