Coarse Particle Retention Testing on a Ball Mill at Lundin's Humboldt Concentrator

R.E. McIvor [1], K.M. Bartholomew [2], O. Arafat [3], S. Daavettila [4] and E. Savola [5] (initials and surnames only)

Note: Presenting author's name should be underlined.

1.Chief Metallurgist, Metcom Technologies Inc., Grand Rapids, Minnesota, USA 55744. rob@metcomtech.com
2.Senior Metallurgist, Metcom Technologies Inc., Grand Rapids, Minnesota, USA 55744. kyle@metcomtech.com
3.Project Metallurgist & Business Development Manager, Metcom Technologies Inc., Grand Rapids, Minnesota, USA 55744. omar@metcomtech.com
4.Processing Superintendent, Eagle Mine., Champion, Michigan, USA 49814. Steve.Daavettila@lundinmining.com
5.Lead Metallurgical Technician, Eagle Mine., Champion, Michigan, USA 49814. Elton.Savola@lundinmining.com

ABSTRACT

Ball mill media sizing investigations were carried out for the parallel ball mill circuits grinding minus 12.5 mm crushing plant product at Lundin's base metal concentrator in Humboldt, Michigan, USA. Initial batch grinding tests were carried out on mill feed (circuit new feed plus cyclone underflow) with a torque-instrumented, pilot ball mill. Using the same ball charge (76 mm top size) as used in the plant, calculated cumulative grinding rates of 4.75 to 9.425 mm particles were approximately four times higher for the plant mill than those of the pilot mill, even though the rates converged at fine particle size (106 microns). One hypothesis was that coarser particles are retained in the plant mill longer, and thus exposed to more energy, than fine material. This challenges the assumption, used by population balance modelling, that particles of all sizes have the same residence time in the mill as indicated by liquid tracer tests. A review of the literature showed that this assumption is ill-founded. In fact, residence time as a function of particle size is indeterminant, even by tracer particle testing, because it is confounded as the tracer particles break in the mill. To test the hypothesis, a plant trial was conducted by dosing one of the Humboldt ball mills with 16-22 mm particles; a size coarser than any in the circuit feed. Liquid residence time was concurrently traced using salt and a conductivity probe. The test showed that coarse particles were retained approximately twice as long as the liquid. It also showed that abrasion of these particles is contributing significantly to their size reduction, revealing another unaccounted factor in the population balance modelling method.