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Lithium Mining: Maximizing yields and lowering costs with electrolyte simulations

ABSTRACT

This paper outlines the use of a modern electrolyte theory (model) to predict the chemical composition and properties of salar brines during evaporation. The aim is to aid the engineer in maximizing lithium product yield and to increase the yield of secondary products like boron and KCl. The paper includes a brief overview of the theory and its departure from strong electrolyte models. The balance of the paper presents the prediction of salt precipitation using several salar brine compositions. It will also cover boron removal during brucite precipitation via surface complexation (adsorption) reactions.

The challenge we address is predicting the species composition and phase solubility in highly concentrated, bittern-type brines. Various double and triple salts will precipitate and dissolve during the evaporation pathway. Several of these salts sequester lithium and boron, reducing overall yield. The model presented in this paper predict at what composition these salts form and the quantitative amount of Li and B lost to the solid phases.

We have validated the model using published experimental data for salts of Li-Na-K-Mg-Ca-Sr-B-SO4-CO3-Cl. The model now predicts the formation of for thirty-four halides, forty-three sulfates, twenty-one carbonates, thirty-four borate, and three mixed-anion salts. This lets us simulate the full evaporation process from leaching to purification, and it allows us to simulate salars of different starting compositions.

The paper will also include process simulation results of brine evaporation. We will manipulate the salts that form during evaporation by changing the amount and type of chemical added (e.g., CaO, Na2CO3, MgO, oxalic acid, etc.). This will change substantially, the concentration of lithium and boron remaining in the bittern.

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