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#### Graphite purification: Importance of acid volume by volume percentage for scaleup the acid leaching process

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**Background:** Laboratory and bench-scale systems are important early-stage tools for assessing and scaling methods prior to industrial-scale pilot plants. The choice of the right scale for the scale-up is crucial when a scale-up is performed and to include scenario analyses for the most important steps before designing the industrial-scale pilot plant.

**Objectives:** This study aims to find optimum laboratory-level scale-up conditions for graphite purification using Hydrochloric acid.

**Methods:** Therefore, in the present study, the patented acid leaching purification method was used for scaling-up of purifying vein graphite. Accordingly, two volume by volume (v/v) percentages 10% v/v HCl (HCl-10) and 20% v/v HCl (HCl-20) were investigated. For laboratory-level scaling-up, the arithmetic general formula used both v/v percentages to prepare samples with different weight ratios of graphite:acid.

**Results:** The Carbon Content (CC) of the raw graphite used for the study was 99.24% and the resultant CC of HCl-10 and HCl-20 samples after initial purification were 99.94% and 99.96%, respectively. Scaled-up samples from both v/v percentages showed slightly different low CC from the initial purified CC. X-ray diffractogram obtained on the purified scaled-up graphite samples show successful elimination of impurities such as pyrite, feldspar, and calcite. Electrochemical characterization was conducted by assembling the anode fabricated from the developed graphite/LiPF6/Li cell configuration with CR 2032-coin cell type. Galvanostatic charge-discharge study revealed the absence of any obvious reversible capacity fading after purification and cycling behaviour was similar to initial purified samples.

**Conclusion:** The Lithium-ion battery coin cells assembled with HCl-20 graphite sample showed better electrochemical performances than the HCl-10 graphite sample. But, these both samples are showing better electrochemical performances despite the significant volumetric scale-up. Therefore, HCl-10 method can be proposed for further studies in order to minimize the environmental risk in the industrial-scale pilot plant.

Keywords: Graphite, Purification, Scale-up, Optimization

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