REDUCTIVE PERCOLATION LEACHING OF A LOW-GRADE COPPER-COBALT ORE PART II: FERROUS ION AS REDUCING AGENT

By

Nontobeko Nxumalo, Petrus Basson, Mpumelelo Ndhlalose

Mintek, South Africa

Presenter and Corresponding Author

Nontobeko Nxumalo

ABSTRACT

Copper / cobalt oxide ore deposits from the Central African Copperbelt contain cobalt(III) oxide minerals such as heterogenite (CoOOH) and stainierite (Co_2O_3), which require reduction of Co(III) to soluble Co(II) for dissolution in acidic sulphate solutions. Reducing agents commonly used in hydrometallurgical plants include sodium metabisulphite ($Na_2S_2O_5$; SMBS), sulphur dioxide (SO_2), ferrous ion (Fe(II)) and pulverised copper metal (Cu°). Several studies have been conducted on the subject matter showing that these reductants can improve cobalt recovery up to 90% when applied in tank leaching. The testwork undertaken in this study investigated the effect of ferrous ion as a reducing agent in the percolation leach of a low-grade copper / cobalt oxide ore.

A copper / cobalt ore sample from the Democratic Republic of the Congo was used for the testwork. The sample contained 952 ppm cobalt, 2.33% copper, 4.05% iron and 1.27% carbonate, with 92% of the copper as acid-soluble copper. The ore sample was crushed to 100% passing 25 mm with 80% passing (P_{80}) 18 mm. The percolation leach tests were conducted in Φ 160 mm (inside diameter), 6 m (height), water-jacketed, polypropylene columns.

The addition of ferrous in irrigation solution improved the extent of overall cobalt dissolution by between 38 and 42 percentage points. Approximately 50% of the cobalt could be leached within 9 days with the addition of ferrous in agglomeration. The extents of overall cobalt dissolution achieved were 39.6% (no ferrous in solution; base case), and up to 81% with ferrous in agglomeration and irrigation solution. The reductive conditions had no negative effect on the copper dissolution, with an average extent of overall copper dissolution reaching 94.9%.

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