Comparison between electrical resistance tomography, CFD and other measurement techniques.

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Abstract

Many industrial processes use stirred tank reactors which involve complex multiphase flows. These require an impeller system to handle liquids, sparged gas, boiling fluids, slurries and heat transfer. There are many designs of such systems and it is extremely challenging to optimise these designs for the wide range of process conditions involved.

One method of design and optimisation is through the use of computational fluid dynamics (CFD). Whilst CFD operates extremely well for single phase systems, it becomes more challenging for multi-phase systems such as gas-liquid and solid-liquid mixing. Improvements to CFD code and a robust operating platform would offer considerable benefits to the operation of many processes in the pharmaceutical, fine chemical and other sectors.

Two electrical tomography systems have been tested. The p2000, which has been applied in a wide variety of previous studies, and the newly developed rapid impedance tomography system (z8000) which has frame rates in excess of 1,000 dual frames per second. These have been used to investigate a model highly gassed stirred tank reactor and applied to test state of the art CFD predictions of gas distribution.

This paper reports on the results of these studies. It presents how new tomographic and traditonal measurement techniques (tomography, bubble size, mass transfer) compare with CFD modelling methods for such challenging systems. Novel software for cross-correlation techniques is also presented and the results used for creating detailed velocity profiles which can then be used to validate CFD and other models. Previous work on cross correlation has been limited by the speed of the hardware so these results represent a step-change in the ability of EIT to monitor high speed flows. Coupled with hardware improvements new software has been used to correlate flows and generate velocity information. It is expected that the application of this high speed system and cross-correlation GUI will be wide ranging in both research and industry.

Keywords Electrical resistance tomography (ERT), Computational fluid dynamics (CFD), validation, gas – liquid mixing

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