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Cleaning Strategies and Membrane Flux Recovery on Anti-fouling Membranes for Pressure Retarded Osmosis

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Abstract

Study of cleaning procedures to maintain the anti-fouling properties is urgently needed to sustain high osmotic power density of the fouling resistant membranes in the pressure retarded osmosis (PRO) process. Therefore, various cleaning agents were evaluated for a charged hyperbranched polyglycerol grafted thin-film composite (CHPG-TFC) membrane: (i) deionized (DI) water; (ii) a high pH alkaline solution, (iii) a low pH acid solution, and (iv) a chelating solution comprised of ethylenediaminetetraacetate (EDTA). Compared with other cleaning agents, the EDTA cleaning was more effective to restore the original surface of the CHPG-TFC membrane and sustain its osmotic power density using a real wastewater effluent as the feed. The power density was maintained at a stable range of 6.0-6.7 W/m^2 in three repeated PRO tests. In comparison, a non-modified PES-TFC membranes with EDTA cleaning showed a large fluctuation of power density from 3.6 to 4.8 W/m^2. Instrumental analyses were conducted to reveal the physicochemical relationship between cleanings and membrane properties. The investigations confirmed the effectiveness of EDTA cleaning to mitigate the sulfate scaling, silica fouling, and calcium deposition. In summary, the EDTA cleaning imparted good recovery to the anti-fouling properties of the CHPG-TFC membrane and maintained its resilience to foulants in osmotic power generation by PRO.