RESEARCH BRIEF
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NAWI National Alliance for Water Innovation

Computational Test Bed for Predictive Fouling Control

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Challenge

We lack tools to accurately predict fouling of reverse osmosis (RO) membranes, especially for complex and changing feed water compositions.[1] Although there is limited application of models in some RO installations,[2] they generally lack the ability to link microscopic phenomena on the membrane surface (such as fouling/scaling) to macroscopic and system-level effects. Consequently, desalination facilities are often over-designed and operated extremely conservatively, leading to increased capital and operational costs.

Research Approach

The objective of this project is to develop computational models simulating feed flows and inorganic scaling in spiral-wound RO elements. The models seek to understand the formation and growth of scale and unsteady flow effects in the membrane module feed channel (Figure 1). An important element of this project is the development of experimental capabilities to quantify the fouling characteristics of commercial membranes and feed spacers for variable feedwater compositions. This testing capability will produce data sets to validate model predictions of reduced membrane performance due to scale formation.

Impact

The development of predictive fouling models will enable optimization of RO system design and operation, mitigate fouling risk, and reduce desalination capital and operational costs. It is anticipated that these predictive tools will form the basis of a suite of applications that can be used by membrane manufacturers and users to improve RO module and system design, improve operating efficiency, and expand the range of water chemistries that can be reliably processed using RO.

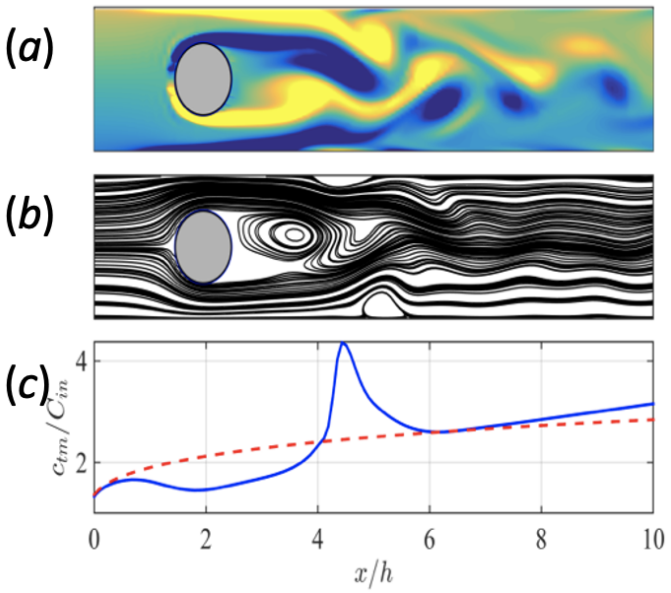

Figure 1. Simulation of fluid mixing in an RO module feed channel: (a) vorticity, (b) streamlines, (c) salt concentration at the membrane surface.

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2. Antony, A.; Low, J. H.; Gray, S.; Childress, A. E.; Le-Clech, P.; Leslie, G. Scale Formation and Control in High Pressure Membrane Water Treatment Systems: A Review. *J. Memb. Sci.* 2011, 383 (1–2), 1–16.

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