CENTER FOR FLUID MECHANICS AND
THE FLUIDS, THERMAL AND CHEMICAL PROCESSES GROUP
OF THE DIVISION OF ENGINEERING
SEMINAR SERIES

Complex flows of concentrated suspensions measured by NMRI

Professor Nina Shapley
Department of Chemical Engineering
Columbia University
New York, New York

Our research focuses on the behavior of dispersed particles in complex geometry and time-dependent flows. These flows are often encountered in such applications as materials processing or flow in the circulatory system. A well-known challenge in materials processing is that particles often end up nonuniformly distributed in space, while the quality of the product usually requires spatial uniformity. One relevant system involving a complex geometry is the flow of a concentrated suspension into an abrupt expansion. An example of a time-dependent flow is pressure-driven oscillatory flow of a concentrated suspension in a tube. Fundamental understanding of such systems is limited, mainly due to the small amount of available experimental data and modeling calculations.

In our study, suspensions of neutrally buoyant, noncolloidal spheres in Newtonian liquids undergo steady, pressure-driven flow in abrupt, axisymmetric 1:2 and 1:4 expansions, or oscillatory, pressure-driven flow in a straight tube. Particle concentration and velocity profiles are obtained by nuclear magnetic resonance imaging (NMRI). We aim to determine the particle properties and flow conditions (e.g. particle volume fraction, particle and flow Reynolds number, particle-tube radius ratio, expansion ratio) that lead to the observed concentration and flow fields. Recent results from oscillatory and expansion flow experiments will be presented, in addition to some recent efforts to scale down the systems into the microfluidic regime.

Tuesday, March 8, 2005
Barus & Holley, Room 190
4:00 pm