2008-2009

Graduate Seminar Series

The Department of Mechanical Engineering – Engineering Mechanics

Proudly Presents

Professor Paul Sojka

Purdue University

Paul E. Sojka received BS, MS and PhD degrees from MSU, after which he joined the ME faculty at Purdue. During his tenure there he has studied spray and related topics ranging from drop formation using multi-phase fluids (detergents, paints, and coal-water slurries) through rheologically complex single-phase fluids (bio-sprays including consumer products and pharmaceutical/medicinals), and on to Newtonian liquids (fuels). This research has shown the importance of efficient atomizing air utilization when forming small drops from rheologically complex fluids, the requirement of swirl to generate the two-dimensional disturbances that lead to axisymmetric sheet breakup, and the advantages of controlling ligament diameter when attempting to form sprays having narrow drop size distributions.

Dr. Sojka and his students have also developed diagnostic techniques for measuring mean drop sizes in media with time dependent indices of refraction, for determining spray patternation, for capturing 3-d spray structure (particularly the near-nozzle phenomena necessary to develop engineering guidelines for atomizer design), and for simultaneously measuring drop diameter and refractive index.

Dr. Sojka has been awarded over 40 spray related research grants and contracts during the past 26 years. Over 30 of those have been from industry. They have resulted in over 30 spray related graduate student theses with another 8 graduate students being supported at this time. Finally, more than 30 undergraduate students have performed independent study work on related topics. This work has resulted in over 120 archival journal and conference proceeding papers.

Prof. Sojka developed an Atomization and Sprays Short Course that has been presented to ten industries, and also developed and teaches a graduate course at Purdue entitled "Spray Applications and Theory."

Thursday, Feb. 12, 2009 3:00 – 4:00 p.m. Room 112, ME-EM Bldg.

Secondary Atomization: The aerodynamic breakup of drops

When a drop is subjected to a surrounding dispersed phase that is moving at an initial relative velocity, aerodynamic forces will cause the drop to deform and, in some cases, fragment. This process is referred to as secondary atomization.

There is abundant literature on uncharged drop secondary atomization: breakup modes and mechanisms, breakup times, plus fragment size and velocity distributions. These results are summarized. A consistent theory to explain the observed behavior is presented.

In contrast, there is a paucity of work describing charged drop secondary atomization. The information that is available is reviewed, using what is available for uncharged drops as a goal.

New results from work at Purdue are then presented. They include listing of charged drop breakup modes themselves and Weber numbers at the boundary between breakup modes. This is followed by the characteristic times for initiation of charged drop breakup, and for its completion. Data are compared and contrasted to uncharged results available in the literature.

The presentation closes with a list of fields for which the work is relevant, as well as a number of future topics to be considered.

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