Design and implementation of a cell for water deionization using Shock Electrodialysis

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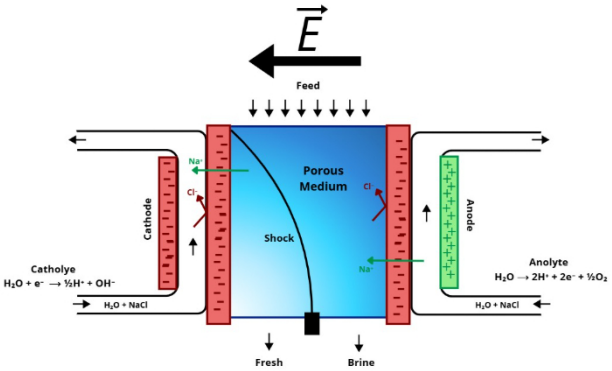
When an electrolyte and oppositely charged solid surfaces, such as electrodes, are immersed, the ions migrate towards them, respectively. This forms an electric double layer (EDL), and capacitive deionization (CDI) can occur if these ions are removed using a low-intensity electric field [1]. One way to address this issue is to increase the strength of the electric field and add a component that allows for ionic selectivity, such as an ionic membrane [2], thereby achieving concentration polarization (CP). This phenomenon is generated by spatial differences in the ionic transport number, which limit the current to the diffusion of species that cannot pass through. It has been proven that using a weakly charged porous medium (acting as a leaky membrane) can intensify CP due to over-limiting currents (OLC) within the EDL of the medium, producing Shock-Electrodialysis (SED) [3]. Consequently, a large quantity of low-concentration water can be recovered from a high-concentration feed, enabling efficient water purification.
This research aims to design a cell capable of distinguishing between the various ionic kinetics discussed above and of operating at a scale suitable for societal use.

Keywords:
Capacitive deionization (CDI), Concentration Polarization (CP), Over-limiting Current (OLC), Shock-Electrodialysis (SED)



Schematic diagram of a cell containing porous material in which a shock wave forms, separating two regions with vastly different concentrations from a common solution

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