Nanofiltration separation of highly concentrated multivalent electrolyte draw solution; a pilot plant study

Ali Altaee\textsuperscript{a,\*}, Adel O. Sharif\textsuperscript{a}, Malak Hamdan\textsuperscript{b}

\textsuperscript{a}Qatar Energy and Environment Research Institute, The Qatar Foundation, Doha, Qatar, Tel. +974 55241752; emails: alialtaee@hotmail.com (A. Altaee), asharif@qf.org.qa (A.O. Sharif)

\textsuperscript{b}Department of Chemical Engineering, Surrey University, Guildford GU2 7XH, UK, email: malakhamdan@hotmail.com

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ABSTRACT

Nanofiltration membrane system is proposed for the regeneration of draw solution in a two-stage forward osmosis (FO) process. Pilot plant experiments were carried out on two types of multivalent electrolyte draw solutions, MgSO\textsubscript{4} and MgCl\textsubscript{2}. Two commercial size NF90-4040 Filmtec Nanofiltration (NF) membranes were packed in a high-pressure vessel for the regeneration of draw solution. The concentrations of the draw solution used were between 20 and 118 g/L. The impact of feed concentration, flow rate and feed pressure on the performance of NF membrane was investigated. Both metal salts have shown a high rejection rate by the NF membrane. The rejection rate to the MgSO\textsubscript{4} was slightly higher than that to the MgCl\textsubscript{2}. Experimental results showed that NF rejection rate and permeate flow rate increased with increasing the feed pressure and flow rate but decreased with increasing the concentration of feed solution. However, this was achieved at the expense of higher power consumption. In general, the efficiency of NF system for the regeneration of draw solution was higher at lower feed concentration. This suggests that NF separation method is probably more suitable for the regeneration of low concentration draw solution which is generated from brackish water FO treatment plants. Furthermore, NF application in the regeneration of high-concentration draw solution is not yet feasible due to the limitations in the NF process such operating feed pressure and rejection rate.

Keywords: Draw solution regeneration; Nanofiltration; Electrolyte rejection; Seawater desalination; Membrane desalination