A DEM-PBM coupling approach for prediction of milling behaviour in an impact pin mill

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ABSTRACT

Milling is widely used in many industrial sectors for particle size reduction. Although milling has been known to be an energy intensive and highly inefficient process, the optimisation of design and operation of a mill still relies heavily on experience and empirical methods due to a lack of fundamental understanding of the milling characteristics of the materials and the particle dynamics inside a mill. In this study, a multi-scale approach coupling the Discrete Element Method (DEM) with the Population Balance Model (PBM) is proposed to predict the milling behaviour of alumina particles in an impact pin mill.

In the study, DEM was firstly performed to study the particle dynamics and stress events in a centrifugal impact pin mill. The mass holdup, particle residence time and impact velocity distribution obtained from the DEM simulations were found to be the key information that could best represent the milling environment. The particle information extracted from DEM was then used to inform the PBM model of the pin mill to predict the milling product size distribution. The effect of material properties and operational milling conditions on the prediction of product particle size distribution was also analysed. The prediction by the coupling of DEM-PBM was compared with the experimental measurements from the impact pin mill and found to be in good agreement. This shows a promising application of the proposed model in the future.