Application Note AN-PAN-1058

Online determination of lithium in brine streams with ion chromatography

Lithium (Li) is an alkali metal that offers excellent heat and electrical conductivity. It is used in a wide range of applications, such as in the production of high temperature lubricants or heat-resistant glass. Because of its remarkable characteristics, this metal is the main ingredient to produce rechargeable batteries for energy storage and electric cars, mobile devices, and more. Compared to other metal commodity markets, the current size of the Li market is small, with a huge potential. The worldwide sales of lithium-ion batteries has been increasing in the last several years and is expected to grow further. An article published by Bloomberg in March 2021 predicted that the market size for Li-ion batteries is expected to grow at a compound annual growth rate (CAGR) of 18% from 2020 to 2027. The rapid growth in demand for lithium has caused a large and rapid increase in its supply chain. Therefore, it is highly desirable to implement new technologies for cost reduction and process optimization. This Process Application Note presents a method to determine the lithium concentration as well as other cations in brines by online process ion chromatography (IC), a multiparameter analytical technique that can measure ionic analytes in a wide range of concentrations.

INTRODUCTION

Lithium is typically obtained from brines, pegmatites «hard rock», and sedimentary deposits. Due to low cost of processing, lithium-based chemicals have been produced from salar or salt lake brines. However, the lithium from these brines is low grade and therefore the lithium extraction process needs to be thoroughly optimized.

Additionally, each individual salar has properties that can influence the overall lithium yield (e.g., different lithium concentrations, ambient temperature, rainfall, and impurities), thus they have to be monitored continuously to pick up any changes in process conditions.

Lithium processing (Figure 1) consists of multiple steps. First, lithium brine is extracted from the ground and pumped to the evaporation ponds. Here, most of the liquid water content is removed through solar evaporation. Once the brine in the evaporation ponds reaches an ideal concentration, then the recovery and purification stages begin.

Lithium Process

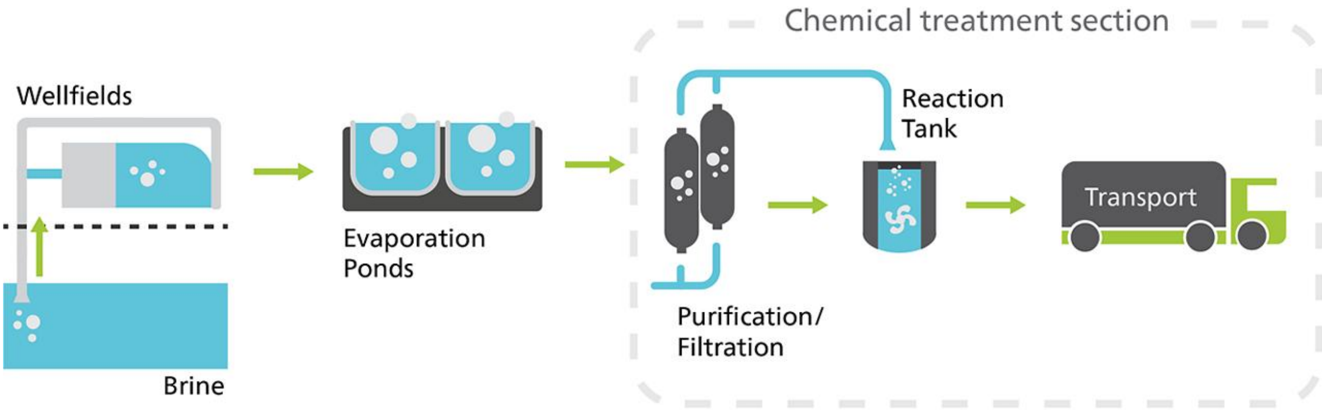

Figure 1. Illustration of a typical lithium extraction process

In the second step, the lithium brine is transported to the chemical treatment section. This step consists of dosing chemicals to isolate the lithium ions from other impurities. This process can vary depending on the nature of the lithium source, but generally involves a purification step to remove any other contaminants (e.g., magnesium and calcium) from the brine by filtration or ion exchanger.

Next, the treated sample stream continues to the filtration step to separate the brine from precipitated solids. Finally, the lithum rich sample stream is sent to the reaction tank to produce different forms of lithium for the market. Depending on the product, different chemicals are applied, e.g., sodium carbonate (soda ash) to form lithium carbonate.

Optimizing the purification step is crucial to obtain high quality lithium. This step removes any unwanted constituents from the stream and thus significantly affects the final yield of the lithium produced.

Typically, lithium in brine could be determined by potentiometric titration which requires a variety of reagents with diverse shelf lives and hazards. In order to optimally measure very low concentrations of lithium, a tight control of the chemical composition is necessary. With ion chromatography (IC), it is possible to determine various inorganic and organic anions and cations in parallel and over a wide concentration range.

The 2060 IC Process Analyzer from Metrohm Process Analytics is able to continuously measure and monitor multiple cationic impurities in brine in a robust housing suitable for such a corrosive environment. This robust analyzer for online process monitoring and control can be connected to multiple sampling points covering multiple measurement points inside a plant. Thus a sequential analysis at multiple areas inside of a production plant is possible.

APPLICATION

The analysis is fully automatic. Lithium and other cationic component measurements are performed by non-suppressed cation IC followed by conductivity detection.

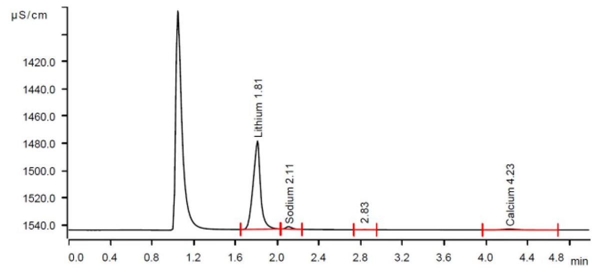

Figure 2. Example chromatograph of the lithium and other cations determination in brine.

Figure 3. The 2060 IC Process Analyzer is available with either one or two measurement channels, along with integrated liquid handling modules and several automated sample preparation options.

REMARKS

This application is also valid for other lithium extraction processes like: pegmatites «hard rock», and sedimentary deposit excavations. After mining extraction, samples go through purification and crystallization steps, where online monitoring of multiple cationic impurities is necessary.

FURTHER READING

Related application notes

Lithium in brine – Reliable and inexpensive determination by potentiometric titration

BENEFITS FOR PROCESS IC IN LITHIUM PRODUCTION

- Optimal monitoring of high purity lithium end product which can be used for rechargeable battery industry
- Inline eluent preparation ensures consistently stable baselines
- Safe working environment and automated sampling
- Automated sampling and calibration to guarantee excellent detection limits, a high reproducibility, and superior recovery rates
- High precision analyses for a wide spectrum of analytes with multiple types of detectors

CONTACT

Metrohm Brasil
Rua Minerva, 161
05007-030 São Paulo
metrohm@metrohm.com.br