

New Method to Measure the Fill Level of the Ball Mill I— Theoretical Analysis and DEM Simulation

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Abstract: Up to now, the accurate measurement of the fill level in the ball mill hasn't been resolved because of the interplay of many variable factors, which led the mill to be operated under the uneconomical condition and lost a lot of energy. At present, some methods, such as vibration method and acoustic method, have been applied for measuring the fill level by the researchers. Aiming at the problem of the traditional methods for measuring the fill level, that is, the feature variables of the fill level suffer the influences of the ball load and the water content of the coal, a novel method to measure the fill level is proposed and a possible relation between the fill level and the angular position of the maximum vibration point on the mill shell is investigated. The angular positions of the maximum vibration point on the mill shell for different fill level cases are calculated theoretically under two assumptions, respectively. Meanwhile the charge motions of the mill for different fill level cases are simulated with the discrete element method (DEM). And the simulation results are verified by comparing the motion trajectories of steel balls and power draft of the mill. The simulated movement trajectories of the outmost layer steel balls in the mill are monitored and analyzed to obtain the angular positions of the maximum vibration point on the mill shell. Both the results of the theoretical calculation and the 3D DEM simulation show that the position of the maximum vibration point on the mill shell moves to a lower angular positions as the fill level decreasing, which provides a new idea for measuring the fill level accurately.

Key words: ball mill, fill level, discrete element method (DEM), simulation

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