Desalination and Water Treatment
www.deswater.com
doi: 10.1080/19443994.2013.874708

52 (2014) 1807–1819
February

Taylor & Francis
Taylor & Francis Group

Development and testing of a transparent membrane biofouling monitor

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Received 28 September 2013; Accepted 17 November 2013

ABSTRACT

A modified version of the membrane fouling simulator (MFS) was developed for assessment of (i) hydraulic biofilm resistance, (ii) performance parameters feed-channel pressure drop and transmembrane pressure drop, and (iii) *in situ* spatial visual and optical observations of the biofilm in the transparent monitor, e.g. using optical coherence tomography. The flow channel height equals the feed spacer thickness enabling operation with and without feed spacer. The effective membrane surface area was enlarged from 80 to 200 cm^2 by increasing the monitor width compared to the standard MFS, resulting in larger biomass amounts for analysis. By use of a microfiltration membrane (pore size 0.05 μm) in the monitor salt concentration polarization is avoided, allowing operation at low pressures enabling accurate measurement of the intrinsic hydraulic biofilm resistance. Validation tests on e.g. hydrodynamic behavior, flow field distribution, and reproducibility showed that the small-sized monitor was a representative tool for membranes used in practice under the same operating conditions, such as spiral-wound nanofiltration and reverse osmosis membranes. Monitor studies with and without feed spacer use at a flux of 20 $L\,m^{-2}\,h^{-1}$ and a cross-flow velocity of 0.1 $m\,s^{-1}$ clearly showed the suitability of the monitor to determine hydraulic biofilm resistance and for controlled biofouling studies.

Keywords: Hydraulic biofilm permeability; Drinking water production; Treatment; Biofouling; Friction; UF; NF; RO; OCT; MFS; tMBM; Seawater desalination

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