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A novel forward osmosis for treatment of high-salinity East Baghdad oilfield produced water as a part of a zero liquid discharge system

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ABSTRACT

This study investigated a novel application of forward osmosis (FO) for oilfield produced water treatment from the East Baghdad oilfield affiliated to the Midland Oil Company (Iraq). FO is a part of a zero liquid discharge system that consists of oil skimming, coagulation/flocculation, forward osmosis, and crystallization. Treatment of oilfield produced water requires systems that use a sustainable driving force to treat high-ionic-strength wastewater and have the ability to separate a wide range of contaminants. The laboratory-scale system was used to evaluate the performance of a cellulose triacetate hollow fiber CTA-HF membrane for the FO process. In this work, sodium chloride solution was used as a feed solution (FS) with a concentration of 76 g/L, while the draw solution (DS) was magnesium chloride solution, and the applied external pressure on the feed solution side was 2 bar. The impact of batch mode with a constant DS concentration (or continuous mode) and batch mode with dilution draw solution concentration (240, 300, and 400 g/L) on the FO performance for oilfield produced water treatment were investigated on normalized flux, recovery, feed solution concentration, reverse salt flux, and rejection. The recovery and feed solution concentration increased with increasing draw solution concentration and time. While the normalized flux increased with increasing the draw solution concentration and decreased with time. The reverse salt flux of Mg^{2+} and the rejection of Na^{+} decreased with time. The produced water feed solution was concentrated to 220 g/L at DS concentration of 400 g/L $MgCl_2$ in batch mode with a constant DS concentration after 16.5 h at which the recovery was 65.67%. The reverse salt flux of Mg^{2+} was 0.06 g/m^2 h after 10 h, at which the rejection of Na^{+} reaches 99.84%.

Keywords: Forward osmosis; Zero liquid discharge system; Iraqi oilfield produced water

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