IMPACT OF ORGANIC IMPURITIES ON ACID LEACHING OF VALUABLE METALS FROM USED LI-ION BATTERIES

By

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ABSTRACT

As the usage of lithium-ion batteries (Li-ion) increases, the need for efficient recycling methods to recover valuable metals such as lithium, nickel, and cobalt becomes critical. Acid leaching is a commonly used technique for extracting metals from spent Li-ion batteries. However, the presence of organic impurities within the battery materials can significantly impact the leaching process. This study aims to investigate the influence of these organic impurities on the effectiveness of acid leaching processes.

The spent Li-ion batteries underwent thermal treatment to eliminate organic components, including binders and separators, followed by sulfuric acid leaching to extract valuable metals. The thermal treatment was conducted at various temperatures, and the resulting black powder was analyzed to observe changes in metal concentration post-leaching. The impact of organic impurities on the leaching process was assessed by comparing the leaching efficiency of samples with and without thermal treatment.

The thermal treatment procedure involved exposing samples to temperatures of 0°C, 200°C, 400°C, 600°C, and 800°C in ambient air for 2 hours, followed by storage at room temperature for leaching purposes. For LCO-based batteries, primary reactions mostly reached equilibrium within an hour, with additional leaching observed after hydrogen peroxide supplementation. The leaching rate increased with higher thermal treatment temperatures, with differences of up to 20% observed. At 1000°C, the cobalt leaching rate reached 94.6%, while samples treated at 800°C, 600°C, 400°C, and 200°C exhibited cobalt leaching rates of 86.2%, 68.9%, 72.9%, and 72.9%, respectively. Untreated samples displayed a cobalt leaching rate of 77.4%.

The provided NCM-based black powder underwent thermal treatment followed by sulfuric acid leaching. With increasing thermal treatment temperature, the anode material (C, graphite) and organic substances were removed, resulting in concentration changes from Ni 5.27 wt%, Co 1.37 wt%, Mn 0.43 wt%, Li 1.07 wt% to Ni 6.56 wt%, Co 2.82 wt%, Mn 0.63 wt%, Li 1.47 wt%. Although leaching rates remained mostly consistent, higher thermal treatment temperatures led to the extraction of relatively more valuable metals. For instance, samples treated at 800°C for 6 hours exhibited leaching of Ni 1002.4 mg/L, Co 537.6 mg/L, Mn 117.4 mg/L, and Li 274.8 mg/L.

In conclusion, the study underscores the significance of thermal treatment in enhancing the efficiency of acid leaching processes for metal recovery from spent Li-ion batteries. The investigation sheds light on the intricate relationship between thermal treatment temperatures, organic impurities, and leaching efficiency, offering valuable insights for optimizing recycling methodologies in the pursuit of sustainable battery management.

Keywords: Recycling, Li-ion Battery(LIBs), Acid leaching, Thermal treatment, Organic impurities