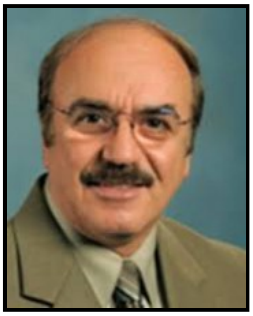

Other - Enabling Process Innovation through Computation (EPIC) Seminar Series

Advancing Industrial and Environmental Processes Multiphase Reactors by Benchmarking CFD via Sophisticated Measurement Techniques

Muthanna Al-Dahhan, Missouri University of Science and Technology

Patrick F. Taylor Hall 1100
January 27, 2017 - 03:00 pm

Abstract:

Multiphase reactors (bubble/slurry bubble columns, packed beds, fluidized and circulating beds, etc.) and multiphase flow systems (blenders/mixers, separators, conveyers, heat exchanges, flow in pipes, etc.) have found extensive applications in every industrial processes related to energy, environmental and variety of products processes. Their design, scale-up, proper operation and performance prediction are challenging tasks due to their complexity and at the mean time due to the lack of their understanding as a result of the limitation in the used measurement techniques. The complexity increases with the presence of internals that are usually exist which affect the hydrodynamics, mixing, transports (mass and heat), reactions and hence, the performance of these reactors. Due to their complexity, most (if not all) of the used models and closures in the CFD to simulate these systems have not been based on proper physics or first principles. Therefore, sophisticated techniques that integrate measurements in a novel way of various hydrodynamic and transport parameters and their integration with kinetics are required to visualize these systems, to provide an effective diagnostic means, to advance the needed fundamental understanding of these complex reactors and flow systems and to provide benchmarking data for validating CFD and models. These advances should provide the mechanistic frame work to properly scale up the results from lab to commercial scales.

In our laboratory various types of multiphase reactors for various industrial and environmental processes have been studied by developing advanced measurement techniques and validating CFD simulations which enable facilitating the implementation of new mechanistic scale up methodologies we have developed recently. In general these techniques are based on radioisotopes – radioactive particle tracking (RPT), dual source gamma ray tomography (DSCT), gamma ray densitometry (GRD) for 3D flow field, velocity and turbulent parameters, phases distribution and flow pattern identification measurements, and are not based on radioisotopes: 4-point optical probe for bubble dynamics, heat transfer probe, combination of bubble dynamics and heat transfer probe, optical probes for solids dynamics that measure simultaneously solids velocity and holdups and their fluctuations, integration of hot wire anemometry and heat transfer probe, gas tracer dynamics, optical probe for local mass transfer, gas tracer technique for global mass transfer, optical probe for local liquid and gas velocities, holdup and their time series distribution in packed beds, pressure transducers, and others. Validated computational fluid dynamics (CFD) has been introduced to enable the implementation of our new mechanistic scale up methodologies. For this, a new advanced non-invasive measurement technique of gamma ray densitometry was introduced to enable the refinement of the hydrodynamics similarity at large industrial unit and to monitor the hydrodynamics similarity at commercial conditions. In this presentation, an overview of our approach in advancing multiphase reactors will be discussed

http://epic.lsu.edu

Speaker's Bio:

Dr. Muthanna Al-Dahhan is Curators' Distinguished Professor of Chemical and Biochemical Engineering and of Nuclear Engineering and the chair of the Department of Chemical and Biochemical Engineering at Missouri University of Science and Technology (Missouri S&T), Rolla. He is a Fellow of AIChE. Prior to that he was a Professor at Washington University in St. Louis (1994-2008), Project Manager at Xytel Corporation, USA (1993/1994), Head of process, process engineer and project engineer in pilot plants – Iraq (1979-1985). He holds three degrees in chemical engineering (BSc in 1979, University of Baghdad-Iraq; Master degree in 1988, Oregon State University and Doctoral degree in 1993, Washington University). He directed from 1999-2008 industry-academia consortium on gas conversion to alternative clean fuels/chemicals using slurry bubble columns. He obtained over $12 million in external funding as PI and Co-PI. He has graduated over 50 PhD students and supervised a large number of post-doc fellows, research associates and undergraduate students on a wide range of topics. His research activities include more than 185 publications in peer reviewed journals and over 400 of national and international conference presentations. Dr. Al-Dahhan has received many awards and recognitions. He formed and chaired a number of international conferences. He has developed research laboratories which are unique in USA and in the world and can be considered a unique global resource.

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