LEWATIT® ION EXCHANGE RESINS FOR THE RECYCLING OF LITHIUM ION BATTERIES

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ABSTRACT

The growing demand for high purity battery lithium, nickel, cobalt and copper requires access to new resources. The most economic and environmentally friendly approach is the recycling of end of life batteries. Due the high concentration of battery metals, they can be extracted and recycled with low carbon footprints and a t low cost. Therefore, the European Union established strictly regulated recycling targets and a minimum level of recycled battery metals content for the manufacturing of new batteries. As a result, processes with true circular economy are developed. A lot of cathode off-spec material is already available from cathode producers and more end of life batteries will be available within the next years. Lewatit® ion exchange resins are crucial for many process steps in the hydrometallurgical recycling flow sheets. In this paper we describe three of most important applications and the benefits of our resins in the field of battery recycling.

Purification of black mass leachate

Recycling usually starts by discharging, dismantling, and shredding of lithium ion batteries. In hydrometallurgical operations the solid black mass powder is separated by filtration because it contains the valuable metals lithium, nickel, cobalt, manganese. Leaching of the black mass with acid dissolves these valuable metals. However also impurities like Cu, Al, Zn, and Fe are usually contained in the concentrates, because mechanical separation cannot be performed perfectly. These impurities can be efficiently removed with selective chelating resin Lewatit® MDS TP 260. We especially developed a new efficient Al regeneration technology with the use of NaOH and elution of the $Al(OH)_4^-$ anionic complex. Thanks to the smaller size of our monodisperse small (MDS) resins and, in turn, shorter diffusion paths, they exhibit faster kinetics during exchange and regeneration. Not only does their high packing density make them ideal for chromatographic separation, but they also have a higher capacity utilization and, in turn, longer service lives with lower requirements for regeneration chemicals.

Purification of individual metal concentrates

Since black mass contains a high concentration of battery metals, separation of the individual metals is usually performed by solvent extraction. The generated metal concentrates are most efficiently purified by our selective chelating resins, e.g. Li with Lewatit® MonoPlus TP 207, Ni with Lewatit® TP 272, and Co with Lewatit® VPOC 1026 and Lewatit® MDS TP 220. Our selective chelating resins are especially suited for this separation task because of their high selectivity and loading capacity towards impurities, which ensures efficient removal below the specification limit. At the same time, they show low interaction towards valuable and concentrated battery metals nickel and cobalt, which pass the resin at high yield and recovery.

Waste water treatment

Waste water streams generated by battery metals recycling plants can be efficiently treated by Lewatit® MonoPlus TP 207. This resin selectively removes toxic heavy metals in the presence of high concentrations of other constituents of the waste water, e.g., hardness. Valuable battery metals can additionally be recovered and recycled from the resin by selective regeneration.

In conclusion Lewatit® ion exchange resins provide benefits including up to two times longer cycle times compared to conventional resins combined with savings on regeneration chemical costs. Excellent exchange kinetics ensures contaminant removal down to trace levels and yields pure battery metal concentrates. Additionally, Lewatit® chelating resins possess high resilience towards osmotic and mechanical stress and ensure long resin lifetimes.

Keywords: Lithium ion battery recycling, black mass leachate treatment, selective chelating ion exchange resins