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Performances of PA hollow fiber membrane with the CTA flat sheet membrane for forward osmosis process

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ABSTRACT

Fertilizer drawn forward osmosis desalination has been earlier explored using flat sheet forward osmosis (FSFO) membrane, which highlighted flux and reverse solute flux (RSF) performance. This study evaluated and compared the performances of a newly developed polyamide (PA)-based hollow fiber forward osmosis (HFFO) membrane and cellulose triacetate FSFO membrane. Both membranes were evaluated for pure water permeability, salt rejection rate (1,000 mg/L NaCl) in RO mode. Physical structure and morphology were further examined using scanning electron micrograph (SEM). SEM images revealed that the overall thickness of the HFFO and FSFO membranes was 152 and 91 μm, respectively. Flux and RSF performances of these two membranes were evaluated using nine fertilizer DS as NH_4Cl, KNO_3, KCl, $(NH_4)_2SO_4$, $Ca(NO_3)_2$, $NH_4H_2PO_4$, $(NH_4)_2HPO_4$, $NaNO_3$, and $CO(NH_2)_2$ in active layer–feed solution membrane orientation. HFFO membrane clearly showed better performance for water flux with five DS ($(NH_4)_2SO_4$, $NH_4H_2PO_4$, KNO_3, $CO(NH_2)_2$, and $NaNO_3$) as they showed up to 66% increase in flux. Beside thick PA active layer of HFFO membrane, higher water flux outcome for forward osmosis (FO) process further highlighted the significance of the nature of support layer structure, the thickness and surface chemistry of the active layer of the membrane in the FO process. On the other hand, most DS showed lower RSF with HFFO membrane with the exception of $Ca(NO_3)_2$. Most of DS having monovalent cation and anions showed significantly lower RSF with HFFO membrane.

Keywords: Fertilizer draw solution; Forward osmosis (FO); Flat sheet FO membrane; Flux; Hollow fiber FO membrane; Reverse salt flux

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