Sustainable recovery of sugarcane biowastes to prepare biochar-derived electrodes for recycling of brackish water

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Membrane capacitive deionization (MCDI) is an emerging technology for the energy-efficient and cost-effective removal of ions from salt water by electrosorption. To further enhance the capacitive deionization performance, sugarcane bagasse biowastes are used as raw materials to synthesize biochars by microwave-assisted carbonization and activation with potassium hydroxide in the flows of carbon dioxide, which has the advantages of reducing preparation time and saving energy. Experimentally, the effect of microwave power (500-800 W) has been studied on the morphology, the ratios of mesoporosity in the biochars and their corresponding desalination performance of MCDI. Accordingly, the biochars which are activated at 700 W of microwave irradiation under carbon dioxide atmosphere (denoted as SB-CO_2-700) possess the ratios of mesopores to total pore volume ratio (V_{meso}/V_{total}) of ca. 64.1% with surface areas of 764 m^2 g^{-1}. By using cyclic voltammetry, the specific capacitance of SB-CO_2-700 is calculated to be ca. 123 F g^{-1} at 5 mV s^{-1}. From the desalination tests at 1.2 V, the electrosorption capacity of SB-CO_2-700 samples is estimated to be 15.8 mg g^{-1} in 5 mM of NaCl solution. The enhancement in the desalination performance of SB-CO_2-700 is possibly due to the greater V_{meso}/V_{total} ratio, reasonable surface area and hierarchically porous structure.

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