Simulation of multiphysics field and analysis of electrosorption characteristics in capacitive desalination

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ABSTRACT

Simulation of multiphysics field was carried out for seawater desalination using capacitive deionization (CDI). For the multiphysics field of a CDI unit capacitance electrode, a mathematical model was constructed using transient coupling analysis. The flow field, concentration field, and potential distribution within the CDI electrode were determined, and the pattern of adsorption on the electrode plate and mass transfer process in solution in the CDI unit was studied. In addition, the effects of different voltages, plate spacings, inlet flow rates, inlet concentrations, and porous materials on the adsorption of the CDI unit were investigated. The higher the voltage between the plates, the smaller the plate spacing. A lower inlet flow rate improved the performance of the CDI desalination unit. With all other parameters fixed, the adsorption performance and desalination efficiency of the CDI desalination unit mainly depended on the conductivity and pore structure of the porous electrode materials. When the porous electrode pore parameters and conductivity were fixed, the adsorption and desalination efficiency of the CDI desalination unit remained unchanged. Excellent adsorption and optimal desalination could be achieved using highly conductive porous electrode materials, which possessed a medium hole structure and the maximum surface area.

Keywords: Capacitive deionization; Porous electrode; Modeling

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