ChE SEMINAR

Recent Advances in Experimental Multiphase Research with relevance to Energy and Environmental Process Applications

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ABSTRACT

Multiphase reactors (bubble/slurry bubble columns, packed beds, fluidized and circulating beds) and multiphase flow systems (blenders/mixers, separators, conveyers, heat exchanges, flow in pipes) have found extensive applications in many industrial processes related to energy, environmental and a variety of product manufacturing processes. These systems in general and multiphase reactors in particular are complex, as they can take various configurations and types based on the way the phases are contacted and interact. Their design, scale-up, proper operation and performance prediction are challenging tasks due to the lack of understanding of these complex interactions. In addition the complexity increases with the presence of internals that affect the hydrodynamics, mixing, transport (mass and heat) and reactions and hence, the performance of these reactors.

Sophisticated techniques that integrate measurements of various hydrodynamic and transport parameters are required. Such instrumentation provide effective diagnostic means for indentifying and quantifying flow related issues in these systems, as well as fundamental insights into these systems. Some of these instrumentation and measurement techniques are employed in our laboratory to study various complex reactors and flow systems such as: I) techniques that are based on radioisotopes – radioactive particle tracking (RPT), dual source gamma ray tomography (DSCT), gamma ray densitometry (GRD) for 3D flow

field, velocity and turbulence parameters, phase distribution and flow pattern identification; and II) techniques that are not based on radioisotopes: four-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 liquid velocity distribution in packed beds, pressure transducers, and others. These techniques are augmented with sophisticated mathematical algorithms and programs that have been developed in our laboratory for data acquisition, processing and image reconstruction.

The utilization of these techniques is complemented by modeling and scale-up methodologies and CFD computations. In this presentation, an overview of our research activities and projects will outlined with some selected results and findings, with an idea to promote possible collaborations.

About the Speaker

Dr. Muthanna Al-Dahhan is Professor and Chairman of the Chemical & Biochemical Engineering Department, and Professor of Nuclear Engineering at Missouri University of Science and Technology (Missouri S&T), Rolla, Missouri since January 2009. 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 a BSc in Chemical Engineering from University of Baghdad – Iraq (1979), a Masters degree from Oregon State University (1988), and a Doctoral degree from Washington University in St. Louis (1993). He has directed during 1999-2008 a very successful industry-academia consortium on gas conversion to alternative clean fuels/chemicals using slurry bubble columns. He has supervised over 50 PhD students and a large number of post-doc fellows, research associates and undergraduate students on a wide range of topics. Prof. Al-Dahhan's research activities include more than 150 publications in peer reviewed journals (h-index: 25) and over 350 of national and international conference presentations. Prof. Al-Dahhan has chaired a number of international conferences, and has served as an expert and consultant to IAEA, UNESCO, and as advisor to companies and research organizations from around the world.