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Hydrodynamic evaluation of an industrial flotation plant by means of radioactive tracers: a tool to support the global metallurgical balance

Content

Chile has established itself as the world's largest copper producer, a position that requires the constant evaluation of industrial flotation plants to ensure optimal process performance. The evaluation of a copper sulfide flotation plant requires establishing mass balances by estimating the flow rates and the concentrations of the main elements in the copper minerals; and the support of Residence Time Distribution (RTD) measurements to characterize process kinetics.

The aim of this work is to characterize the flotation operation at the concentrating plant Los Pelambres, Chile. The general objective is measuring the flow rates and their distributions in the flotation circuit (see attached figure) and determining the liquid phase and particle size distribution of the non-floatable minerals in the different currents. The specific objectives are the measurement of flow distributions; the hydrodynamic evaluation of the flotation circuit (including Rougher and Scavenger cells); the identification of potential operational improvements; and the validation of flow measurement instrumentation to inform plant operators.

The methodology considers the use of radioactive tracers: Br-82 labeled potassium bromide which attaches to the liquid phase, and non-floatable solids of different sizes which are activated in a nuclear reactor generating Na-24. The radioactive tracers are injected into the feed streams and measured at various points of the circuit using nuclear instruments, allowing for non-invasive and real time detection (sampling rates of the order of 1 second). Amounts of 50 mCi of Na-24 are sufficient for adequate counting rates. The mass of tracer injected into the solids varies between 18 and 25 grams.

Results show that in the Rougher flotation stage, the feed flow is distributed evenly in lines 2 and 3 (approximately 38% of the flow goes to each line) and to a lesser extent towards line 4 (approximately 24%). In lines 1 and 2 of the Scavenger stage, a greater percentage of the flow goes towards line 1 (approximately 59%) and a lesser percentage towards line 2 (41%). Furthermore, line 6 of the Rougher flotation is the fastest of the circuit (shortest residence time).

In terms of mineral particle size distribution, there is little variation in the percentage of particles per each size (fine, intermediate and coarse) that goes to lines 1, 5 and 6 in the Rougher flotation stage. For example, from the total amount of fine sizes, 25% goes to line 1, 20.9% goes to line 5, and 25.8% goes to line 6 (standard deviation 2.1%). However, lines 7 and 8 present a significant deviation, with only 16.1% of the total amount of fine particles going to line 7 and 12.3% to line 8.

This work is an example of how radiation technologies can be applied to improve industrial production and processes. The paper provides reliable information to be used in combination with other metallurgical data to properly assess the functioning of the collective flotation plant at Los Pelambres.

Country or Int. Organization

Chile

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