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Flow and stability of a viscoelastic liquid curtain ANTOINE GAILLARD, LUC LEBON, MATTHIEU ROCHE, CYPRIEN GAY, SANDRA LEROUGE, LAURENT LIMAT, Laboratoire MSC, Matiere et Systemes Complexes, CNRS UMR 7057, Univ Paris Diderot, Paris, France — We experimentally investigate the flow of a sheet of viscoelastic liquid falling freely from a thin slit under gravity. We observe new phenomena that are not described by the Newtonian curtain theory derived by Brown and Taylor. For low-viscosity elastic fluids, the mean falling velocity does not reduce to a free fall, even far downstream from the slit: we observe a shift towards sub-gravity accelerations. This corresponds to a dramatic increase of the length of the transient regime where gravity is balanced by internal stress instead of inertia. The flow in the curtain is stable for dilute and semi-dilute aqueous solutions of polyethylene oxide (PEO), a flexible polymer, but it becomes time dependent and horizontally modulated for aqueous solutions of partially hydrolyzed polyacrylamide (HPAM), a semi-rigid polyelectrolyte. In the latter case, the curtain becomes varicose. This extrusion instability results from the existence of large vortices at the entrance of the slit, where the liquid undergoes a strong planar contraction, which creates over-fed and under-fed regions. Finally, we show that the varicose curtain is prone to hole opening in its thinner parts and may cease to exist.

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