Other - CCT Enablement Staff Candidate

Process Intensification through Computational and Experimental Fluid Dynamics

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Abstract:

Multiphase flows are commonly encountered in chemical process equipment like heterogeneous chemical reactors, boilers, nuclear reactors, distillation columns, dryers and liquid-liquid extractors. Such equipment is designed based on empirical correlations employing different dimensionless numbers, often resulting into significant overdesign or under design (and subsequent loss of money and time). Process intensification aims at re-designing such equipment to maximize its efficiency and reduce the capital and operating expenditure. CFD modelling and experimental investigation of multiphase flow are invaluable tools for process intensification.

The use of CFD simulation to ensure that the proposed design can achieve benchmark performance saves money and time. The performance of several improvised designs can be tested using CFD with a fraction of resources required to test the designs experimentally, which results in short design cycle and reduced down time. A meticulous approach is required to achieve such objectives. Briefly, such approach includes: selection of CFD model (RANS/LES/DNS), selection of models for transport processes (momentum, heat and mass transfer), validation against experimental data on a small test setup and the simulation of flow pattern in a number of alternative geometries with validated CFD model.

In this Presentation, the process of CFD modelling and experimental validation in multiphase flows will be described with case studies of Centrifugal annular extractor, Bubble Column and droplet evaporation. Additionally, a case study of Residence time distribution in the centrifugal extractor will be presented to illustrate the use of CFD modelling, validation and subsequent modification in the design to achieve the benchmark performance in terms of residence time distribution. It will be shown that a carefully designed program including CFD simulations and controlled experiments result into significant performance enhancement at a fraction of the cost involved with conventional empirical design and testing methods.

Speaker's Bio:

Mayur Sathe (Chem Eng PhD, Mumbai University, 2011) is a Postdoctoral Fellow in Priority research centre for advanced particle processing and transport, University of Newcastle, Australia. His interest is in design and development of multiphase flow process equipment. Using CFD modelling and experimental analysis, Dr. Sathe is researching ways to characterize the transport phenomena and turbulence for gas-liquid, liquid-liquid and gas-liquid-solid flow systems. In essence, the aim is to be able to 'tune' the flow pattern in multiphase process equipment to maximize efficiency- resulting in capital and operating cost reduction in a sustainable way.

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