Mining Magazine

Transforming lithium mining through data

Vineeth Ram explores how data and simulation software tools can help optimise lithium production

Lithium producers are seeking new and effective ways to optimise planning, productivity and implementation

Processing > Operational-excellence

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For today's minerals and mining companies, the ability to grow and succeed hinges on the ability to innovate. Lithium mining is particularly challenging, as producers operate in remote and arid locations. Because mine sites are dry and difficult to access, the resource demands for design and construction, as well as the cost of operations and chemicals, can be astronomical.

For example, mining a lake at 3,000m in elevation poses major hurdles for companies, particularly once materials are ready to be transported to distant locations for processing.

Major capital investments are required for lithium mining - from purchasing equipment to extract the lithium, investing in pipelines or trucks to transport materials, building roads to and from the worksite, and much more. As

operations move away from industry, electrification and roadways, resources become exponentially more valuable and more expensive. Fresh water is at a premium in these arid environments, and chemicals become more expensive. As extraction sites become increasingly remote, lithium producers must find new ways to decrease upfront and operational costs to increase their bottom lines.

Industry challenges

Lithium is a valuable and widely used alkali metal, with implementations spanning batteries, special glass and ceramics, heat transfer applications, lightweight metals in aircraft, lubricants, medicines, and so forth.

With a wide variety of uses for lithium and its compounds, the demand for this element is expected to double in the next decade. In fact, the total worldwide lithium demand increased from 234,788 metric tonnes in 2017 to 252,653 metric tonnes in 2018 - and this number is projected to skyrocket, reaching 422,614 metric tonnes by 2025.

To produce lithium, brine (saline groundwater) is pumped from the ground and placed into manmade ponds. The lithium is then concentrated in these ponds by evaporation. It can take a few months to a year for lithium concentrations to reach the necessary 1-2%, depending on the climate and weather in the region of the brine deposit.

There are several important factors that affect the speed, cost and yield of production:

Evaporation rate: Sunlight, humidity, wind and temperature all influence the evaporation rate. If the rate is too low, lithium extraction in that particular region or deposit can be uneconomical. The higher the rate, the more profitable the lithium deposit.
Lithium grade: Grade is one of the most critical factors of a deposit. The higher the lithium grade, or concentration, the more economical the deposit.
By-products: By-products can be a very useful and lucrative result of mining. Potassium is the primary by-product of lithium, which can be sold to drive overall profits.
Purity levels: Separating impurities from lithium is one of the costliest parts of the brine refinement process. Ideally, producers look for low ratios of magnesium to lithium and sulphate to lithium.

With all these factors to consider, lithium producers are seeking new and effective ways to optimise planning, productivity and implementation. This can be achieved by using simulation software tools such as OLI Systems' platform based on a combination of process simulation and water chemistry insights and predictions.

OLI Systems provides an electrolyte thermodynamic framework and database (with chemistry parameters for over 80 elements on the periodic table), which are used to deliver predictions on solids formation during the evaporation and lithium purification process by modelling the precipitation, purity, evaporation, and all other properties associated with processing brine into lithium.

The OLI Flowsheet: ESP and OLI Studio interfaces are designed expressly for water chemistry applications. This software is a tool for designing and augmenting lithium extraction, providing thermodynamic predictions over a broad range of chemistry and concentrations present in lithium recovery to streamline production (read the technical briefs **here**).

Ongoing innovations

As the demand for lithium rises, finding and exploiting new sources is becoming more cost-competitive. By increasing top line - for example, by expanding production and augmenting product purity - and decreasing costs, companies can significantly boost their profit margins.

Advancements in lithium chemistry are paving the way for more comprehensive simulations, equations and chemistry. These developments provide a rigorous foundation to help customers deliver higher-purity products, lower chemical requirements, and anticipate process upsets caused by fluctuating flow rates and compositions.

Additionally, innovative software tools will progressively enable mining companies to perform phase equilibrium predictions for core mixtures of lithium, sodium, potassium, sulphate and chloride in order to enhance mining operations and optimise lithium production.

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