Abstract Submitted
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Nonlinear wave evolution in pressure-driven stratified flow of Newtonian and Herschel-Bulkley fluids[1] PRASHANT VALLURI, KIRTI SAHU, HANG DING, PETER SPELT, OMAR MATAR, Imperial College London, CHRIS LAWRENCE, Institutt for Energiteknikk — Pressure-driven stratified channel flow of a Newtonian fluid flowing over a Herschel-Bulkley (HB) fluid is considered. The effects of yield stress and shear-thinning rheology on the nonlinear wave evolution are studied using numerical simulations; the HB rheology is regularized at low shear rates using a bi-viscosity formulation. Two different numerical methods were used to carry out the computations: a level-set method (based on that by Spelt, J. Comput. Phys. 2005) and a diffuse-interface method (based on that by Ding et al., J. Comput. Phys., in press). The simulations, which account for fluid inertia, surface tension and gravity are validated against linear theory predictions at early times. The results at later times show the spatio-temporal evolution into the nonlinear regime wherein waves are strongly deformed, leading to the onset of drop entrainment. It is shown that the apparent viscosity in the region of the HB fluid directly involved in the onset of entrainment is almost constant; unyielded regions are confined to wave troughs at late stages of the nonlinear evolution.

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Omar Matar
Imperial College London

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