

Recovery of Draw Solution in Forward Osmosis by Direct Contact Membrane Distillation

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Abstract : Forward osmosis (FO) is an emerging technology for direct and indirect potable water reuse application. However, successful implementation of FO is still hindered by the lack of draw solution recovery with high efficiency. Membrane distillation (MD) is a thermal separation process by using hydrophobic microporous membrane that is kept in sandwich mode between warm feed stream and cold permeate stream. Typically, temperature difference is the driving force of MD which attributed by the partial vapor pressure difference across the membrane. In this study, the direct contact membrane distillation (DCMD) system was used to recover diluted draw solution of FO. Na₃PO₄ at pH 9 and EDTA-2Na at pH 8 were used as the feed solution for MD since it produces high water flux and minimized salt leakage in FO process. At high pH, trivalent and tetravalent ions are much easier to remain at draw solution side in FO process. The result demonstrated that PTFE with pore size of 1 µm could achieve the highest water flux (12.02 L/m²h), followed by PTFE 0.45 µm (10.05 L/m²h), PTFE 0.1 µm (7.38 L/m²h) and then PP (7.17 L/m²h) while using 0.1 M Na₃PO₄ draw solute. The concentration of phosphate and conductivity in the PTFE (0.45 µm) permeate were low as 1.05 mg/L and 2.89 µm/cm respectively. Although PTFE with the pore size of 1 µm could obtain the highest water flux, but the concentration of phosphate in permeate was higher than other kinds of MD membranes. This study indicated that four kinds of MD membranes performed well and PTFE with the pore size of 0.45 µm was the best among tested membranes to achieve high water flux and high rejection of phosphate (99.99%) in recovery of diluted draw solution. Besides that, the results demonstrate that it can obtain high water flux and high rejection of phosphate when operated with cross flow velocity of 0.103 m/s with T_{feed} of 60 °C and T_{distillate} of 20 °C. In addition to that, the result shows that Na₃PO₄ is more suitable for recovery than EDTA-2Na. Besides that, while recovering the diluted Na₃PO₄, it can obtain the high purity of permeate water. The overall performance indicates that, the utilization of DCMD is a promising technology to recover the diluted draw solution for FO process.

Keywords : membrane distillation, forward osmosis, draw solution, recovery

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