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Modelling of gold-cyanidation reaction in Percolation Leaching

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Abstract
At a global scale, depletion of large ore reserves and relative limited operation period of mines has made large investment to be tough to implement. This has prompted the implementation of new sustainability strategies to fulfill the world's metal demand. Percolation leaching is one of the new sustainability strategies and normally applied as vat leaching in gold extraction process.

The effects of gold leaching parameters namely cyanide concentration, pH and permeability of the fixed ore bed is studied in this work in order to optimize the percolation leaching process. A numerical modelling method is applied to predict the amount of gold remaining in the fixed ore bed after a known time has elapsed. The surface reaction between gold grains and free cyanide ions and aqueous oxygen is modeled based on the framework of the shrinking core model, the internal diffusion of the oxygen through the ash layer is accounted for using the pseudo-steady state mass balance. Other factors incorporated into the model include convective transport of cyanide from the top of the column through the fixed ore bed to the bottom of the column and the amount of unreacted gold particles in the fixed bed ore. The results of the simulation model are then used to analyze, control and optimize the percolation leaching process. This reduces the number of experiments required to achieve the same results.

The model can simulate the overall gold oxidation level as well as the oxidation profile of the gold grains i.e the oxidation depth of gold grains of different sizes and at different locations within the rock particles. The experimental data from laboratory leaching column is used to estimate the model parameters.

The amount of slimes and clays in a specific ore that can reduce the permeability of the ore is also established through column leaching experimental work. This value is an essential input required for efficient permeability of the fixed ore bed. Under these conditions, the fixed bed of ore has a narrow size range which favors efficient percolation of the leaching solution.

Keywords: Percolation leaching, shrinking core model, Parameter estimation,

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