numerous environmental problems due the increase of industrial waste. Ion exchange method is also studied for recovering lithium, but strong acids are employed to regenerate adsorbents, resulting in the degradation of the adsorption efficiency. For this reason, electrochemical lithium recovery is considered as an ideal extraction method due its non-hazardous characteristic and high efficiency in time and energy. Nevertheless, precious metal was used for anion capture in previous reports on electrochemical recovery system, limiting the practical use and giving rise to the stability problem. In this study, lithium ions were recovered using λ-MnO_2 and activated carbon electrodes with excellent performance and reliability, enabling lithium ions and counter anions to be captured at each electrode with low energy consumption. This system can be utilized for lithium recovery from various sources including brine, seawater and RO concentrate.

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CFD modelling of profiled membranes channels for reverse electrodialysis

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Reverse electrodialysis (RED) is a promising technology for electric power generation from controlled mixing of two differently concentrated salt solutions (salinity gradient power, SGP) where ion exchange membranes are adopted for the generation of ionic current within the system. Channel geometry strongly influences the fluid flow behaviour and, thus, crucial phenomena such as pressure drops along the channels and concentration polarization. Net-spacers are normally adopted in ED and RED stack manufacturing, with the double aim of mechanical support for membranes and enhancing mixing within the channel, but on the other side they significantly increase pressure drops. Profiled membranes are presented as an alternative, with a number of advantages: avoiding the use non-conductive and expensive net-spacers, reducing hydraulic losses and increasing the active membrane area.

In this work, computational fluid dynamic (CFD) simulations have been performed to predict the fluid flow and mass transfer behaviour in channels with profiled membranes for reverse electrodialysis. The influence of the channel geometry on fluid flow behaviour and concentration polarization phenomena is assessed, by means of parametric analysis for different profiles geometries. The Unit Cell approach along with periodic boundary conditions has been adopted for reducing the computational efforts. Transport equations for the electrolyte are obtained from the rigorous Stefan-Maxwell equation along with the assumptions of binary electrolyte and local electroneutrality, and are suitable also for concentrated solutions. Steady solutions were found for all cases investigated, indicating that no turbulence occurred in the fluid velocity range investigated. The relation pressure drop-fluid flow rate and concentration polarization effects were predicted, highlighting which configurations, among those investigated, offer the best performance for the process.

Keywords: Reverse electrodialysis; Profiled membranes; Concentration polarization; Computational fluid dynamics