Application of Yianatos method to determine kinetic rate constants of different size fractions in rougher cells of Sungun copper concentration plant

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Abstract

Distributed performance of a flotation bank, consisting of a number of cells in series is determined for different purposes such as process design, scale up, diagnosis, operation and control and optimization. Traditionally in plant operation mass balances around the whole flotation bank is developed in order to characterize the overall recovery typically in rougher floatation. However, carrying out experiments to fit flotation rate models are seldom undertaken on industrial floatation banks due to laborious sampling, preparation and analysis. In this work, in order to investigate the effect of particle size distribution of rougher cells feed on metallurgical characteristics at Sungun copper plant, kinetics of different size fractions through rougher bank was studied by using both traditional method and Yianatos method which depends on collecting samples from only five points. It is indicated that, the Yianatos method can be beneficial in kinetic rate constant determination for the whole size range and -75 µm fractions.

Keywords: flotation, kinetic rate constant, particle size.

Introduction

The efficiency of a flotation depends on solid particles characteristics including mineralogy and particle size; the type of instrumentation; and operation of the controlled variables such as air flow rate, pulp level and reagent dosage (Yianatos et al 2006)

Usually to study kinetics rates of a flotation bank, sampling of all cells is performed. Thus, too many samples are to be collected and assayed, which is time consuming and costly. Yianatos proposed a short-cut method for flotation rates modeling of industrial flotation banks based on only five sampling points. In this work, the Yianatos method which is basically introduced was used to study kinetic rates constant of size fractions in rougher flotation cells of Sungun copper concentration plant. Then the results which are obtained by using the traditional and the Yianatos methods are compared with each other.

Rougher floatation banks at Sungun consist of 12 RCS 130 cells in 6 double cell units. The average retention time for rougher bank is 33 minutes that is about 2.5 minutes for each cell. Feed solids flow rate to rougher bank is about 900 tph, with D_{80} of about 90 µm, and solids concentration of 34 %.

Kinetics modeling of continuous flotation process

The distributed performance of a floatation bank can be correctly determined by the tanks-in-series model, Eq. (1), considering a rectangular rate constant distribution function (figure 1) to account for the rate constant change along the bank, while keeping a constant residence time for each cells (Yianatos 2006)

$$R = R_{max}\left[1 - \frac{\left(1 - \left(1 + K_{max}\tau_p\right)^{1-n}\right)}{(n-1)K_{max}\tau_p}\right] \qquad \text{Eq. (1)}$$

Where R is the cumulative mineral recovery in the flotation bank, R_{MAX} is the maximum recovery at infinite time, k_{MAX} is the maximum rate constant of the rectangular distribution function, τ is the residence time of one cell and N is the number of cells in the bank. Eq. (1) is only useful for N > 1. For N = 1, the solution is given by the following equation. (Yianatos et al 2006)

$$R = R_{max}\left[1 - \frac{\left(1 - ln(1 + K_{max}\tau)\right)}{K_{max}\tau}\right] \qquad \text{Eq. (2)}$$

Rectangular distribution function is shown in figure 1.