

Hydrometallurgical Processing of a Nigerian Chalcopyrite Ore

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Abstract : Due to increasing demands and diverse applications of copper oxide as pigment in ceramics, cuprammonium hydroxide solution for rayon, p-type semi-conductor, dry cell batteries production and as safety disposal of hazardous materials, a study on the hydrometallurgical operations involving leaching, solvent extraction and precipitation for the recovery of copper for producing high grade copper oxide from a Nigerian chalcopyrite ore in chloride media has been examined. At a particular set of experimental parameter with respect to acid concentration, reaction temperature and particle size, the leaching investigation showed that the ore dissolution increases with increasing acid concentration, temperature and decreasing particle diameter at a moderate stirring. The kinetics data has been analyzed and was found to follow diffusion control mechanism. At optimal conditions, the extent of ore dissolution reached 94.3%. The recovery of the total copper from the hydrochloric acid-leached chalcopyrite ore was undertaken by solvent extraction and precipitation techniques, prior to the beneficiation of the purified solution as copper oxide. The purification of the leach liquor was firstly done by precipitation of total iron and manganese using $\text{Ca}(\text{OH})_2$ and H_2O_2 as oxidizer at pH 3.5 and 4.25, respectively. An extraction efficiency of 97.3% total copper was obtained by 0.2 mol/L Dithizone in kerosene at $25 \pm 2^\circ\text{C}$ within 40 minutes, from which $\approx 98\%$ Cu from loaded organic phase was successfully stripped by 0.1 mol/L HCl solution. The beneficiation of the recovered pure copper solution was carried out by crystallization through alkali addition followed by calcination at 600°C to obtain high grade copper oxide (Tenorite, CuO : 05-0661). Finally, a simple hydrometallurgical scheme for the operational extraction procedure amenable for industrial utilization and economic sustainability was provided.

Keywords : chalcopyrite ore, Nigeria, copper, copper oxide, solvent extraction

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