CSEG Technical Luncheon

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A preliminary assessment of reinjection of direct lithium extraction effluent-based miscible fluids in unconfined salar aquifers

Abstract

Since Chile's new National Lithium Strategy signals the departure from the use of evaporation ponds, the spotlight shifts squarely onto Direct Lithium Extraction ("DLE") as the technology of choice to produce lithium from salars in the Andean plateau. Brine ponds, which will hold reservoir fluid for up to 18 months in conjunction with chemical reagent additives, provide a flexible approach to post-evaporitic effluent and waste management involving the use of dry stacking and trucking. Fluids in this scenario are minimized by way of evaporation—the primary mechanism to yield valuable precipitates such as lithium carbonate. In contrast, DLE will by nature extract lithium in-line and generate a lithium-depleted effluent stream at a rate that is effectively equal in volume to the inlet rate. At commercial volumes, this process necessitates effluent stream management using reinjection or deep, permanent well-based disposal to manage waste. Reinjection has the potential to maintain the hydrostatic pressure of the brine zone in the reservoir, supporting freshwater that is relied on by local communities, flora, and fauna. By preserving brine zone pressures, drawdown can be mitigated and which can maintain extraction well efficiency while preserving freshwater zones. DLE providers must consider the chemical compatibility of their effluent with the brine zone geochemistry and the economics of the reinjection array which requires optimization for pressure, flow rate, and the number of wells to establish a viable and attractive operation.

A preliminary two-part study to support the recommendations consisted of:

1. A well optimization pressure and flow model based on two analogue synthetic aquifers
2. A practical mixing zone model based on a real-world effluent-reservoir interaction study

The preliminary study has yielded the following recommendations and areas of future focus:

1. Spatially optimize injector arrays relative to extractors, considering flow rate and pressure
2. Minimize the geochemical contrast between injected fluid and the reservoir
3. Assess the potential for unwanted precipitation to avoid performance impacts
4. Monitor the process in real-time, providing transparent data to stakeholders

A well optimization pressure and flow model was compiled through hydrogeological modeling and interpretation by Hidroestudios SpA, a qualified firm with experience in both the public and private sector in South America, located in Santiago, Chile. An practical injection fluid interactions and effluent compatibility study is underway at Interface Fluidics, a Canadian firm located in Edmonton, Alberta.

With respect to geological factors influencing reinjection optimization, geophysical surveys can provide clarity for well planning and subsurface risks. Going beyond frequently employed transient electromagnetic surveys, it is recommended that operators pursue 3D and other deep-resolution techniques to resolve faults, stratigraphic traps, intrusions, and other geohazards early on in the design of a reinjection program. Resolution of deeper porous horizons may also present opportunities for efficient, permanent disposal of DLE byproducts not suitable for reinjection.

Bio

Stefan Walter is a professional geologist with 16 years of diverse experience in the energy and critical minerals industry. His expertise includes technical management, business development, and resource characterization of unconventional and disposal plays including source rocks, carbonates, and salt flats.

He has led the development and execution of business models to support joint ventures through an earn-in structure, and facilitated technology deployment in assets throughout North and South America. Focused on leveraging innovations in extraction through a subsurface-up and data-driven approach, he has enabled teams to collaboratively deliver high quality, practical geoscience products that optimally serve stakeholders.

Stefan is currently the Director of Geoscience at a lithium technology company, Summit Nanotech, and a graduate of the University of Calgary.