Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

On the Link Between Kolmogorov Microscales and Friction in Wall-Bounded Flow of Viscoplastic Fluids FABIO RAMOS, Department of Applied Mathematics, Federal University of Rio de Janeiro, HAMID ANBARLOOEI, DANIEL CRUZ, ATILA SILVA FREIRE, CECILIA M. SANTOS, Department of Mechanical Engineering, Federal University of Rio de Janeiro — Most discussions in literature on the friction coefficient of turbulent flows of fluids with complex rheology are empirical. As a rule, theoretical frameworks are not available even for some relatively simple constitutive models. In this work, we present a new family of formulas for the evaluation of the friction coefficient of turbulent flows of a large family of viscoplastic fluids. The developments combine an unified analysis for the description of the Kolmogorov's micro-scales and the phenomenological turbulence model of Gioia and Chakraborty (Phys. Rev. Lett. 96 044502 2006). The resulting Blasius-type friction equation has only Blasius' constant as a parameter, and tests against experimental data show excellent agreement over a significant range of Hedstrom and Reynolds numbers. The limits of the proposed model are also discussed. We also comment on the role of the new formula as a possible benchmark test for the convergence of DNS simulations of viscoplastic flows. The friction formula also provides limits for the Maximum Drag Reduction (MDR) for viscoplastic flows, which resembles MDR asymptote for viscoelastic flows.

FABIO RAMOS
Univ Fed Rio de Janeiro

Date submitted: 18 Jul 2017 Electronic form version 1.4