Flow Characteristics of Non-Spherical Particles Simulated with Super-Quadric DEM

Shunying Ji* and Siqiang Wang

State Key Laboratory of Structural Analysis for Industrial Equipment, Dalian University of Technology, Dalian, China.

*Corresponding Author: Shunying Ji. Email: jisy@dlut.edu.cn.

Abstract: Granular flow is commonly encountered in industry or nature, and is significantly affected by particle shapes. Super-quadric particles which can construct the geometric shape of irregular particles are simulated by the Discrete Element Method (DEM). In this study, the influence of aspect ratio and blockiness of particles on the flow characteristics is investigated, and the different discharge angles are used for different shaped particles to show the superposed effect of hopper configuration. Meanwhile, the Lacey mixing index is used to explore the effects of particle shapes on the mixing and motion of the granular system in a horizontal rotating drum. In addition, the previous experimental results for the dynamic hopper discharge and the mixing degree of ellipsoids are compared, and this method is verified by the good agreement between the simulated results and the previous experiments. Furthermore, the results indicate that the discharge rate of particles depends on both the particle shape and discharge angle. the 'flowability' of cubes is the lowest while the spheres have the fastest discharge rate for different discharge angles, and the difference in discharge rate caused by the particle shape decreases as the angle increases. Moreover, the flow is continuous for spherical particles, while the characteristics of non-particles are mostly intermittent flow.

Keywords: discrete element method (DEM); granular flow; super-quadric particles; hopper discharge; rotating drum