Abstract Submitted
for the DFD09 Meeting of
The American Physical Society

Steady propagation of Bingham plugs in 2D channels PARSA ZAMANKHAN, SHUICHI TAKAYAMA, JAMES GROTBERG, University of Michigan - Department of Biomedical-Engineering — The displacement of the yield-stress liquid plugs in channels and tubes occur in many biological systems and industrial processes. Among them is the propagation of mucus plugs in the respiratory tracts as may occur in asthma, cystic fibrosis, or emphysema. In this work the steady propagation of mucus plugs in a 2D channel is studied numerically, assuming that the mucus is a pure Bingham fluid. The governing equations are solved by a mixed-discontinuous finite element formulation and the free surface is resolved with the method of spines. The constitutive equation for a pure Bingham fluid is modeled by a regularization method. Fluid inertia is neglected, so the controlling parameters in a steady displacement are; the capillary number, Ca, Bingham number ,Bn, and the plug length. According to the numerical results, the yield stress behavior of the plug modifies the plug shape, the pattern of the streamlines and the distribution of stresses in the plug domain and along the walls in a significant way. The distribution along the walls is a major factor in studying cell injuries. This work is supported through the grant NIH HL84370.

Parsa Zamankhan
University of Michigan - Department of Biomedical-Engineering

Date submitted: 10 Aug 2009 Electronic form version 1.4