



A review of draw solutes in forward osmosis process and their use in modern applications

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ABSTRACT

Forward osmosis (FO) is one of the emerging membrane technologies which has gained renewed interest recently as a low energy desalination process. The central to FO process is the draw solution (DS) and the membrane because both play a substantial role on its performance. Hence, the selection of an appropriate DS is crucial for the process efficiency. Many DS have been tested so far for a wide range of modern applications and this paper aims to review the various aspects of the DS in the process performance and provides valuable information regarding the selection criteria of suitable DS. Several general DS properties such as the osmotic pressure and the water solubility can affect the process performance. Other intrinsic properties to specific novel DS such as the emerging magnetic nanoparticles (MNPs) can also have an impact on the process efficiency and have to be evaluated. Separation and recovery of the DS are one of the major challenges facing the development of FO process. The recovery process should not be energy intensive, otherwise the FO process cannot be comparable with other pressure-driven processes. Thermolytic solutions such as ammonia carbonates are considered as the promising DS for desalination applications; however, their recovery process efficiency relies on the availability of low-grade heat. MNPs are emerging and effective DS for desalination and can be readily recovered by a magnetic field or conventional membrane processes. However, the aggregation of MNPs due to their magnetic properties has been issued. The vast numbers of studies on the use of NaCl as DS for the treatment of impaired water open up the possibilities of using seawater or reverse osmosis brine streams as suitable DS for such purpose. Fertilisers were also suggested as DS for seawater and wastewater treatment when the diluted DS can be used directly for irrigation. The development of an adequate and efficient DS coupled with a low-cost energy recovery system is crucial to the performance of the process and to achieve success for the large scale of FO.

Keywords: Forward osmosis; Draw solutions; Desalination; Wastewater reuse

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