SUCCESS STORY

FuLIBatteR
Future Lithium Ion Battery Recycling for Recovery of Critical Raw Materials

Programme: COMET – Competence Centers for Excellent Technologies

Programme line: COMET-Module

Type of project: FuLIBatteR-Project 1, 01.07.2022 – 30.06.2026, multi-firm

Figure 1: Froth flotation of black mass for the recovery and enrichment of graphite in the froth product (© UVR-FIA).

RECYCLING OF SPENT LITHIUM-ION-BATTERIES - FROTH FLOTATION FOR THE RECOVERY OF GRAPHITE

WITH THE FROTH FLOTATION OF THE BLACK MASS, IT IS POSSIBLE TO EXTRACT 85 % OF THE CRITICAL RAW MATERIAL GRAPHITE WITH A PURITY OF 94 %

The mechanic-thermal recycling of spent lithium-ion batteries (LIB) produces a fine black powder with a particle size of less than 100 µm. This powder, also known as black mass or active material, mainly consists of the raw materials cobalt, nickel, manganese, lithium, and graphite. These raw materials are classified as critical and strategic by the European Commission, which makes it necessary to recover these raw materials from a spent LIB.

For this reason, UVR-FIA GmbH is investigating the possibility of recovering the graphite from a thermally pre-treated black mass using the wet-mechanical sorting process of froth flotation as part of the COMET Module FuLIBatteR. For froth flotation, the black mass is mixed with water in a flotation cell using a powerful stirrer with air addition. The air rises as fine bubbles within the stirred solids/water mixture and forms a froth on top (see Figure 1). As the air bubbles rise, they collide with the solid particles, whereby substances with a water-repellent surface, such as graphite, adhere to the air bubbles and rise into the froth. Solid particles with a water-loving surface remain in the water, whereby sorting takes place based on different surface properties. To achieve a better sorting effect, reagents are added to the process, which specifically influence the surface properties of the substances or, for example, increase the bubble stability. The influence of reagents on the froth flotation depends on the type of reagent and its dosage and must be tested in laboratory tests.

Federal Ministry
Republic of Austria
Climate Action, Environment, Energy, Mobility, Innovation and Technology

Federal Ministry
Republic of Austria
Labour and Economy

Version 01/2020

The laboratory tests on black mass flotation are intended to achieve two main goals in the FuLIBatteR Module. First, the production of a graphite concentrate ("froth product") being as pure as possible for further use. Second, the production of a metal concentrate ("cell product") with a defined graphite content. Due to the defined graphite content, the metal concentrate should serve as a feed material a. o., for a more efficient pyro-metallurgical processing to be done in Sub-Project 2 of FuLIBatteR to recover the metals. To achieve these two goals, a simplified test procedure with several flotation stages is carried out (see Figure 2).

The laboratory tests carried out with the reagent's diesel, pine oil, and lignosulphonate demonstrated that the objectives can be achieved. The initial graphite content of the black mass of ~40% can be variably reduced up to 3 % in the metal concentrate by varying the number of flotation stages. Up to 90 % of nickel, cobalt and manganese are recovered in the metal concentrate. It has also been shown that it is possible to recover approx. 85 % of the graphite with a purity of 94 % for further use.

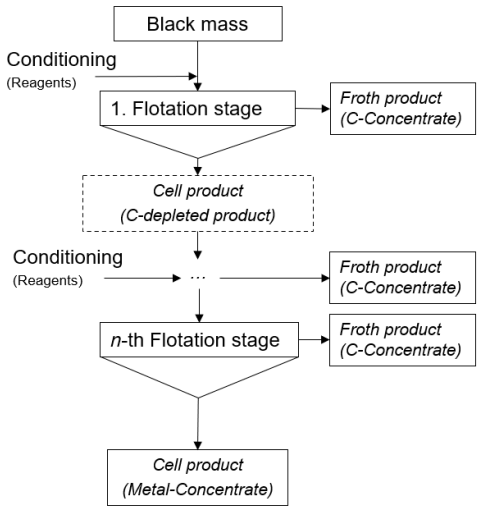

Figure 2: Schematic test procedure of a multi-stage froth flotation test for the recovery of graphite from the black mass (C…carbon/graphite, © UVR-FIA).

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- TÜV SÜD Landesgesellschaft Österreich GmbH, AT
- voestalpine High Performance Metals GmbH, AT
- Montanuniversitaet Leoben, AT
- UVR-FIA GmbH, DE

This success story was provided by K1-MT and by the mentioned project partners for the purpose of being published on the FFG website. FuLIBatteR is a COMET-Module within the COMET – Competence Centers for Excellent Technologies Programme and funded by BMK, BMAW, and the provinces Upper Austria and Styria. The COMET Programme is managed by FFG. Further information on COMET: www.ffg.at/comet