Direct fertigation with brackish water by a forward osmosis system converting domestic reverse osmosis module into forward osmosis membrane element

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Received 7 March 2015; Accepted 18 July 2015

\textbf{ABSTRACT}

Forward osmosis has found numerous applications in water treatment, water reuse, and other sectors e.g. desalination, concentration of wastewater, landfill leachate treatment, controlled drug release, emergency water treatment kit, etc. because of its low pressure operation and low fouling. The present paper demonstrates that the fertilizers can function as draw solution and be employed for drawing water from the brackish water. The proposed process eliminates the recovery step and the diluted draw solution can directly be utilized in fields for fertigation. We have selected fertilizers as a draw solution which provides nutrients to the crops for their basic growth. The domestic reverse osmosis membrane element has been converted to forward osmosis membrane element in a novel approach. The performance of each fertilizer is accounted in terms of experimentally obtained flux by comparing it with theoretically estimated flux. It has been found that there is a significant difference in experimentally obtained flux and theoretically estimated flux because of internal concentration polarization due to the presence of draw solution on permeate side and low availability of the effective membrane surface area. We have also investigated reverse draw solute diffusion for each fertilizer and the increase in concentration of feed solution to understand the movement of ions across the membrane. The reverse salt diffusion was observed in all three fertilizers studied with water as feed, however it was absent when sodium chloride feed solution was used. This shows that the presence of salt on feed side of the membrane suppresses the reverse salt diffusion on account of Donnan exclusion.

\textit{Keywords}: Forward osmosis; Fertilizer; Draw solution; Reverse solute diffusion; Brackish water