Conference abstract PMS16

Novel Modeling Technique for Simulations of Turbulent Bubbly Flows with Coalescence and Breakup

R. Sungkorn [1], **J. J. Derksen** [2], **J. G. Khinast** [1]

[1] Institute for Process and Particle Engineering, Grz University of Technology, Graz, Austria
[2] Chemical and Material Engineering Department, Univeristy of Alberta, Edmonton, Alberta, Canada

E-mail: r.sungkorn@tugraz.at (R. Sungkorn)

Sci Pharm. 2010; 78: 643 doi:10.3797/scipharm.cespt.8.PMS16

Flows encountered in processes involving turbulent bubbly flow are highly complex, especially when the gas holdup and gas-liquid interface mobility are such that coalescence and breakup of bubbles take place. These phenomena have an enormous impact on the performance and productivity of the processes. Attempts have been made by researchers to gain insight in the hydrodynamics of bubbly flows by detailed numerical simulation. However, resolving coalescence and breakup has often been ignored due to their large computational requirements.

The goal of this presentation is to assess the feasibility of using computational fluid dynamics (CFD) modeling as an engineering tool for analyzing, designing and scale-up of processes involving bubbly flow with coalescence and breakup of bubbles. The parallel and highly efficient modeling technique for bubbly flows described in the work of Sungkorn et al. [1] was extended to incorporate coalescence and breakup phenomena. The continuous liquid phase is simulated using the lattice Boltzmann (LB) scheme originally developed by Derksen and Van den Akker [2]. The trajectory of the individual bubbles is tracked by solving their equations of motion including the effect of the fluid fluctuation along the bubble trajectory. Bubble-bubble collisions as well as coalescences are described based on the stochastic inter-particle collision model according to kinetic theory. The breakup of bubbles is considered using a model based on the local size of turbulent eddies.

Simulations of gas-liquid flow in a bubble column have been performed. The simulations provide detailed insight for the liquid flow field as well as the gas dispersion pattern. The accuracy of the simulations is demonstrated by comparing the predictions with experimental data. Additionally, excellent speedup and scalability on parallel computing platforms demonstrate the capability of the present modeling technique for simulations of large-scale reactors.

[1] Sungkorn R, Derksen JJ, Khinast JG. Modeling of turbulent gas-liquid bubbly flows. To be submitted to AIChE J.

[2] Derksen JJ, Van den Akker HEA. Large eddy simulations on the flow driven by a Rushton turbine. AIChE J. 1999; 45: 209–221. doi:10.1002/aic.690450202