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Recovery of PGMs from an oxide ore by flotation and leaching

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ABSTRACT

Froth flotation is the process used in the Platinum Group Metal industry to upgrade the run-of-mine ore for subsequent processes such as smelting and hydrometallurgical PGM refining. The PGM concentrator plants achieve high PGM recoveries (>85%) when treating prestine (unweathered) sulphide ores. However, the depletion of prestine sulphide PGM bearing minerals has triggered interest in exploration of techniques for PGM recovery from near surface oxidised PGM ores. All earlier attempts to process the oxidised PGM ores by conventional flotation methods achieved poor recoveries (typically less than 50 %) hindering the commercial exploitation of these resources.

The characterisation of the non-sulphide PGM ore used in this study indicated that the ore is enriched in oxide iron minerals as a result of weathering. In the flotation work, the maximum PGM flotation recoveries achieved using the sulphide co-collector schemes were 55.1% 3E (Pt, Pd and Au). Application of the hydroxamate oxide collector improved the flotation performance to recoveries of 74.7% 3E. The superior PGM recoveries achieved with hydroxamates probably lies in their ability to form complexes with metals such as iron. Hydroxamates co-collectors have been proven to improve recoveries without any adverse effects on performance of primary collectors such as SIBX.

In this study the non-sulphide PGM ROM ore was leached directly using different acids. Low PGM extractions were recorded for hydrochloric acid (36.6% Pt and 8.8% Pd) and nitric acid (34.5% Pt and 7.1% Pd). The best leaching results of 48% Pt and 24.5% Pd were obtained using aqua regia solution though it is non-selective. Leaching of ROM ore is generally not preferable as it leads to high reagent consumptions. In this study it was postulated that leaching of low grade flotation concentrate would be preferred. Experiments were conducted to leach the concentrate that had the highest PGM recovery with sulphuric acid in order to target the base metals and further concentrate the PGMs in the residue. The base metal recovery from flotation concentrate using sulphuric acid was only efficient for copper and nickel while poor iron recoveries were achieved.