Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Internal Concentration Polarization in Asymmetric Membrane in Forward Osmosis System GABRIELA GADELHA, HERMES GADELHA, NICK HANKINS, University of Oxford — There has been a re-emerging interest in the study of the osmotic-driving desalination process known as Forward Osmosis (FO), due to its potential for significantly lower energy demand. However, the employed asymmetric semi-permeable membranes are notorious for the formation of unstirred boundary layers. These boundary layers may be dilutive or concentrative, causing an undesired decline on the osmotic flux. To date, although several models have been proposed in the literature to describe various applications in membrane separation processes, the fundamental theoretical basis has remained unchanged. Here, we detail an alternative formulation for the solute concentration profile and the water flux decline in terms of the osmotic Peclet number and the dimensionless solute permeability. Our analysis shows that the osmotic potential efficiency and the resulting water flux are inversely related, preventing any simultaneous optimization of the system, i.e. the larger the water flux is, the less osmotically efficient it becomes. We equally investigated the effect of distinct flat-sheet membrane configurations on the water flux. In this case, when the active layer faces the solution of low concentration (feed solution), under normal operations conditions, the water flux can be 60% lower than its counter configuration, when the active layer faces the solution of high concentration (draw solution). Finally, we contrast the theoretical formulation with experiments using inorganic ions and micelle as draw solutions.

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Date submitted: 01 Aug 2013 Electronic form version 1.4