Enhancing Gold Recovery from Refractory Bio-oxidised Gold Concentrates through Mechano-chemical Activation

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ABSTRACT

This paper aims at investigating the gold leaching behaviour of refractory, bio-oxidized flotation gold concentrates, before and after mechano-chemically activation, for enhancing plant gold extraction. Specifically, the influential role of activation factors such as milling time and ceramic balls-to-pulp mass ratio, coupled with corresponding physico-chemical changes on the gold extraction yield and leaching kinetics was studied. Characterisation techniques involving semi-quantitative X-ray diffraction, scanning electron microscopy, laser diffraction and BET surface analysis were employed in understanding the nature of the activated and non-activated concentrates in tandem with pulp interactions during leaching. From the results, mechano-chemical activation of the bio-oxidised flotation concentrate reduced the average particle size by increasing the fraction of fines mainly through abrasion/attrition, and increased surface area by both fine particle and crevice production. Furthermore, notable increase in sodium cyanide consumption was observed with an increase in the mechanical stress deployed, consistent generally with degree of mineral relative amorphisation and reactive gangue mineral exposure. In the case of sodium hydroxide, lower consumption was evident compared with the as-received concentrate. Notwithstanding, increasing mechanical stress showed corresponding increase in alkali consumption. About 1.6 to 1.8 times variable increase in gold yield was observed after 24 h of cyanide leaching for all the investigated activation parameters, irrespective of their impacted mechanical stress and degree of mineral amorphisation. All parameters, the 20 min activation gave the highest of about 1.8 times increase in gold yield. The mechano-chemical activation mechanism was, therefore, ascribed to gold surface cleaning, creation of pores/crevices that are linked to gold sites, and disintegration of gold-gangue mineral agglomerates that encapsulated gold particles. It has further been noted that, increasing mechanical stress generally led to a reduction in the gold leaching kinetics. This behaviour was due to the increased fine particle generation and coalescence in those samples, leading to an increase in the effective thickness of liquid film surrounding gold particles which further led to a reduction in the lixiviant and reaction product mass transfer.

Keywords:

Mechano-chemical activation, refractory bio-oxidised gold concentrates, leaching kinetics, physico-chemical properties, ore mineralogy, alkaline cyanide leaching