Best Practice Guidance Seminar

CFD for Dispersed Multi-Phase Flows 2018

Lecture on:

Industrial challenges and needs for the application of CFD to industrial dispersed multiphase flows

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Multiphase flow is of key importance in many industrial processes and product fabrication. Think of chemical plants, oil refineries, steel making, food making, and nuclear plants. In general a feedstock (which can be a single phase, or a combination of gas/liquid/solid phases) will be transported and or chemically converted, up to new process or product conditions. Understanding of the multiphase flow requires knowledge of the thermodynamics, conservation laws of mass, momentum and energy, and the chemistry.
For the design of industrial processes and products with multiphase flow the use of Computational Fluid Dynamics is increasing. However, verification and validation use lab experiments, data from pilot plants, and data from actual full scale operating conditions remain essential. The increased benefits of CFD is due to (i) the development of numerical methods for multiphase flow, (ii) increased computer power, and (iii) the availability of a number of reliable commercial packages, like Fluent, Star CCM+, OpenFOAM, and TransAT.
The choice of the numerical method is dependent on the type of multiphase flow, which can broadly be distinguished into separated (or segregated) flows and dispersed flows. In separated flow the multiple phases flow as individual layers, with a smooth or wavy interface in between. An example is stratified flow in a pipeline. At higher flowrates the various phases will be dispersed into one another and an example is a gas carrying a dispersion of liquid droplets or solid particles, or a liquid carrying a dispersion of gas bubbles, droplets of another liquid type, or solid particles.
This lecture will give a number of industrial examples with dispersed multiphase flow, including chemical reactors, heat exchangers, separators, pipe flow, and flow splitters. The design philosophy of new processes and products relying on multiphase flow will be discussed. And in particular what can we expect from using state of the art CFD methods? What are their strengths and weaknesses? How can we do quality control and assurance? What is the wish list for future functionalities in the CFD tools?