Modeling Low-Pressure Nanofiltration Membranes for Softening and Pretreatment

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Abstract

Nanofiltration (NF) for softening and brine/seawater pretreatment has had surging interest lately in view of its ability to selectively reject scale-causing multivalent ions in feed waters. Two major limitations on the viability of NF for such applications has been the increased energy consumption associated with the pretreatment system, and a lack of "specialized" membranes for these applications. In this work, a recently developed cross-linked layer-by-layer (LbL) NF membrane for low-pressure applications will be modeled for the first time using the Donnan Steric Pore Model with Dielectric Exclusion (DSPME-DE). An overview of the modeling procedure along with validation experiments run on hard water solutions, including artificial seawater, will be presented. The results obtained by running parametric studies on different operating conditions, such as varying flow rates and applied pressure, will be addressed. The insights and implications of our modeling, and the reasons underlying the membrane's superior performance relative to other NF membranes will also be discussed.