

https://dspace.org/

Optimization of the flotation of copper smelter slags from Namibia Custom Smelters' slag mill plant

Sipunga, Elias

2016-03-17
http://hdl.handle.net/10539/20110

Downloaded from a DSpace repository. https://dspace.org/

Synopsis

Namibia Custom Smelters treats complex copper concentrates. At the time of the research, three furnaces were in operation namely, the Top Submerged Lance Furnace, the reverberatory furnace and the converters. All these three furnaces produce fayalite slag as a byproduct. The slags contain copper with the content ranging between 0.8 to 5% copper. The slags cannot be discarded due to the high content of copper and hence they are sent to a milling and flotation plant (Slag Mill Plant) for liberation and recovery of copper. This work focuses on optimizing the recovery of copper minerals in copper smelter slags by means of froth flotation. Most of the copper minerals present in the Namibia Custom Smelters' slags are free sulphide minerals, however a certain proportion is copper minerals that cannot be floated easily because they could either be in oxide form or locked in or occluded in the gangue matrix. This residual copper content continues to present a tough challenge in the copper mineral recovery process. It was initially postulated that these 'refractory' copper minerals were oxide minerals and an acid solubility test was performed after fine griding in an attempt to validate this hypothesis. It is known that oxides tend to dissolve in dilute sulphuric acid more readily while sulphides are refractory to acid leaching. The acid liquor obtained from the acid tests were found to contain dissolved copper which re-enforced the school of thought that the copper minerals were oxide minerals, however doubt still remained because literature has shown that copper sulfide also dissolves slightly before passivation sets in.

To further investigate the nature of the refractory copper minerals in the slag, mineralogical analysis on the slag samples were performed using X-Ray Diffraction (XRD) and Scanning Electron Microscopy (SEM) techniques.

Both these techniques did not reveal the presence of copper oxide minerals, most scans showed that copper sulphide minerals are locked and occluded in fayalite gangue. The slags were milled to 75 percent less than 45 microns in order to liberate the copper minerals sufficiently for the flotation tests which were performed on slag samples from three different sources (TSL furnace, copper converters, reverberatory furnace) to recover the copper minerals. A range of commercial flotation reagents including xanthates, dithiophosphates, mercaptobenzothiazole, thionocarbamates, fatty acids, sulphides and sulphates were tested in the flotation tests. The highest recovery obtained in the first mill-float stage was about 75.8%. Flotation tailings were milled and floated again in a Mill-Float-Mill-Float (MF2) configuration. After re-grinding and floating again, the highest recovery (cumulative) obtained was 92.2% which represented a significant improvement in the copper recovery. The best flotation performance was obtained with the reagent FC 4146 which contains thionocarbcarbamate and methyl isobutyl carbinol as a froth enhancer.