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Understanding the Permeation of Solutes in Water Treatment Membranes

WILLIAM PHILLIP, University of Notre Dame

The responsible management of the world's water resources is essential to supporting human life on earth. The successful development of reverse osmosis seawater desalination makes it a crucial component in the portfolio of water supply options. However, other measures to alleviate the stresses on water supplies are necessary to responsibly and sustainably meet the worldwide demand for fresh water. Osmotically driven membrane processes (ODMP) are an emerging set of technologies that show promise in water conservation and reuse, as well as wastewater reclamation. The majority of research in the field has focused on predicting and enhancing water permeation through membranes, however, the effective operation of ODMP systems requires that the permeation of solutes across water treatment membranes be better understood. For example, the reverse flux of draw solute from the concentrated draw solution into the feed solution should be minimized. Additionally, due to the presence of solute-solute interactions that arise because of the unique geometry of ODMPs, the rejection of dilute solutes in these processes can be dramatically different than those observed in traditional pressure driven operations. In this talk, theoretical and experimental approaches are used to explore the permeation of solutes in osmotically driven membrane processes. Phenomenological models were developed that describe the forward and reverse permeation of the solutes across an asymmetric membrane in forward osmosis operation; and experiments were carried out to validate the model predictions. Using independently determined membrane transport coefficients, strong agreement between the model predictions and experimental results was observed.