Recovering lithium from natural salt pools – purity up to 99.9 per cent

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New methods for lithium recovery from natural brine have been studied at Lappeenranta University of Technology (LUT). The methods enabled increasingly effective recovery of lithium and the purity of the lithium solution increased from 95 per cent to 99.9 per cent, which is difficult and resource-intensive to accomplish using traditional methods.

Lithium and lithium carbonate used in accumulators are primarily produced from salt lake deposits. Prior to the actual separation process, the brine is pumped up and concentrated by evaporation of water which usually takes place in large pools under the sun. Finally, the concentrated solution is led into a process in which the solution is purified of impurities and the lithium is separated.

At LUT, solvent extraction has been used for purifying the solution. In this process, the separation occurs between two insoluble liquid phases. In this case, impurities, calcium and magnesium were separated from the concentrated lithium salt solution into an organic solution consisting primarily of kerosine.

'We were typically able to purify 99–100 per cent of calcium and also over 90 per cent of magnesium. Lithium loss only amounted to 3–5 per cent. In traditional methods, the purification outcome is either weaker, the lithium loss is more substantial, or both', explains Sami Virolainen, a post-doctoral researcher at LUT.

The researchers demonstrated the new separation process on a pilot

scale. Flow rates in the extraction varied from one litre to five litres per hour.

'On the industrial scale, we are talking about a cube or dozens of cubes per hour. However, the process has been constructed similarly is it would be in the industry, i.e. constant streams go in and come out and the number of processing phases is the same as in an industrially conducted extraction.'

According to Virolainen, solvent extraction is a profitable alternative to an extraction process when the product is required to have the purity of nearly 100 per cent and a high recovery of the target metal is demanded.

'The extraction process we use is more expensive than regular precipitation but, as the study indicates, separation is more efficient and easier. This simplifies the overall process, which also makes it an economically sensible alternative.'

The global demand for lithium increases year by year. Above all, it is fostered by the demand of the electric car as well as the accumulator and battery industry. Lithium is a so-called hi-tech metal, i.e. raw material for high technology applications. The majority of hi-tech metals are produced in Asia and South America, which might complicate the supply of the metals in the countries within the EU. For the time being, little lithium is produced in the EU countries. Recycling could be used to increase the volume of the available lithium, but currently only around 3 per cent of lithium is recycled in the EU region. Solvent extraction, utilised in this study, is also suitable for the separation of lithium and other metals from electronic waste, for example.

'The need for lithium might increase by up to four times by the year 2025. As the demand grows, recycling of products containing lithium and the use of new alternative sources for raw material must be

increased', Virolainen says.

More information: Sami Virolainen et al. Removal of calcium and magnesium from lithium brine concentrate via continuous counter-current solvent extraction, *Hydrometallurgy* (2016). DOI: 10.1016/j.hydromet.2016.02.010

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