Simulation Study on Particle Fluidization and Drying in a Spray Fluidized Bed

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Abstract : The quality of final products in the coating process significantly depends on particle fluidization and drying in the spray-fluidized bed. In this study, fluidizing gas temperature and velocity are changed, and their effects on particle flow, moisture content, and heat transfer in a spray fluidized bed are investigated by the CFD – Discrete Element Model (DEM). The gas flow velocity distribution of the fluidized bed is symmetrical, with high velocity in the middle and low velocity on both sides. During the heating process, the particles inside the central tube and at the bottom of the bed are rapidly heated. The particle circulation in the annular area is heated slowly and the temperature is low. The inconsistency of particle circulation results in two peaks in the probability density distribution of the particle temperature during the heating process, and the overall temperature of the particles increases uniformly. During the drying process, the distribution of particle moisture transitions from initial uniform moisture to two peaks, and then the number of completely dried (moisture content of 0) particles gradually increases. Increasing the fluidizing gas temperature and velocity improves particle circulation, drying and heat transfer in the bed. The current study provides an effective method for studying the hydrodynamics of spray fluidized beds with simultaneous processes of heating and particle fluidization.

Keywords : heat transfer, CFD-DEM, spray fluidized bed, drying
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