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Compatibility study of nanofiltration and reverse osmosis membranes with 1-cyclohexylpiperidenium bicarbonate solutions

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ABSTRACT

Any forward osmosis (FO) based water treatment process using a thermolytic draw solute requires a method to remove/recycle low concentrations of residual draw solute contained in the product water. For switchable polarity solvent forward osmosis (SPS FO) this means the removal of residual tertiary amines from the product water. This study explores membrane filtration of 1-cyclohexylpiperidenium bicarbonate (CHP-H_2CO_3) draw solute under conditions relevant to the SPS FO process. Fourteen commercially available nanofiltration (NF) and reverse osmosis (RO) membranes were screened. Several NF membranes displayed good chemical compatibility at CHP-H_2CO_3 concentrations of 2.5 weight percent or higher while maintaining fair selectivity, with flux normalized rejection of ~80 - 99% and flux normalized net driving pressure of 80 - 400 psi for the normalized flux of 20 LMH. Most sea water and brackish water RO membranes tested showed flux normalized rejection of above 98% and flux normalized net driving pressure of 300 - 900 psi. A two-pass NF/tap water (TW) RO system is proposed as an effective low-pressure method to remove residual CHP-H_2CO_3 from water.