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GRANULAR AND MULTIPHASE FLOWS

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Professor Benjamin J. Glasser
Department of Chemical and Biochemical Engineering
Pharmaceutical Engineering Program
Rutgers University

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Segregation and Spatio-Temporal Dynamics of Granular Shear Flows

Granular flows are critical to a large number of industries including the chemical, agricultural, food products, pharmaceutical, ceramics, mineral processing, materials, munitions, aerospace and energy industries. In the pharmaceutical industry, an understanding of flow and segregation of powders is crucial for scale-up of production of pills, tablets and capsules. At the same time this is an industry that is increasingly relying on engineers as it seeks greater R&D productivity and places unprecedented demands on its manufacturing capabilities. In this talk we will discuss work we have done on developing an understanding of granular flows. We will present computational, theoretical, and experimental results on the response of grains to shear and body forces. In shear flows, we observe strong stress fluctuations with a measured stress that is scale dependent. These stress fluctuations can be related to an instability that leads to density waves that deform with the flow. We observe that the presence of the density waves means that shearing or stirring faster doesn't necessarily lead to better mixing. In fact, stirring faster can lead to separation of ingredients that were thoroughly mixed. Finally, we will go on to present our results for granular flow instabilities in more complex geometries and we will discuss the application of these results to improving the design and operation of pharmaceutical processes.

Benjamin Glasser received his BS (1989) and MS (1991) in Chemical Engineering from the University of the Witwatersrand, Johannesburg, South Africa. He obtained his PhD, also in Chemical Engineering, from Princeton University (1996). He then spent a year as a postdoctoral fellow at Cambridge Hydrodynamics Inc. In 1997 he joined the Department of Chemical and Biochemical Engineering at Rutgers University. His honors include the Merck Excellence Faculty Development Award and the Bristol-Myers Squibb Young Faculty Award. Prof. Glasser serves as the Director of the Catalyst Manufacturing Center and Associate Director of the Pharmaceutical Engineering Program at Rutgers. His research interests include flow and segregation of granular materials, the mechanics of fluidized beds, multiphase flows and reactors, nonlinear dynamics of transport processes.

For further information, please contact Dr. A. Rosato, ME Department (rosato@adm.njit.edu; 973-596-5829), or Ms. Barbara Valenti (Valenti@adm.njit.edu; 973-596-3332)