Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Viscous-elastic dynamics of power-law fluids within an elastic cylinder AMIR GAT, EVGENIY BOYKO, MORAN BERCOVICI, Technion - Israel Institute of Technology — We study the fluid-structure interaction dynamics of non-Newtonian flow through a slender linearly elastic cylinder at the creeping flow regime. Specifically, considering power-law fluids and applying the thin shell approximation for the elastic cylinder, we obtain a non-homogeneous p-Laplacian equation governing the viscous-elastic dynamics. We obtain exact solutions for the pressure and deformation fields for various initial and boundary conditions, for both shear thinning and shear thickening fluids. In particular, impulse or a step in inlet pressure yield self-similar solutions, which exhibit a compactly supported propagation front solely for shear thinning fluids. Applying asymptotic expansions, we provide approximations for weakly non-Newtonian behavior showing good agreement with the exact solutions sufficiently far from the front.

Amir Gat
Technion - Israel Institute of Technology

Date submitted: 27 Jul 2016 Electronic form version 1.4