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Novel Approach for Sizing Forward Osmosis Membrane Systems

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Abstract

Analytical solutions for sizing ideal Forward Osmosis membrane systems are developed for both co-current and counter-current flow configurations. They are integral solutions of the mass balance equations, including the one representing transfer across the membrane. Salt passage is assumed to be zero but allowance is made for concentration polarisation. The solutions presented obviate the need for approximations based upon a log mean driving force which are only mere approximations when there is transfer of mass from one side of the transfer surface to the other. Secondly a comparison between the estimates of areas using a log-mean approximation and the calculated areas using the analytical solution shows that the former will generate significant errors at high recoveries for the case of counter-current flow. Thirdly the potential recovery is also elucidated for various combinations of salinity, flow rate ratios and flow arrangement.

Keywords: Forward Osmosis; Membrane area; Desalination; effectiveness

Highlights (to be uploaded separately)

Exact solutions for sizing ideal Forward Osmosis membrane systems

Solutions include allowance for concentration polarisation

Limitations on use of log-mean driving force demonstrated for a range of conditions

Large difference in membrane area for counter-current exchangers at high recoveries

Graphical Abstract (to be uploaded separately): modified version of Fig 3