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The role of surface viscosities in the instability of liquid threads[1]
ALEJANDRO MARTINEZ-CALVO, ALEJANDRO SEVILLA, Universidad Carlos III de Madrid — We analyse the effect of surface viscosities on the capillary instability of a free liquid thread in inviscid surroundings coated with insoluble surfactant, extending the results of Timmermans & Lister (2002). To that end, we use the Boussinesq-Scriven constitutive equation, deriving the correct expressions for the normal and tangential stress boundary conditions at a general axisymmetric interface in cylindrical coordinates. These stress conditions are applied to obtain a new dispersion relation for the liquid thread, which is solved to describe its temporal stability as a function of four governing parameters, namely the capillary Reynolds number, the elasticity parameter, and the shear and dilational Boussinesq numbers. It is shown that surface viscosities have a stabilising influence for all values of the Reynolds number and elasticity parameter, the effect being more pronounced at low Reynolds numbers. It is also worth mentioning that, given a certain ratio of surface viscosities, the wave number associated with the maximum growth rate of perturbations has a non-monotonous behaviour with respect to the surface shear viscosity.

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