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EFFECT OF BUBBLE-PARTICLE INTERACTION MODELS ON FLOW PREDICTIONS IN THREE-PHASE BUBBLE COLUMNS

Michael C. Gruber[1], Stefan Radl[1], Johannes G. Khinast[1,2]*

[1] Institute of Process and Particle Engineering, Graz University of Technology, Inffeldgasse 13/3, 8010 Graz, Austria.

[2] Research Center Pharmaceutical Engineering GmbH, Inffeldgasse 13/3, 8010 Graz, Austria.

***** Author to whom correspondence may be addressed. E-mail address: khinast@TUGraz.at

Abstract

The hydrodynamics of gas-liquid-solid flows are investigated by applying event- and time-driven three-dimensional Euler-Lagrange-Lagrange simulations. Thereby, the focus is put on the modeling of the interaction between ascending gas bubbles and solid particles, which are suspended in a liquid. Specifically, the following approaches are used: i) coupling via a simple drag force modification (Mitra-Majumdar et al., 1997), ii) solely elastic collisions, iii) a multistage collision model (Ralston et al., 1999), iv) coupling via advanced drag models, v) bubble-particle cohesion models, and vi) no interactions between the phases. The setup of the simulations is based on the experimental measurements of Gan (2013), who used a laboratory-scale cylindrical bubble column, neutrally buoyant acrylic beads of *3 mm* in diameter, and a solids hold-up of *1.6 vol-%*.

The results indicate a vertical transport of solid particles from the lowest column quarter towards the upper column region. Further, the effect of the particles on the suspension's viscosity has a significant impact on the local gas hold-up distribution. While the drag force modification model of Mitra-Majumdar et al. (1997) leads to uniform solid hold-ups and lower bubble velocities, the elastic collision model and the multistage collision model showed similar flow predictions. Compared to the experimental measurements of Gan, the velocities at the column's center are underpredicted for the solid phase and overpredicted for the gas phase. The inclusion of the advanced drag model of Holloway et al. (2010), a bubble-particle cohesion force model, as well as a fine computational grid significantly improves the predictions.

Graphical Abstract