Investigation of residence time and collision velocity in a Wurster fluidized bed using CFD-DEM simulations

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ABSTRACT

The Wurster fluidized bed is a common device for film coating of particles in pharmaceutical and food industries. In a typical coating process, particles experience wetting, drying and film formation in different zones of circulating motions. Thus, the residence time distributions and collision dynamics are significant in achieving uniform coating thickness and prevent particle agglomeration. The computational fluid dynamics-discrete element method (CFD-DEM) has shown to be effective in capturing majority of macro-scale and micro-scale characteristics that are related to the coating process in the fluidized bed.

In this work, an open source CFD-DEM framework [1] is used to investigate particle residence time and particle collision velocity in spray zone and Wurster tube, according to the configuration and operation conditions of PEPT measurements [2]. Ideal and non-ideal circulating motions of particles are distinguished to evaluate distributions of cycle times. The simulation, conducted for mono-disperse system using Hertzian contact model, predicts the ideal cycle time and residence time distribution that are in good agreement to available experimental data. The relatively high collision velocities in the spray zone prevent the appearance of agglomeration. The pre-defined spray zone is used to initialize wetting properties and limit the effective region of cohesive contact model [3, 4]. Moreover, influences of applying capillary force and viscous force on residence time distributions are discussed.

Keywords: residence time, collision velocity, CFD-DEM, Wurster-coater, cohesive contact

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