

Application of Membrane Capacitive Deionization (MCDI) to Draw Solute Separation in Forward Osmosis (FO) Process

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Forward osmosis (FO) induces water permeation through semi-permeable membrane by concentration difference between two solutions. In FO desalination process, as pure water transports from feed seawater to a draw solution with higher concentration, the feed seawater becomes concentrated whereas the draw solution becomes diluted. Thus, in order to obtain pure water, the diluted draw solution should be again separated. In this work, a membrane capacitive deionization (MCDI) process is suggested for draw solute separation and the feasibility is demonstrated by theoretical modeling and simulation. The fundamentals underlying the MCDI process come from capacitive deionization (CDI) in which charged electrodes attract counterions and repel coions. By adding an ion exchange membrane in front of each electrode, efficiency of ion adsorption and desorption is greatly improved. Considering a phenomenon occurring in ion exchange membranes and electrodes, a theoretical model is developed based on electrochemical theory, and is used to investigate influences of operating conditions on performance and energy consumption.