Oxidation Of A Refractory Gold Concentrate Using Pressure, Atmospheric and Bacterial Oxidation Processes

C.Casingena[1], C.Czerny[2], L.Paterson[3], P.Carter[4]

1. Group Metallurgist, SGS Minerals Metallurgy, 431 Victoria Road, Malaga, Western Australia, 6090, Christopher.Casingena@sgs.com
2. Manager - Gold Metallurgy, SGS Minerals Metallurgy, 431 Victoria Road, Malaga, Western Australia, 6090, Chad.Czerny@sgs.com
3. Senior Mineralogist, SGS Minerals Metallurgy, 431 Victoria Road, Malaga, Western Australia, 6090, Lorraine.Paterson@sgs.com
4. Senior Metallurgist, SGS Minerals Metallurgy, 431 Victoria Road, Malaga, Western Australia, 6090, Paul.Carter@sgs.com

ABSTRACT

Hydrometallurgical processing of refractory gold ores as a rule generally entails production of a gold-rich bulk sulphide concentrate which then requires oxidation to enable recovery of the precious metals by cyanidation leaching. Whilst it can be argued that there are some key similarities in the chemical mechanism(s) whereby the key sulphide minerals are oxidised, there is no question that the chemical and mineralogical compositions of the oxidation products vary depending on the oxidation technology that is used.

The gold group at SGS Minerals Metallurgy (Malaga, Western Australia) has conducted a test programme in which a refractory gold ore sample was beneficiated by bench-scale flotation to generate a bulk sulphide concentrate grading 10.6 g/t Au, 13.1% S, 11.4% Fe, 0.18% C and 2.36% As. Mineralogical analyses determined that gold in the ore was primarily associated with pyrite and arsenian pyrite.

Representative samples of the product concentrate were the subjected to oxidative leaching using: (i) mesophile bacteria in a stirred tank reactor, (ii) an atmospheric continuously stirred tank reactor (CSTR) system, and (iii) autoclave pressure oxidation (POX). Timed "thief" samples were taken during the leach tests, and the residues washed, dried and analysed to determine the sulphur speciation, and thus establish the sulphur oxidation kinetics. The interim and final kinetic residue samples were also leached with excess cyanide to investigate the relationship between gold leach extractions and the extent of sulphur oxidation. The solutions and residues were also analysed by ICP-OES and fusion-XRF, respectively, to determine elemental concentrations, metal deportments and percentage elemental accountabilities.

The pressure leach tests were conducted at test conditions of: 210 to 225 °C, 2500 to 3000 kPa, with oxygen overpressures of 500 to 700kPa and 90 to 120 mins residence time, whilst the atmospheric CSTR test was carried out at approximately 90 °C for 48 hrs with injection of oxygen using a sparger, and intensive mixing to ensure optimal gas dispersion. The slurry pH was maintained at pH ~ 5 by the addition of limestone slurry. Bacterial leaching entailed adaptation of a mesophile bacterial inoculum to the concentrate which was then used to conduct bioreactor tests. The bacterial leach test duration was 3 to 4 weeks. For each process examined, intermediate and final oxidation products were taken to evaluate chemical and mineralogical composition.

The key findings obtained in the study will be reported and discussed in the presentation. The presentation will include data analysis, a commentary about the relative performance of each technology, comparison of chemical and mineralogical compositions of intermediate and final oxidation test products and an assessment of cyanide leach performance obtained with residues from each process with respect to parameter such as: leach kinetics, cyanide consumption and overall gold recovery. The cyanide leach final residues will also be assessed for chemical stability from an environmental perspective.