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REDUCTIVE PERCOLATION LEACHING OF A LOW-GRADE COPPER-COBALT ORE PART I: SODIUM SULPHITE AS REDUCING AGENT

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ABSTRACT

Cobalt is generally recovered in low quantities as a by-product during other major metal extraction processes such as copper and nickel, with the nickel process being the major producer of cobalt metal. Most of the oxide cobalt occurring in the central African Copperbelt deposit is in the trivalent state, Co(III), which needs to be reduced to divalent Co(II) in order to dissolve. The objective of this study was to test whether the initial rate and extent of overall cobalt dissolution could be enhanced when leaching in reductive sulphate solutions by the addition of a suitable reductant during agglomeration of a copper oxide ore containing cobalt as heterogenite (CoOOH).

In previous testwork, it was found that optimising the amount of acid added in the agglomeration step could significantly enhance the initial rate of copper dissolution. However, cobalt recoveries higher than 46% could not be achieved. In an attempt to improve overall cobalt recovery, the effect of adding sodium sulphite (Na_2SO_3) in the agglomeration step, was investigated. A low-grade copper-cobalt ore sample from the Democratic Republic of the Congo was used for the testwork. The sample contained 3.60% copper, 0.29% cobalt, 3.53% iron and 6.81% carbonate. The sample was crushed to 100% passing 25 mm and percolated in Φ 160 mm (inside diameter), single-sectioned (1 m in height), water-jacketed, polypropylene columns.

The initial rate and extent of overall cobalt dissolution were significantly enhanced. For example, an improvement of 258% with respect to cobalt dissolution was obtained during the initial stages of leaching when the reductant dosage was increased from 0 to 5 kg SO_3/t; and the extent of overall cobalt dissolution improved by 85% when copper solvent extraction raffinate was recycled at the same dosage. The highest cobalt dissolution obtained was 79.4% at 5 kg SO_3/t, and 43.0% was the lowest at 0 kg SO_3/t. The addition of sodium sulphite in agglomeration had no adverse effect on the initial rate and extent of overall copper dissolution. The overall copper dissolution ranged from 90.3% to 94.6%.

Keywords: Cobalt, Copper, Percolation, Reductive leach, Heap leaching