Cohesive Powder Flow of Faceted Particles in Screw Feeders

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Abstract

Powder flow in screw feeders is of great interest to a wide range of industries. However, analysis of flow of cohesive powders with sharp corners and edges presents a great challenge and it has not been widely addressed. In the present work, an in depth analysis of cohesive powder flow of faceted particles in screw feeders is carried out. The influence of fundamental parameters (physical properties) and phenomena such as cohesive arching in the hopper and screw feeder pitches are analysed and their influence on the outlet mass flow rate is evaluated. Cohesive arching only takes place when the surface energy of the particles goes above certain values and its onset is also affected by the particle geometry.
Parameters for the simulations are carefully characterised through different test methods such as the Drop Test Method[1] for surface energy and high speed camera footage for the coefficient of restitution.

Cohesive arching and flow irregularities are studied and the parameters leading to this condition are analysed. Different contact models for cohesive particles are implemented and tested both in Rocky DEM[2] and EDEM[3] software packages and the results obtained with faceted particles are compared with the clumped-spheres method. Differences arise between both methodologies due mainly to the sharp corners of the faceted particles. The computational results are compared with experiments in the FT4 rheometer showing a good correlation between both.

U. Zafar, C. Hare, A. Hassanpour, M. Ghadiri, 2014. Drop Test: A New Method to Measure the Particle Adhesion Force, Powder Technology 264, 236–241

ESSS, https://rocky.esss.co/index.php?pg=a_esss

DEM Solutions, https://www.edemsimulation.com/software/

Keywords: Cohesive powder flow, DEM, Particle shape

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