

**SCALE-UP OF ACID LEACHING PROCESS FOR VEIN GRAPHITE
PURIFICATION: APPLICATION FOR LITHIUM-ION BATTERIES**

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With the rapid development of electrochemical energy storage systems, vein graphite has received significant attention as an anode material for Lithium-Ion Batteries (LIBs) due to enhanced power and energy density while maintaining excellent cycling stability in LIBs. The recently patented optimised acid leaching method is one of the well-identified methods for developing natural vein graphite (Sri Lankan Patent: 18729). However, this finding is based on a study conducted using a small sample (< 5.0 g), far less than industrial-scale production of battery anode materials. The present study investigates the feasibility of scaling up the acid leaching method used to purify the vein graphite at the laboratory level before designing an industrial-scale pilot plant. Varying ratios of graphite: acid weight and unit operations parameters were considered to obtain the optimum performance. The Carbon Content (CC) analysis and X-ray diffractogram obtained on the raw and purified scaled-up graphite samples successfully eliminated impurities while improving the CC by more than 99%. The electrochemical characterisation was carried out by assembling purified scaled-up graphite anode/LiPF₆/Li cell configuration with CR 2032-coin cell type. Galvanostatic charge-discharge analysis of the LIB coin cells assembled with the scaled-up upgraded graphite as the anode material revealed a high and stable initial specific discharge capacity of 340 mA h g⁻¹ with high Coulombic efficiency of over 97%. Cyclic voltammetry and electrochemical impedance spectroscopy analysis revealed smooth diffusion and lithiation-delithiation process of Li-ion, an acquiescent formation of solid electrolyte interface and structural stability of scaled-up developed graphite anode materials by acid leaching method. The scale-up process in the laboratory shows similar results, despite the significant volumetric scale-up and slight differences of apparatus. Choosing the correct scale for the scale-up is crucial, and the process should be closely integrated into a multidisciplinary approach before designing the industrial-scale pilot plant.

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