

Hydrodynamics and particle mixing/segregation measurements in an industrial gas phase olefin polymerization reactor using image processing technique and CFD-PBM model

ABSTRACT

Particle size distribution (PSD) has a significant impact on the performance of fluidized bed reactors due to uneven distribution in the segregation and mixing phenomena. This paper develops a new method of digital image processing that investigates the hydrodynamics of an industrial gas phase olefin polymerization reactor and studies the fluidization structure of a wide range of particle size distribution in an industrial gas phase polymerization reactor by means of a CFD-PBM coupled model, where the direct quadrature method of moments (DQMOM) was implemented to solve the population balance model. It was shown that the applied parameter assumptions and closure laws were appropriately chosen to satisfactorily predict the available operational data in terms of pressure drop and bed height. The transient CFD-PBM/DQMOM coupled model and image analysis technique are then implemented extensively to analyze bubble fluidization structure and segregation phenomena at different velocities. The particle segregation indicates that the small bubbles present in the bed are unable to induce vigorous mixing at low superficial gas velocity while particle mixing improves at a velocity above the minimum fluidization velocity. Further, the predicted results show higher axial segregation phenomena when compared to the radial direction.

Keyword: Fluidized bed reactor; Image processing; Computational fluid dynamics; Particle size distribution; Bubble size distribution