# Graphite recovery from spent alkaline batteries

Hossein Shalchian*, Touseef Younas, Pietro Romano, Valentina Innocenzi, Francesco Veglio'[a]

[a] Department of Industrial and Information Engineering and Economics (DIIIE), Engineering Headquarters of Roio, University of L'Aquila, 67100 L'Aquila, Italy

E-mail: hossein.shalchian@univaq.it

Graphite is a versatile material with applications in industries such as automotive, steel production, powder metallurgy, batteries, fuel cells, and flame retardants. Its significance has grown in the transition to cleaner energy technologies, where it plays a crucial role in reducing carbon emissions, particularly in transportation and heavy industry, which are two of the largest contributors to greenhouse gas emissions.

In this study, graphite was recovered from the black mass of spent alkaline batteries. The process began with a sulfuric acid leaching stage to dissolve the majority of zinc and some manganese oxides. This was followed by a reductive sulfuric acid leaching step to further purify the recovered graphite by removing additional impurities. The results demonstrated a 100% recovery of graphite with a purity of approximately 85.08%. The main residual impurities in the final graphite were barite, silica, and iron oxide.

**Keywords**: *Graphite, recycling, spent alkaline batteries, leaching*