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Study of a depth filter (Disruptor™) for the novel application of reducing SWRO membrane fouling

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ABSTRACT

The removal efficiency of a nanoalumina depth filter (Disruptor™) was tested using raw seawater from the North Sea in a laboratory scale filtration unit and reverse osmosis (RO) test unit. Permeate flux was measured against time using untreated and pre-filtered seawater. Untreated seawater exhibited a rapid permeate flux decline. Seawater pre-filtered through the Disruptor™ showed showed high flux that declined only slightly after 120 min of operation due to increasing of osmotic pressure and formation of scaling on the membrane surface. The surface morphologies of clean and fouled RO membranes were examined using scanning electron microscope (SEM). The surface of the membrane fouled by untreated seawater was completely covered by a fouling layer, while the membrane surfaces exposed to Disruptor™ pre-filtered seawater were clean and only scaling was detected. The functional groups on clean and fouled RO membrane samples were investigated by attenuated total reflection — Fourier transform infrared spectroscopy (ATR–FTIR). The spectra of the RO membrane fouled by untreated seawater showed absorption bands at 1025, 1006 and 915 cm^{-1}, indicating that the fouling materials were polysaccharides and silica clay materials. The spectrum on the RO membrane exposed to pre-filtered seawater through the Disruptor™ was indistinguishable from that of the clean RO membrane. The involvement of transparent exopolymer particles (TEP) in the establishment of biofouling and development of biofilm was investigated. Results showed that TEP size increased as well as the number of bacteria with time of incubation. However, the number of TEP decreased by about 80% in seawater pre-filtered through the Disruptor™.

Keywords: Reverse osmosis; Fouling; Disruptor™; Nano-alumina depth filter

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