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Evaluation of Shell and Pulp Lifters in Semiautogenous Mills with the Dem Simulation

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Abstract

Today's high capacity semiautogenous grinding (SAG) mills expend vast amounts of energy and in doing so consume tons of steel balls and shell liners. The energy efficiency of these mills can be directly examined by looking at the motion of rocks and grinding balls inside the mill. The make-up of the charge and the design of lifter bars attached to the inside of the mill shell can be chosen particularly to maximize the mass of ore fractured per unit of energy spent. At the same time, the unnecessary collisions of balls against the mill shell can be prevented. Furthermore, the cascading charge flow can be altered in a way to maximize grinding efficiency. The harsh environment in the mill prevents any instrumentation in the interior of the mill. Instead, the simulation of charge motion became a practical tool with the emergence of the discrete element method (DEM).

In the last fifteen years, the DEM for simulation of tumbling mills has advanced sufficiently that it has become a very practical tool in the mining industry. This presentation gives an overview of the DEM as applied to the tumbling mill problem. Both the two- and three-dimensional (2-d and 3-d, respectively) models as well as the parallelization of the 3-d code are described. Also, the discrete element method can be readily applied to the simulation of the motion of broken rock particles and pebbles in pulp lifters. Pulp lifters play a critical role and in conjunction with grates, they control the mill capacity. This simulation methodology alone can bring about major improvements in energy efficiency in SAG mills.