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Electrically conductive membranes for in situ fouling detection in membrane distillation using impedance spectroscopy

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Abstract

Online monitoring of fouling in desalination processes enables early and appropriate action for fouling control. This study demonstrates the use of Electrochemical Impedance Spectroscopy (EIS) to electrically conductive membranes for online monitoring of fouling by eliminating the need for external electrodes and/or canary cells. Electrically conductive membranes are prepared by incorporation of silica in carbon nanostructures and subsequent fluorination to yield hydrophobic membranes. These membranes are applied to direct contact membrane distillation with 99.9% salt rejection and a flux of 4.3 LMH. EIS is used for online monitoring of inorganic fouling on the membrane surface during the MD process. Impedance spectra taken over a duration of 15 hours indicated that impedance in the low frequency (<100 Hz) region gradually decreased with fouling early on, and increased towards the end. Impedance-based monitoring is more sensitive to changes in the system than monitoring of flux and permeate conductivity. This