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Abstract

Fluidized beds reactors with liquid bridge and solid bridge coupling actions have been widely used in industry and thus studies of particle agglomerations under such fluidization conditions are of great significance. This work proposed an experimental apparatus combining electro-magnetic induction heating system with fluidized bed to simulate the real conditions for particle reaction heat release and heat transfer in industrial polymerization fluidized bed reactors. The effects of liquid content on agglomeration behavior of wax/graphite composite particles under different fluidization gas temperatures, gas velocities and heating powers have been studied. Through a force balance analysis of particles with liquid bridge and solid bridge coupling actions, relative solid bridge force was taken as a key parameter to demonstrate the effects of solid bridge force and other forces on agglomerations. Results showed that as the relative solid bridge force varied in different ranges, the agglomeration mass presented three different variation trends with liquid increases, namely monotonic increasing, non-monotonic changing and monotonic decreasing, due to different dominating agglomerating mechanisms (liquid evaporation and liquid bridge) during fluidization. According to the results of this study, the proposed criterion based on relative solid bridge force can be used to guide the regulation and control of particle agglomerations in fluidization with liquid bridge and solid bridge coupling actions.

Key words

liquid bridge and solid bridge forces; fluidized beds; electro-magnetic induction heating; relative solid bridge force; meso-scale agglomeration; agglomerating mechanism