

Author's Accepted Manuscript

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PII: S0376-7388(18)31075-5
DOI: <https://doi.org/10.1016/j.memsci.2018.09.022>
Reference: MEMSCI16467

To appear in: *Journal of Membrane Science*

Received date: 20 April 2018
Revised date: 12 August 2018
Accepted date: 5 September 2018

Cite this article as: Bharat Honmane, Tejaswini Deshpande, Abhishek Dhand, Rhea Bhansali and Pushpito K. Ghosh, Channelizing the osmotic energy of proximate sea bittern for concentration of seawater by forward osmosis under realistic conditions to conserve land requirement for solar sea salt production, *Journal of Membrane Science*, <https://doi.org/10.1016/j.memsci.2018.09.022>

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Channelizing the osmotic energy of proximate sea bittern for concentration of seawater by forward osmosis under realistic conditions to conserve land requirement for solar sea salt production

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ABSTRACT

The present investigation relates to partial dewatering of seawater or seawater-like feed solutions ($\pi = 20\text{-}26$ bar) by Forward Osmosis (FO) using concentrated brine/virgin sea bittern ($\pi = 549\text{-}715$ bar) available in proximity. An Aquaporin InsideTM hollow fibre FO membrane module (0.6 m^2 active area) was used for the study. Initial studies with deionized water as feed and sea bittern as draw revealed that the reverse solute flux was $4560\text{-}6066\text{ mgm}^{-2}\text{h}^{-1}$, with salt rejection efficiency of $99.45\text{-}99.87\%$. Studies with ca. $36,000\text{ mgL}^{-1}$ NaCl feed and $24\text{ }^{\circ}\text{Bé}$ [$^{\circ}\text{Bé} = 145(1-1/\rho)$, where ρ = specific gravity] concentrated sea brine draw resulted in 26.41% , 13.29% and 9.15% dewatering of feed (v/v) in continuous single pass (CSP) mode, with average flux (J_w) of 6.17 , 6.48 and $6.73\text{ Lm}^{-2}\text{h}^{-1}$, for feed to draw (F/D) ratios of $10:1$, $20:1$ and $30:1\ v/v$, respectively. Outlet feed concentrations estimated from density data were in good agreement with the values computed considering pure water permeation. FO experiments were subsequently undertaken with $2.84\text{ }^{\circ}\text{Bé}$ natural seawater as feed and $29\text{ }^{\circ}\text{Bé}$ virgin sea bittern as draw. The feed and draw flow rates were 45 and 1.5

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