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ILASS – Americas

The Institute for Liquid Atomization and Spray Systems

Newsletter #28 March 2006

Meetings

- ILASS-Americas 2006 will be held May 23 through May 26 in Toronto, Ontario. The conference will be held at the Delta Chelsea – conveniently located in downtown Toronto. This will be the 19th annual meeting and will cover all areas related to atomization. Participants from industry, academia and government will present recent work on the theory, modeling and measurements of sprays and droplets. The conference will include technical sessions, poster presentations, tutorial sessions, technical committee meetings and manufacturer's exhibits with the latest instrumentation. Abstracts for presentations are due April 3. Conference proceedings will be distributed on CD. The deadline for early registration and hotel reservations with special conference rates is April 17.

Toronto, Canada, is the site of the 2006 ILASS-Americas conference

Local arrangements are being handled by Nasser Ashgriz and the Program Chair is Shankar Subramaniam. Please see http://www.ilass.org/2006 for additional information.

- The 10th International Congress on Liquid Atomization and Spray Systems (ICLASS) will be held in Kyoto, Japan from August 27 through September 1, 2006. Final papers are due July 27. Stipends to cover travel costs for up to ten students will be provided by ILASS-Americas. Please visit http://comb.doshisha.ac.jp/iclass2006 for additional information.
- The 31st International Symposium on Combustion will be held August 6 through August 11, 2006 in Heidelberg, Germany. Scientists, engineers and others interested in combustion are invited to attend. Technical papers, poster sessions, lectures and reviews will be presented. For work-in-progress posters, abstracts are due April 14. See http://www.combustion2006.org for more information.

Recent Advances in Medical Applications of Sprays

Spray system technology is now critical in medical aerosol spray applications

Aerosol Medication: Insulin.

After ten years of clinical trials and research, inhalation of insulin has been proven to be an effective alternative to direct insulin bloodstream injection. Diabetics currently inject themselves with insulin periodically in a day, making the spray alternative an attractive one. One of the two aerosol therapies currently being developed, Exubera, has just been approved by the FDA. With the Exubera system, the insulin is

first spray dried to form solid particles. With the other spray methodology, plastic blisters (sacks) of insulin are punctured with needles

continued on page 2

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Edited by David P. Schmidt, University of Massachusetts Amherst

Produced by Rudi Schick, Spraying Systems Co.

Short Course

Atomization and Spray Technology Short Course
May 8 through May 10, 2006; Pittsburgh, PA

Engineers, scientists, atomization/spray technicians — join your colleagues worldwide in a four-day course exploring the most recent advances in spray technology taught by recognized experts in the fields of atomization and sprays.

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Recent Advances in Medical Applications of Sprays (continued)

and pressurized so that small diameter liquid jets are ejected. The liquid jets break up to generate uniform micro-sized droplets, which are blown by an air stream into a transparent cylindrical chamber. In both cases, the patient inhales the spray and receives the required dose when the cylindrical chamber is clear.

Extensive research at Carnegie Mellon University, in collaboration with the University of Pittsburgh Medical Center (UPMC), has examined the aerodynamics of micron-sized aerosol particles in human respiratory systems. Particles of size greater than 5 microns have sufficient momentum to impact on throat and/or respiratory surfaces, where they lodge or pass down into the stomach. In the stomach, proteins such as insulin are often destroyed by the acids of the digestive track. Particles of 0.5 microns or less (such as cigarette smoke), have high drag forces, which keep them airborne and result in exhalation, followed directly after inhalation.

Particles with diameters between 1 and 4 microns can penetrate through the respiratory tract and reach the lungs; they are then deposited on lung surfaces and the medication is passed directly to the bloodstream. In principle, any medication can be administered by inhalation, provided that the aerosol particles are between 2 and 4 microns in diameter.

Aerosol medication: cyclosporine.

At the Lung Transplant Center at UPMC, patients who have undergone lung transplants must be treated with the drug cyclosporine to lower the patient's immune system, which otherwise treats the transplanted lung as a foreign body and attacks it. Cyclosporine is normally administered orally and passes through the stomach to the bloodstream—with considerable reduction in intensity—before it reaches the lung surfaces. Administering cyclosporine by inhalation of droplets 1-4 microns in size provides topical deposition on lung surfaces, a more effective method for distributing the drug.

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Board Member Profile

Corinne Lengsfeld has been a member of ILASS since 1995 and was elected as a board member in 2005. She initially became a member to increase her professional network in the spray community and receive critical feedback on the research she was conducting in this area. Corinne began co-chairing the physics of atomization technical committee in 1997. The service activities have enhanced her professional career by offering opportunities to see and practice leadership skills. However, it is the students and industry people who come to ILASS to learn that drives her passion for service.

