ABSTRACT

Modelling of comminution in tumbling mills is usually done using the selection and breakage function models. While this has been a success for ball milling it has not been the case with Autogenous and Semi- Autogenous mills where performance is easily affected by slight variations in operations. A numerical model, Discrete Element Method (DEM) a much more detailed model for the non-linear behaviour of mill loads is proposed as a possible solution to this problem.

The Discrete Element Method algorithm is a numerical technique for solving problems that involve a large number of interacting bodies. The dissipative forces (normal, tangential or frictional) at points of contact are modelled using a spring-slider-dashpot and the dynamics of the particles are modelled by applying Newton's laws of motion. A record of information about contact events occurring during simulation is stored in the output files and can be thereafter applied for a wide range of purposes.

The contact events and their corresponding energy levels derived from the simulation are applied to determine the particle failure rate in a mill. The probability of particle failure does however also depend on the inherent fracture properties of a material; hence particle fracture tests on the ore samples were conducted using the JK drop-weight impact test machine. Using this tool, data that related the probability of breakage to the energy input and the number of impact attempts were obtained and a model describing this relationship was derived.

Using the energy spectra that resulted from the simulations of milling and the Breakage probability model, an attempt was made to predict the experimental results of a mill operating under a wide range of conditions.

Good prediction was achieved after a careful choice of model parameters. A systematic approach of establishing the most suitable parameters is recommended for future work. These parameters would also compensate for conditions beyond

the limits of the model such as particles being too small to simulate or having a complex shape.

The predictions were based on two size fractions as a way of making this task more manageable. It is apparent that this work can be extended to do a full SAG and AG mill simulation.