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Investigation of Single Particle Breakage inside an Impact Mill

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Abstract : In current work, a numerical model based on the discrete element method (DEM) was developed which provided information about particle dynamic and impact event condition inside a laboratory scale impact mill (Fritsch). It showed that each particle mostly experiences three impacts inside the mill. While the first impact frequently happens at front surface of the rotor's rib, the frequent location of the second impact is side surfaces of the rotor's rib. It was also showed that while the first impact happens at small impact angle mostly varying around 35º, the second impact happens at around 70º which is close to normal impact condition. Also analyzing impact energy revealed that varying mill speed from 6000 to 14000 rpm, the ratio of first impact's average impact energy and minimum required energy to break particle (W_{min}) increased from 0.30 to 0.85. Moreover, it was seen that second impact poses intense impact energy on particle which can be considered as the main cause of particle splitting. Finally, obtained information from DEM simulation along with obtained data from conducted experiments was implemented in semi-empirical equations in order to find selection and breakage functions. Then, using a back-calculation approach, those parameters were used to predict the PSDs of ground particles under different impact energies. Results were compared with experiment results and showed reasonable accuracy and prediction ability.

Keywords : single particle breakage, particle dynamic, population balance model, particle size distribution, discrete element method
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