

Citrate-coated magnetite nanoparticles as osmotic agent in a forward osmosis process

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ABSTRACT

Iron oxide (Fe_3O_4) magnetic nanoparticles (MNPs) is the most promising draw solutes (DS) that have been studied during the past years. They gained their reputation because of the unique properties they possess, such as large surface area to volume ratio, magnetic properties, and the easiness of surface functionalization. Two samples of MNPs (MNPs-1 and MNPs-2) were synthesized by co-precipitation of ferric and ferrous ions in alkaline solution depending on certain parameters including pH, temperature, $\text{Fe}^{2+}/\text{Fe}^{3+}$ molar ratio, mixing rate, adding base to the reactants (and vice versa), and using N_2 gas. Tri-sodium citrate (TSC) was selected to functionalize the MNPs surface because of the carboxylate groups that it possesses. Hydrophilic citrate-coated magnetic nanoparticles (cit-MNPs) were obtained. The performance of cit-MNPs as DS was investigated by applying them in forward osmosis (FO) process with the use of cellulose triacetate (CTA) membrane. TSC was applied as DS to investigate the efficiency of cit-MNPs in comparison with it. Also, two types of salts were chosen for comparison with cit-MNPs, sodium chloride (NaCl) and sodium formate (HCOONa). The highest water fluxes obtained from MNPs-1, MNPs-2, TSC, NaCl and HCOONa at 2 g/l were 34.77, 28.41, 25.27, 24.6 and 30.67 LMH, respectively. All the results demonstrated that citrate-MNPs-1 performed better as DS.

Keywords: Forward osmosis; Draw solution; Citrate-coated magnetic nanoparticles; NaCl; Sodium formate

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