Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Bulk flow coupled to a viscous interfacial film sheared by a rotating knife edge[1] ADITYA RAGHUNANDAN, FAYAZ RASHEED, AMIR HIRSA, Rensselaer Polytechnic Institute, JUAN LOPEZ, Arizona State University — The measurement of the interfacial properties of highly viscous biofilms, such as DPPC (the primary component of lung surfactant), present on the surface of liquids (bulk phase) continues to attract significant attention. Most measurement techniques rely on shearing the interfacial film and quantifying its viscous response in terms of a surface (excess) viscosity at the air-liquid interface. The knife edge viscometer offers a significant advantage over other approaches used to study highly viscous films as the film is directly sheared by a rotating knife edge in direct contact with the film. However, accurately quantifying the viscous response is non-trivial and involves accounting for the coupled interfacial and bulk phase flows. Here, we examine the nature of the viscous response of water insoluble DPPC films sheared in a knife edge viscometer over a range of surface packing, and its influence on the strength of the coupled bulk flow. Experimental results, obtained via Particle Image Velocimetry in the bulk and at the surface (via Brewster Angle Microscopy), are compared with numerical flow predictions to quantify the coupling across hydrodynamic flow regimes, from the Stokes flow limit to regimes where flow inertia is significant.

[1]Supported by NNX13AQ22G, National Aeronautics and Space Administration

Aditya Raghunandan
Rensselaer Polytechnic Institute

Date submitted: 31 Jul 2015 Electronic form version 1.4