Desalination and Water Treatment
www.deswater.com
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doi: 10.5004/dwt.2009.137

1 (2009) 277–288
January

Detailed numerical simulations of flow mechanics and membrane performance in spacer-filled channels, flat and curved

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Received 30 April 2008; accepted revised 10 August 2008

ABSTRACT

Desalination by reverse osmosis is receiving increasing attention due to recent improvements in membrane technology in particular. This technique is now used for small to very large scale applications and has been identified as a key contributor to the Syrian water commission plans for example; there have also been comments in the British press about possible applications to the UK. Computational Fluid Dynamics (CFD) is increasingly used for complex modelling applications in the chemical process and water industries. In the present paper CFD is used to model desalination modules (channels and membranes) in which spacers are used to enhance mixing and maintain performance. In this work the fluid dynamics and the membrane physics are fully coupled. CFD offers bulk quantities, e.g. pressure, wall shear and mean salt accumulation on the membrane as already reported in part in [1], on the merits of various spacer setups but it also allows the computation of detailed maps for these values in the channel, along and across the membrane, which are the object of the paper. These maps permit the analysis of what is happening at the membrane level in great detail and could be used to further refine the channel and spacer setups. Whilst most of the experimental and CFD work done on these issues appears to have been done for flat channels, including in the present work, preliminary results are also included to report on the effects of curvature on the membrane performance.

Keywords: Desalination; Pressure-driven membrane; Concentration polarization; Spacers; Computational fluid dynamics (CFD)

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