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Wavy regime of a viscoplastic film flow[1] SYMPHONY CHAKRABORTY, CHRISTIAN RUYER-QUIL, Université Pierre et Marie Curie, FAST, Campus Universitaire, 91405 Orsay, France, BHABANI S. DANDAPAT, Sikkim Manipal Institute of Technology, Majitar, Rangpo, 737 132, East Sikkim, India — We consider a power-law fluid flowing down an inclined plane under the action of gravity. The divergence of the viscosity of a shear-thinning fluid at zero strain rate is taken care of by introducing a Newtonian plateau at small strain rate. Applying a weighted residual approach, a two-equations model is formulated in terms of two coupled evolution equations for the film thickness h and the local flow rate q within the framework of lubrication theory. The model accounts for the streamwise diffusion of momentum. Consistency of the model is achieved up to first order in the film parameter for inertia terms and up to second order for viscous terms. Comparison to Orr-Sommerfeld stability analysis and to DNS show convincing agreement in both linear and nonlinear regimes. In the case of shear-thinning fluids, lowering the power index has a non-trivial effect on the primary instability of the film: the threshold of the instability occurs at a smaller Reynolds number but the range of instable wavenumber is also reduced. In the nonlinear regime, we have evidenced a subcritical bifurcation of the traveling-wave solutions from marginal stability conditions.

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