

Unravelling Causes of Refractoriness in Complex Flotation and Bio-oxidised Auriferous Concentrates for Efficacious Gold Extraction

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ABSTRACT

In this paper, the nature of gold occurrence coupled with leaching limitations of two types of refractory flotation concentrates and their corresponding bio-oxidised products has been investigated using several analytical techniques. The refractory concentrates originated from ores of the same deposit, yet having different mineralogical characteristics and leaching response. One flotation concentrate displayed a higher nominal gold grade of 28 g/t and further produced bio-oxidised product with 38 g/t gold grades. The other flotation concentrate had much lesser gold grade (17 g/t) and, hence, produced a bio-oxidised product of 23 g/t gold grade. Different proportions of minerals such as quartz, muscovite, illite, gypsum, albite, ephesite, bassanite, jarosite, larnite, rutile, chamosite, pyrite, apatite, goethite and arsenopyrite were observed in the samples. The sulphate minerals (e.g., gypsum) were secondary minerals formed during the bio-oxidation process. From the results, all four samples comprised mixture of polydispersed visible and invisible gold particles with varying mineralogical associations. Whilst the visible gold grains showed association with mixed group of gangue minerals (e.g., pyrite, chalcopyrite), the invisible gold was predominantly disseminated in the arsenian pyrite and arsenopyrite mineral phases. Visible gold-sulphate mineral associations were noticeable in the bio-oxidised products, showing evidence of gold encapsulation during their precipitation process. Notable differences in gold occurrence were more evident between the two bio-oxidised products. For example, the secondary sulphate minerals, specifically gypsum and jarosite, accounted for about 43 wt.% Au lost to the tailings stream of the lower gold-bearing bio-oxidised product whilst ~ 9 wt.% Au was lost for the higher gold-bearing product. The results from the samples suggested that, sulphide minerals were the major cause of refractoriness in the flotation concentrates. On the other hand, carbonaceous matter effect showed predominance (~ 29 wt.% Au) for the higher gold-bearing bio-oxidised product whilst jarosite and gypsum encapsulation of the gold were the main cause of refractory in the lower gold-bearing bio-oxidised product.

Keywords:

Gold ore refractoriness; ore pre-concentration; ore pre-treatment; refractory secondary minerals.