Corinne is Associate Professor of Mechanical Engineering at University of Denver and earned her PhD at University of California, Irvine. Her specialties include spray atomization, super critical fluid behavior, pharmaceutical processing and drug delivery. Corinne currently also holds a graduate faculty appointment in the Department of Pharmaceutical Sciences, University of Colorado Health Sciences Center.

Corinne Lengsfeld; Member-at-Large
clengsfe@du.edu

Research Brief

by Željko Tukovic´ and H. Jasak

Editor's note: Though this brief is not about droplets, per se, the potential here is noteworthy.

The behavior of drops and bubbles in two-phase fluid mixtures is significantly influenced by the presence of surfactant chemicals. As part of a Ph.D. study[1], the authors have developed a numerical procedure for simulation of surface tension-dominated interface flows with surfactant effects. The solution procedure is based on four components: a Finite Volume (FV) solver used to simulate the flow in two phases; an interface tracking procedure with mesh deformation and phase-coupled boundary conditions; a vertex-based automatic mesh motion solver and a Finite Area (FA) solver handling the transport of surfactants along the surface.

The FV solver incorporates the effects of a moving deforming mesh based on the given vertex motion and includes polyhedral cell support. The interface boundary coupling incorporates the kinematic and dynamic condition, with the normal stress jump due to surface tension and the tangential shear stress jump due to surface tension gradient. An automatic mesh motion solver[2] provides the vertex motion, where the boundary motion is specified by the solution-dependent deformation of the interface. The FA method is equivalent to a 2-D variant of the FV method on a polygonal mesh, additionally accounting for the effects of curvature and surface motion in 3-D. The numerical procedure is implemented in OpenFOAM[3], an open-source object-oriented C++ Computational Continuum Mechanics library.

A free-rising air bubble in water is chosen as a test case for the evaluation of the numerical procedure. At the start of the simulation, a spherical bubble 2 mm in diameter is uniformly covered with an insoluble surfactant. As the bubble rises, surfactants are convected from the front to the rear part of the bubble surface. The surface tension variation due to the non-uniform surfactant concentration causes additional tangential shear stress on the bubble surface, known as the Marangoni effect. Future work will be devoted to other two-phase flows, such as droplets treated with surfactants.

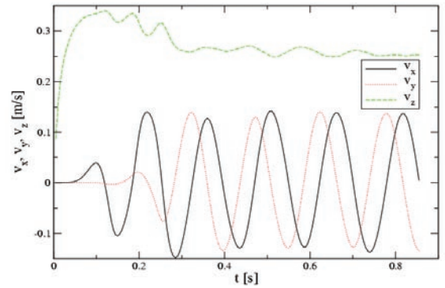
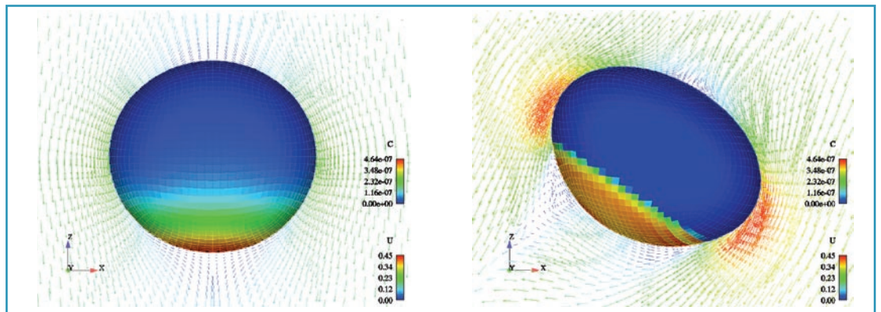


Figure 1

Figure 1 shows the time evolution of the bubble velocity, which evolves from linear to helicoidal, in agreement with the available experimental data. Velocity vectors around the bubble and the surfactant concentration on the surface are shown for two time instances in Figures 2a and 2b. When compared to the surfactant-free case, the rising velocity differs by about 30%, with a considerably different trajectory and bubble shape.



Figures 2a and 2b

To nominate a topic for future Research Briefs, email your ideas to the editor, David P. Schmidt at schmidt@ecs.umass.edu or call (413) 545-1393.

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Footnotes

[1] "Finite volume method on domains of varying shape", Ž. Tukovic´, Ph.D. thesis, Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, in Croatian (2005).

[2] "Automatic Mesh Motion for the Unstructured Finite Volume Method", H. Jasak and Ž. Tukovic´, under review, Computers & Fluids.

[3] "A tensorial approach to computational continuum mechanics using object orientated techniques", H.G. Weller, G. Tabor, H. Jasak, and C. Fureby, Computers in Physics, 1998, http://www.openfoam.org.

www.ilass.org March 2006