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Electrochemical Recovery of Lithium from Geothermal Brines

Authors : Sanaz Mosadeghsedghi, Mathew Hudder, Mohammad Ali Baghbanzadeh, Charbel Atallah, Seyedeh Laleh Dashtban Kenari, Konstantin Volchek

Abstract : Lithium has recently been extensively used in lithium-ion batteries (LIBs) for electric vehicles and portable electronic devices. The conventional evaporative approach to recover and concentrate lithium is extremely slow and may take 10-24 months to concentrate lithium from dilute sources, such as geothermal brines. To response to the increasing industrial lithium demand, alternative extraction and concentration technologies should be developed to recover lithium from brines with low concentrations. In this study, a combination of electrocoagulation (EC) and electrodialysis (ED) was evaluated for the recovery of lithium from geothermal brines. The brine samples in this study, collected in Western Canada, had lithium concentrations of 50-75 mg/L on a background of much higher (over 10,000 times) concentrations of sodium. This very high sodium-to-lithium ratio poses challenges to the conventional direct-lithium extraction processes which employ lithium-selective adsorbents. EC was used to co-precipitate lithium using a sacrificial aluminium electrode. The precipitate was then dissolved, and the leachate was treated using ED to separate and concentrate lithium from other ions. The focus of this paper is on the study of ED, including a two-step ED process that included a mono-valent selective stage to separate lithium from multi-valent cations followed by a bipolar ED stage to convert lithium chloride (LiCl) to LiOH product. Eventually, the ED cell was reconfigured using mono-valent cation exchange with the bipolar membranes to combine the two ED steps in one. Using this process at optimum conditions, over 95% of the co-existing cations were removed and the purity of lithium increased to over 90% in the final product.

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