CFD modelling of mixing and separation in multiphase flows

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Mixing and separation of materials in multiphase flows are extremely common and frequent operations in chemical and process engineering. For example, stirred reactor is used to give good mixing and uniform dispersion of catalyst particles in the reactor to ensure uniform quality product is produced. At the end of the process, the catalyst particles may need to be recovered and removed from the product by separation equipment such as a settling tank. The commonly asked questions by plant operators in relation to these processes are: (a) What is the optimum rotating speed should be set for the stirrer to give uniform dispersion of the catalyst particles. (b) What is the appropriate settling time to allow for complete separation and recovery of the catalyst particles in the settling tank. Answers to these questions could have considerable financial impact in the operations of the equipment. Increasingly numerical analyses based on computational fluid dynamics (CFD) are used to help providing these answers.
In this paper the multiphase flow model in the commercially available CFD software, STAR-CD, is used in simulations of (a) mixing and suspension of catalyst particles in a stirred tank and (b) separation of particles in a settling tank. In the stirred tank experiment, three different stirrer speeds were considered. At different stirrer speed the particles were lifted to a different level in the tank. The levels of particle suspension computed by STAR-CD for all three stirrer-speeds were found to be in good agreement with the measured data from the laboratory. For the settling tank, the computed settling time and the height of the settled layer were also found to be in good agreement with experimental and analytical values.

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