Author's Accepted Manuscript

Elucidating the impact of temperature gradients across membranes during forward osmosis: Coupling heat and mass transfer models for better prediction of real osmotic systems

Maqsud R. Chowdhury, Jeffrey R. McCutcheon

www.elsevier.com/locate/memsci

PII: S0376-7388(17)30278-8
DOI: https://doi.org/10.1016/j.memsci.2018.01.004
Reference: MEMSCI15858

To appear in: *Journal of Membrane Science*

Received date: 29 January 2017
Revised date: 21 December 2017
Accepted date: 1 January 2018

Cite this article as: Maqsud R. Chowdhury and Jeffrey R. McCutcheon, Elucidating the impact of temperature gradients across membranes during forward osmosis: Coupling heat and mass transfer models for better prediction of real osmotic systems, *Journal of Membrane Science,* https://doi.org/10.1016/j.memsci.2018.01.004

Elucidating the impact of temperature gradients across membranes during forward osmosis: Coupling heat and mass transfer models for better prediction of real osmotic systems

Maqsud R. Chowdhury, Jeffrey R. McCutcheon[1]*

Department of Chemical and Biomolecular Engineering University of Connecticut, Center for Environmental Sciences and Engineering, 191 Auditorium Rd. Unit 3222. Storrs, CT 06269-3222, US

Jeffrey.mccutcheon@ uconn.edu

Abstract

The forward osmosis (FO) process is an emerging desalination, reuse, and dewatering technology that can operate off of a thermally regenerated draw solution. Using thermal energy to regenerate the draw solution, however, can lead to a draw solution with elevated temperature. Likewise, certain feed streams, including wastewaters from the food, agriculture, and oil and gas industries, may be elevated in temperature. While each of these concepts has been discussed in the literature individually, lacking from the field is an understanding of how *gradients* of temperature can impact FO performance. This investigation elucidates how temperature gradients impact water flux, reverse solute flux, and intrinsic membrane properties using both experiments and model based prediction. A model was developed that couples the effect of simultaneous heat and mass transfer across the membrane. The model uses local solution conditions (temperature, concentration) to calculate local solution properties (diffusivity, viscosity, density) that are important for mass transfer. Results show that the direction of water flux is the critical factor when understanding the impact of a transmembrane temperature gradient. Specifically, when the draw and feed differ in temperature, the feed solution temperature has a more

[1] Telephone: (860)486-4601