Abstract Submitted
for the DFD07 Meeting of
The American Physical Society

Buoyancy-Driven Motion of a Gas Bubble with Soluble Surfactants[1] METIN MURADOGLU, Koc University — Computations are performed to study the effects of soluble surfactants on the motion of a fully deformable gas bubble using a finite-difference/front-tracking method. The evolution equations of the interfacial and bulk surfactant concentrations are solved fully coupled with the incompressible Navier-Stokes equations using a non-linear equation of state that relates interfacial surface tension to surfactant concentration at the interface. The method is first validated for simple test cases and the computational results are found to be in a good agreement with the analytical solutions. It is then applied to study the effects of soluble surfactants on the motion of a buoyancy-driven bubble in a circular tube. It is shown that the terminal velocity of bubble reduces significantly as surfactant accumulates at the bubble interface and the terminal velocity of a contaminated bubble approaches to that of a solid sphere in the limit of creeping flow regime. In this regime, the results are found to be in a good agreement with available experimental data. The effects of governing nondimensional numbers such as Peclet numbers based on the interfacial and bulk surfactant diffusivities, elasticity, Damkohler, E*ö*tv*ö*s and Morton numbers are also investigated.

[1]Supported by the Scientific and Technical Research Council of Turkey (TUBITAK) (105M043)

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Date submitted: 03 Aug 2007 Electronic form version 1.4