Experiment and modelling of spherical particle mixing in a rotating drum

Kaicheng Chen, Rui Wang, Wencong Wu, Evangelos Tsotsas, Otto von Guericke
University Magdeburg, Magdeburg, Germany
Michael Jacob, Glatt Ingenieurtechnik GmbH, Weimar, Germany

Nowadays, particulate products can be found in the daily life of every people, for instance, the instant coffee and the detergent. Usually, these products consisted of different ingredients, which should be mixed uniformly to ensure quality. For achieving this purpose, a variety of mixers have been designed in the industry. In the previous research, the mixing index has been proposed and commonly used for defining the mixing effect of one device. Here, this work aims to investigate the mixedness of spherical particles with different methods, which can provide useful background knowledge for further research on the mixing of particles with irregular morphology.

In this study, a series of mixing experiments of γ-Al_2O_3 particles with different colors was firstly conducted using a lab-scale rotating drum mixer. For each test, the complete mixing process was recorded by a high-speed camera. In the end, several samples were taken at different positions inside the drum for obtaining the final mixing index. Later, some numerical experiments were simulated. The Eulerian, as well as Lagrangian methods, have been proved, can describe the particle mixing and segregation process in many devices. Hence, based on the settings and results of the benchmark experiments, both CFD and DEM simulations were conducted and calibrated here. In the end, the mixing indexes of particles from different methods were calculated and compared. Besides, the interconnection between the mixedness from the 2D and 3D simulation was also depicted and discussed.

Keywords: Rotating Drum, Mixing index, Eulerian, Lagrangian