Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

A Well-Posed, Objective and Dynamic Two-Fluid Model. KRISHNA CHETTY, Purdue University, West Lafayette, IN, USA, AVINASH VAIDHEESWARAN, National Energy Technology Laboratory, Morgantown, WV, USA, SUBASH SHARMA, Purdue University, West Lafayette, IN, USA, ALEJANDRO CLAUSSE, CNEA-CONICET and Universidad Nacional del Centro, Tandil, Argentina, MARTIN LOPEZ DE BERTODANO, Purdue University, West Lafayette, IN, USA — The transition from dispersed to clustered bubbly flows due to wake entrainment is analyzed with a well-posed and objective one-dimensional (1-D) Two-Fluid Model, derived from variational principles. Modeling the wake entrainment force using the variational technique requires formulation of the inertial coupling coefficient, which defines the kinetic coupling between the phases. The kinetic coupling between a pair of bubbles and the liquid is obtained from potential flow over two-spheres and the results are validated by comparing the virtual mass coefficients with existing literature. The two-body interaction kinetic coupling is then extended to a lumped parameter model for viscous flow over two cylindrical bubbles, to get the Two-Fluid Model for wake entrainment. Linear stability analyses comprising the characteristics and the dispersion relation and non-linear numerical simulations are performed with the 1-D variational Two-Fluid Model to demonstrate the wake entrainment instability leading to clustering of bubbles. Finally, the wavelengths, amplitudes and propagation velocities of the void waves from non-linear simulations are compared with the experimental data.

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Date submitted: 13 Nov 2016 Electronic form version 1.4