Transient buoyancy-driven flows of viscoplastic fluids: A critical review of the theory & experimental observations

Ida Karimfazli

Department of Mechanical, Industrial & Aerospace Engineering,
Concordia University, Montreal, QC, Canada

ida.karimfazli@concordia.ca

Yield stress fluids (YSF) resist flowing despite the presence of finite shear stresses. These materials flow only when the applied shear surpasses the yield stress. This duality of material behaviour complicates various natural and industrial processes where YSF are present, in mud pools, sewage processing and cementing alike. Investigating the evolution of motion in YSF is indispensable to understanding such processes.

Earlier studies, numerical or experimental, primarily focus on steady flows or on development of 1D flows. Unsteady flows, however, are often more pertinent to practical applications: because of the high effective viscosity of these fluids, flow development can be quite slow and a steady state may not be reached in realistic timescales; the final steady state may also be sensitive to the initial condition, an effect completely ignored in steady-state analysis. I will review the experimental and theoretical studies of the transient buoyancy-driven flows of yield stress fluids in pursuit of a unifying perspective. New experimental evidence will be presented to complement the proposed interpretations. A brief investigation of numerical tools will aim to assess the appropriateness of different schemes in computational studies of unsteady flows.