DEM simulations of particle shape induced radial segregations in horizontal, rotating cylinders

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ABSTRACT

Particle shape induced radial segregation in half-filled, horizontal, rotating cylinders was studied numerically using three-dimensional DEM simulations. The particles (different shapes) were modelled using the super-quadric equation. Both local and global measures were used to quantify radial segregation [1]. The following observations were made. Non-spherical particles segregated from volume equivalent spheres. The non-spherical particles moved preferentially to the core of the bed. Here, the aspect ratio of the particle had a more profound effect on the segregation dynamics than the blockiness of a particle (see Figure 1). The segregation patterns obtained were stable and robust and occurred along the entire length of the bed. In addition we observed that the degree of segregation was also dependent on the rotational speed of the cylinder. The segregation of differently shaped particles was linked to differences in the flowability of non-spherical and spherical particles. The flowability of non-spherical particles is lower than for spheres. A higher degree of segregation was observed for particle mixtures with larger flowability differences. The lower flowability corresponds to a longer residence time of non-spherical particles on the free surface/in the active region of the bed. In addition, we determined the projected area of the avalanching particles. It was found that non-spherical particles did not flow necessarily with their minimal area parallel to the bed surface while percolating to the centre of the bed.

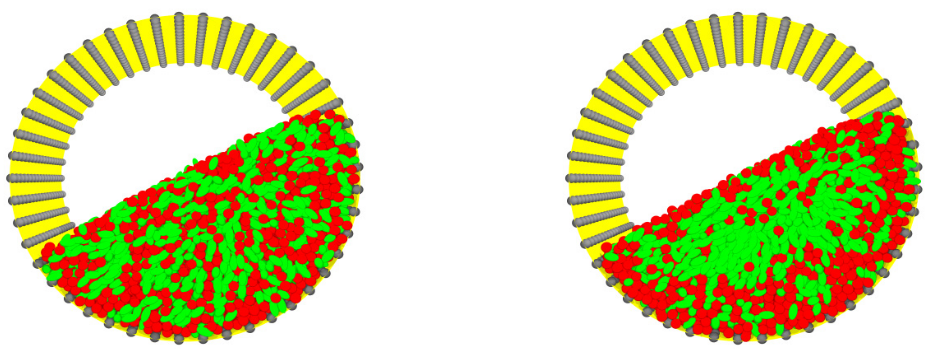

Figure 1 Snapshots showing segregation patterns in the central plane of a rotating cylinder for a mixture of volume equivalent spheres and ellipsoids of aspect ratio 2.0 (left: time evolved 5.5 s; right: time evolved 71.5 s). The non-spherical particles are colored in green.

REFERENCES

[1] G.G. Pereira and P.W. Cleary, Radial segregation of multi-component granular media in a rotating tumbler, *Granular Matter*, 2013, 15, 705-724.