Experimental Studies on Acid Leaching of EV Battery Production Scrap

Madina NAUKANOVA, Clemence NIKITINE, Etienne COMBE-LABOISSIERE, IFP Energies Nouvelles, 69360, Solaize.

Strategic metal recycling from end-of-life electric vehicle (EV) batteries is crucial for Europe's economic sovereignty, significantly reducing reliance on imported strategic raw materials. In this context, recent European legislation imposes minimum recycling rates and sets clear requirements for incorporating recycled metals into newly manufactured batteries to ensure circularity in the battery economy and to lower the environmental impact [1].

Two principal approaches exist for battery recycling: hydrometallurgical and pyrometallurgical methods. The hydrometallurgical route is favored due to its lower energy consumption, higher recovery rates, and greater product purity, all of which are essential for compliance with European regulations. Within this approach, leaching is a central process for metal extraction [2]. Current experimental research efforts mainly focus on developing and optimizing acid leaching conditions to maximize metal recovery efficiency. However, many studies rely on synthetic "black mass" (BM), typically consisting of metal oxide mixtures or cathode active materials (CAM), which provide limited representation of the complexity and heterogeneity of actual black mass derived from industrial battery production scrap.

This study presents experimental findings from acid leaching of battery production scrap black mass, highlighting specific challenges and practical insights gained from working with industrial materials. Optimal test results demonstrated leaching efficiencies greater than 99% for Cu, Fe, Ni, Mn, Co, and Li, whereas aluminum (Al) exhibited significantly lower efficiency at 28%. Further analysis revealed that the poor Al leaching performance is attributed to the presence of the highly stable Al_2O_3 corundum phase.

References:

[1] Regulation (EU) 2023/1542 of the European Parliament and of the Council of 12 July 2023 concerning batteries and waste batteries, amending Directive 2008/98/EC and Regulation (EU) 2019/1020 and repealing Directive 2006/66/EC (Text with EEA relevance)

[2] Chagnes, A. (2022). *Enjeux dans le recyclage des batteries lithium-ion*. Techniques de l'Ingénieur, Réf. M2460 V2.