# VISCOSITY FUNCTION OF MATERIALS CHARACTERIZED BY STEADY NON-MONOTONOUS FLOW CURVE (DEDICATED TO THE MEMORY OF ACADEMICIAN G. V. VINOGRADOV)

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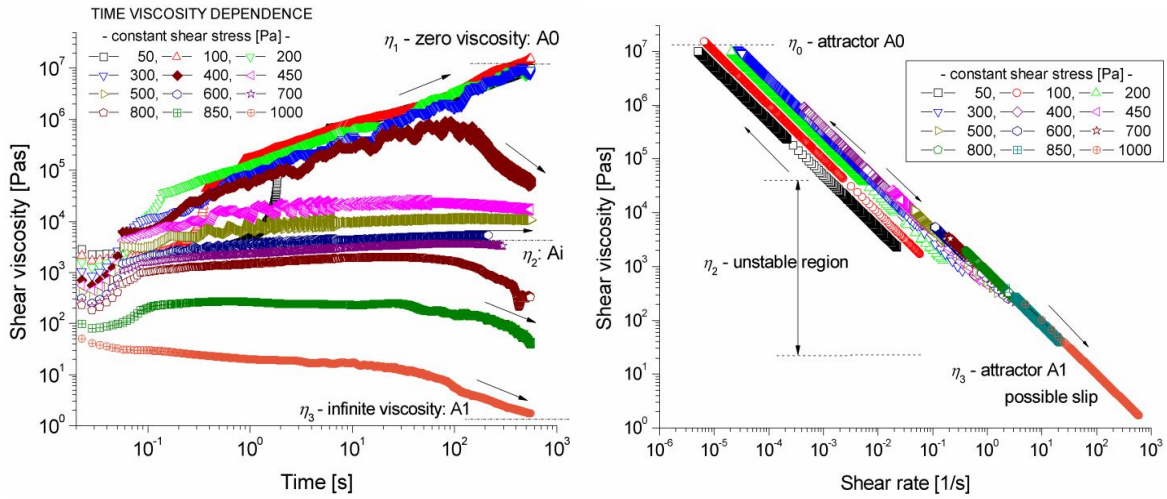
The non-monotonous of the steady flow curve is a possible explanation for spurious phenomena (wall deplation, apparent yield stress, stick-slip flow and shear banding) which are observed in the shear rheological tests of complex fluids with unstable internal network structure. In this paper, lubricating greases, polyxiloxane based cream and solder pastes are experimentally investigated to detect possible existence of instability region in the flow curve. The experiments are based on simple shear and dynamic tests performed both in the linear and non-linear flow regimes, strain and stress controlled modes. In particular, the LAOS procedure is applied in order to measure the value of shear stress corresponding to the jump between the stable branches of the flow curve. The results evidenced the time dependence of viscosity function and the existence of stable and unstable attractors associated with steady viscosity values, see the attached figures. All tested samples disclose a behaviour similar to the models characterized by two steady stable viscosities, separated by a region where that viscosities are coexisting, in the limit of infinite experimental time.

The experiments are accomplished by numerical simulations of generalized Newtonian models with non-monotonic flow curve, for both simple shear and oscillatory tested flows. The correlation between experiments and simulations indicate that material instability (i.e. monotonous steady flow curve) is always related with the onset of banding flow structure in the vicinity of the moving plate. The numerical results (obtained in an axial-symmetric plate and plate configuration) are qualitatively consistent with experiments and prove that shear bands location within the gap are determined (for given material parameters) by the dynamics of the flow, respectively the values of initial/boundary conditions.




Time dependence of viscosity function and viscosity function vs. shear rate for a lubricated grease based on lithium soup. The experiments are performed in creep tests and evidence the presence of two stable attractors (A0-zero shear viscosity and A1-infinite viscosity) and an unstable region, where the viscosity values are not reached in the limit of infinite experimental time.