Abstract

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# Bio-hydrometallurgy applied to carbonate-rich polymineral concentrate for copper recovery

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Abstract

There are nowadays two principal production paths to treat copper ores. Smelting, converting and electrorefining have dominated the copper industry since the 1800s and represent 80% of the copper production. The other 20% are produced via hydrometallurgy. Research is going on to develop alternative routes to conventional processing as there is a need to exploit more diverse resources, more complex in composition and with lower grades.

The copper concentrate subject of this study is produced by flotation from a black shale organic rich ore. This resource is a carbonate-rich, multi-element (Cu, Ag) and polymineral concentrate. Due to ore specific properties, flotation indexes have always been poor in the concentrator. Moreover, in the last 5-6 years, ore characteristics dramatically changed and the concentrate grades (mostly Cu and As) degraded. As a consequence, research on alternative technologies to pyrometallurgy is necessary.

The first part of the study consisted in testing nontraditional operating conditions during continuous bioleaching experiments: high solids concentration (> 20% solids), reduced agitation and aeration rates. For the same residence time, bioleaching performances at high pulp density (25%) were the same as those reached during previous bioleaching tests at 15% solid. No mixing or microbial issues were encountered. The bacterial consortium used in the experiments demonstrated a high copper tolerance.

The second part of the study was devoted to technology development for metal recovery from copper bearing solutions obtained during bioleaching experiments cited above. Due to the high copper concentration of the leachate, the results obtained show that solvent extraction is not necessary and can be replaced by direct electrowinning. Copper cathodes of proper quality (morphology and composition) are obtained at industrial current densities. The control of Fe(III) content in solution (< 2g/L) allowed to obtain high electrowining efficiencies (between 90 and 95%) and low energy consumption factor (~

2000kWh/t Cu). Chlorine removal enabled to avoid dendrites and nodules formation in copper cathodes.

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