Ball mill energy efficiency optimization: A lifter face angle optimization approach

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Abstract

On average, approximately 40% of the total energy consumed by grinding comminution industries is attributed to industrial ball mills, underscoring the urgent necessity to address this energy consumption challenge. This study investigates the influence of lifter face angle variations on the performance of ball mills in comminution processes. Through a combination of Discrete Element Method (DEM) simulations and experimental design, the study explores the effects of lifter face angle on energy efficiency, wear rates, and comminution effectiveness. Findings reveal that smaller lifter face angles result in increased scattering of ore particles within the mill, while larger angles lead to reduced wear and improved grindability of materials. The optimal lifter face angle is identified as approximately 24.8°, falling within the typical range used by industrial ball mill accessories manufacturers. An overall energy saving of 5.89% is achieved by using the optimum ball mill lifter face angle of 24.8°. Recommendations for future research include further exploration of optimal parameters, experimental validation of findings, and the development of advanced modelling techniques. By implementing these recommendations, the study aims to contribute to enhanced efficiency, durability, and sustainability in ball mill operations.

Keywords: Ball mill energy optimization, ball mill operational efficiency, discrete element modelling, response surface modelling, comminution processes