Desalination and Water Treatment
www.deswater.com
9 (2009) 211–220
September
1944-3994 / 1944-3986
doi: 10.5004/dwt.2009.778

CFD modeling of unsteady fluid flow and mass transfer in spacer-filled membrane modules

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Received 15 September 2008; Accepted 14 July 2009

ABSTRACT

The CFD simulations in spacer-filled membrane modules reveal complex fluid structure in diamond-type spacers as flow directional changes are seen due to inclined spacer filaments. Despite this complex fluid behavior the flow remains steady for the Reynolds number considered in this study. However, the flow in a parallel-type spacer earlier thought to be less complicated has shown three dimensionality as well as time dependency. Due to this transient nature, the flow becomes asymmetric with flapping motion. The eddies appear immediately behind the transverse filaments, grow in size and finally dissipate in the center of the filaments. The flow unsteadiness also causes the shear and mass transfer rates to vary in time and major fluctuations are seen in the center of the spacer filaments which may be useful in the periodic removal of foulants from membrane surfaces, thus improving the process efficiency.

Keywords: CFD; Membrane; Spacer; Shear rates; Mass transfer

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Presented at the Conference on Membranes in Drinking and Industrial Water Production, 20–24 October 2008, Toulouse, France.