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Performance evaluation of optimized carbon xerogel electrode in desalination through flow-electrode capacitive deionization: capacitance optimization by response surface methodology

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ABSTRACT

Capacitive deionization (CDI) is an energy efficient desalination method which is founded on the simple mechanism of ion attraction and repulsion by charged electrodes. One of the main challenges in implementation of this method in industrial scale is the synthesis of an optimum electrode material. Carbon gel is known to be one of the most promising candidates for the electrode material of CDI. Among different types of carbon gels, carbon xerogels have much lower costs of synthesis due to subcritical drying method used at the expense of reducing the porosity and specific capacitance. Here, we optimize carbon xerogel fabrication parameters using response surface methodology (RSM), in order to achieve maximum capacitance. Specifically, we focus our attention on investigation the effect of (i) the pH of initial RF solution, (ii) Reactant to liquid ratio of RF solution, and (iii) Pyrolysis temperature of dried carbon gel. Through our methodology, we show that with the choice of pH = 6.25, R/L = 30%, and PT = 736°C, an optimum capacitance of 42.26 F/g can be achieved. We then use this electrode in our FCDI cell and demonstrate that we can desalinate up to 87.7% a solution containing 1 g/L NaCl whit salt adsorption capacity of 7 mg/$g_{electrode}$.

Keywords: Water desalination; Capacitive deionization; Carbon xerogel; Response surface methodology

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