THE GRAPHITE CHALLENGE. BEYOND CATHODES:

THE RECOVERY OF ANODE MATERIALS IN LITHIUM-ION BATTERY RECYCLING

Lithium-ion batteries (LIBs) consist of two electrodes, electrode foils, a separator, an electrolyte, and organic and plastic components. After being used, spent LIB cells are collected and subjected to mechanical and thermal treatment, followed by sieving to obtain the "black mass", a complex mixture of metals, organics, and graphite. In fact, anode material represents up to 40% of the black mass.[1]

Although several techniques have been developed to treat spent LIBs, such as pyrometallurgical, hydrometallurgical, biohydrometallurgical and direct methods, these initiatives mainly focus on recovering metallic components, leaving the recovery of anode materials largely overlooked.[2] For a sustainable battery value chain and optimization of materials quality for downstream processing, more efficient recycling approaches considering the anode materials recovery must be applied.

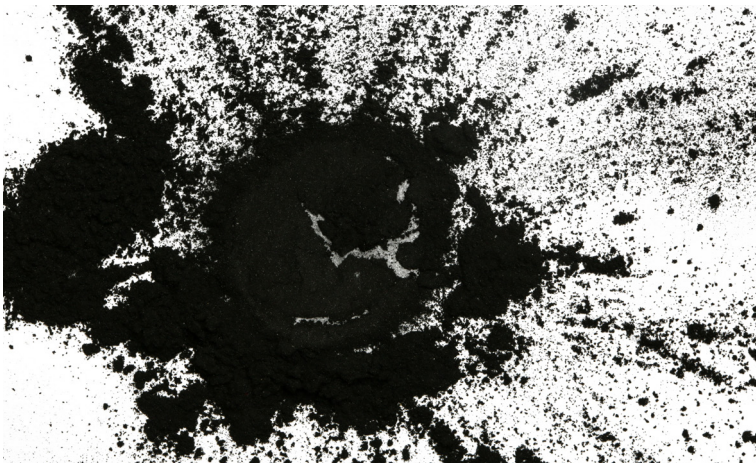
The anode is made of copper foil coated with conducting graphite powder and an electrolyte with a polymeric binder such as polyvinylidene fluoride. The removal of graphite from the black mass is essential for efficient recycling processes, as it can negatively impact metal recovery and process efficiency in pyrometallurgy. By removing graphite in hydrometallurgy, the feed material volume is minimized, resulting in a reduction of water and reagent consumption.[3]

One promising technique for separating anode graphite and other materials from the black mass is froth flotation, exploiting specific differences in surface wettabilities. The flotation process begins by suspending black mass in water with the addition of flotation reagents, such as collectors and frothers. Kerosene or diesel can be used as collectors to attach to the graphite particles, increasing the hydrophobicity and causing them to adhere to air bubbles introduced into the suspension. Frothers, such as MIBC (methyl isobutyl carbinol), create a stable froth layer on top of the suspension. The froth is then removed from the top, enriched with concentrated graphite that can be further processed.[4] By improving this process, more efficient recycling approaches can be developed, leading to a more sustainable battery value chain.

Project 1 of the FuLIBatteR Module "Waste management and technological approaches for LIB recycling" is focused on addressing this challenge. Specifically, the project aims to recover quality graphite from the black mass using a flotation process. At present, the project team is in the process of selecting appropriate reagents and preparing for upcoming experiments.

Apart from that, dissemination actions were recently fixed, in which FuLIBatteR contents will be presented. These are as follows:

- 12th DGAW Science Congress "Waste and Resource Management" in Hamburg (Germany) from 9 March to 10 March 2023, presentation by Ms. B. Rutrecht (K1-MET GmbH in cooperation with Montanuniversitaet Leoben) (Project 1)
- Biomining Conference in Falmouth (UK) from 5 June to 6 June 2023, presentations by Mr. K. Kremser (BOKU University of Natural Resources and Life Sciences in cooperation with K1-MET GmbH and acib GmbH), Ms. A. Sieber (K1-MET GmbH in cooperation with BOKU University of Natural Resources and Life Sciences), and Mr. L. Lalropuia (K1-MET GmbH in cooperation with BOKU University of Natural Resources and Life Sciences) (all from Project 3)



- 19th International Symposium on Waste Management and Sustainable Landfilling in Santa Margherita di Pula (Italy), presentation by B. Rutrecht (K1-MET GmbH in cooperation with Montanuniversitaet Leoben) (Project 1)

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