Upgrading Low-Grade Graphite Tailing into High-Grade Graphite in Pilot Scale using Agglomeration

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Abstract

Froth floatation is the only beneficiation technique currently need for low-grade Graphite. Liberation of Graphite from Graphite bearing rocks for the froth flotation is more prominent using wet grinding techniques with grinding mills. This generates a high amount of Graphite fines of size less than 100 microns which ultimately mixed with tailing and discarded as waste without further recovery of Graphite. This occurs as the froth flotation process is optimum for recovering a range of particle sizes between (100 to 200) microns. Agglomeration of Graphite fines has been proven to be a possible by size enlargement technique proven by previous studies.

In the initial stages of the study, the character of the low-grade Graphite tailing samples obtained from the column flotation plant of Ragedara Graphite mine was characterised by carrying out analysis on particle size distribution and the amount of fixed carbon according with the American Standards for Testing Materials (ASTM). In the latter stages of this comprehensive study, the amenability of the agglomeration of Graphite for the beneficiation of low grade Graphite tailing samples containing 23.4% to 25.5% of fixed Carbon from Ragedara Graphite mines was assessed by varying bridging liquid to tailing ratio for optimum purity and recovery of Graphite. The study continued with increasing the sample size from 1 kg to 25 kg for variations in purity and recovery of upgraded Graphite for a fixed bridging liquid to tailing ratio. The surface structural changes of upgraded Graphite was observed with comparison to Natural Vein Graphite (NVG) using Scanning Electron Microscope (SEM).

The beneficiation study has been able to obtain a concentrate with 88% fixed Carbon at a recovery of 69.6% for 25 kg sample suggesting its amenability to be implemented in commercial scale with periodic iterations for upgrading over 99+% fixed Carbon. The results from the SEM study in similar topographies using three different magnifications (x120, x1000 and x12000) have suggested no significant changes between the untreated NVG and the agglomerated NVG.

With respect to the froth flotation process, this novel processing method has a low water requirement and ability to process tailing with any purity, while cutting off the time for the separation of Graphite and also reduce the loss of the Graphite fines to the tailing, while improving sustainability of the process.

Keywords: Graphite, Beneficiation, Waste Minimization, Sustainability