Capacitive Deionization With Bipolar Membranes

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Membrane capacitive deionization (MCDI) is a low-cost and energy efficient desalination technology used for remediating brackish water. MCDI is an electro-sorption technique that removes salt ions from liquids and stores them in the electrochemical double layer of porous electrodes. The ions in MCDI migrate across ion-selective permeable membranes prior to adsorbing in the electrochemical double layer. MCDI is an energy efficient technique as it can recover some of the energy used for deionization during the electrode regeneration step. In this project, a new bench-scale MCDI was setup. This work included installing in-line ionic conductivity and pH probes and making sure the cell does not leak when flowing liquid in it. Successful deionization with 1000 ppm NaCl feeds occurred with the new MCDI unit using anion exchange and cation exchange membranes in the lab. Chronoamperometry experiments were performed for 45 second charge-discharge cycles with various current values. Increasing the electrical current resulted in more salt being removed from the MCDI cell. The current range was restricted to 1.5 V to prevent corrosion of the carbon cloth electrodes. Finally, MCDI experiments with bipolar membranes were attempted for modulating the pH value of liquid streams without addition of acid/base salts. However, the initial experiments did not show water-splitting. It is hypothesized that the cell voltage is not high enough for water splitting or that the pH probe is not working properly. Future work will pursue higher cell voltages, even if carbon corrosion occurs, to see if water-splitting is possible with bipolar membranes in MCDI.

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