

## Exploitation Framework of Lithium-Rich Brine Resources in Saskatchewan: A Tale of Two Industries

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World demand for lithium continues towards outpacing supply as interest for electric vehicles and electronic devices maintains its rapid growth. Surface evaporitic salars and lithium mines are burdensome on the environment and are receiving increased opposition to their expansion. Interest is growing for other ways to extract lithium that are commercially viable and more environmentally sustainable. One such way that is environmentally acceptable is through extraction of lithium from formation brines in mature hydrocarbon producing regions.

The Saskatchewan portion of the Williston Basin is a prime example of such a region. Testing of oil field brines for lithium concentration has been conducted in Saskatchewan over the past two decades to determine its stratigraphic occurrence and spatial distribution. Knowledge of the hydrogeology and hydrochemistry of the Williston Basin is key to understanding the occurrence and distribution of lithium-rich brines.

Technical skills and knowledge employed in the exploitation of lithium-rich brine resources share many similarities with those of the petroleum industry. Three main steps can be addressed when considering the exploitation framework of a lithium project. Those include: understanding regional hydrogeology and hydrochemistry and thus developing an exploration model; evaluating lithium volumetrics in prospective resources; and the production of lithium-rich brines from discovered resources. This exploitation framework from exploration to development, transitioning to production, mirrors that of any petroleum project.

The first phase of a lithium exploitation project is to understand the regional hydrogeological framework of the basin. Various questions need to be addressed including, but not limited to: where do the lithium resources occur; why do they occur in a particular location and stratigraphic interval; where did the lithium originate from; and how did it migrate from source to reservoir? A sound exploration model is the key to discovery of large, voluminous accumulations of lithium-rich brine. This involves examining all available hydrochemical information, understanding fluid flow dynamics across the basin and reconstructing the basin history. This knowledge leads to enhanced prediction and improved chances of discovery of economic quantities of lithium.

The second phase comprising an exploitation framework is the resource assessment of lithium accumulations. This is conducted following the guidelines set out in NI43-101. Several factors need to be considered when evaluating the viability of a lithium-rich resource. First, there must be economic levels of lithium concentrated in the formation water. Second, there needs to be sufficient storage capacity, and third there needs to be capable deliverability of the reservoir. The lithium concentration is critical: minimum lithium concentration in brines is dependent on specific project economics. Yet there are many challenges to doing this properly. Determining lithium concentrations from brines requires the acquisition of representative (uncontaminated) fluid samples via swabbing, DSTs or pump tests. Testing must be selected from appropriate stratigraphic intervals. Fluid samples must be carefully measured with suitable specialized

equipment using correct and consistent procedures. The second factor when considering the economic viability of a lithium resource is the resource quantity. Volumetric assessment requires suitable knowledge of the pore space, reservoir thickness and concentration of lithium, similar to petroleum resource volumetric evaluation. The third subsurface aspect required for a successful project is the determination of reservoir/aquifer deliverability potential leading to adequate fluid flow rates to support economic levels of brine production. Flow rates within the reservoir can be affected by the matrix pore connectivity network and the natural fracture system.

The final phase of the exploitation framework is to produce lithium-rich brines from the reservoir. Many similar production techniques can be shared between the lithium and petroleum industries, such as common drilling techniques and practices and well production techniques (e.g., using ESPs and other techniques). Suspended, shut-in or abandoned wellbores may be accessed for production, thus reducing the environmental footprint and reducing cost of drilling a new wellbore. The reservoir flow potential may also be improved through stimulation by fracturing, acidizing or other approaches. Once the lithium-rich brines are produced, lithium must be separated, and the brine reinjected into a receiving reservoir.

To satisfy the increasing demand for lithium a successful company requires a deep understanding of the resource, exploitation technology and extraction processes. This talk will highlight some of the plans and results required to develop lithium extraction in Saskatchewan.