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Title: *Motion of rigid and deformable particles in complex fluids*

Abstract

We will present our very recent results on two long-standing problems: The first one is related to the abrupt increase in the rise velocity of an isolated bubble in a semi-dilute polymer solution occurring at a critical value of its volume. This “velocity discontinuity” has been somehow associated with the change of the shape of the bubble to an inverted teardrop with a tip at its pole and/or the formation of the “negative wake” structure behind it. So far, the interconnection of these phenomena with the “velocity jump” is unclear. By means of steady-state analysis, the aid of pseudo arc-length continuation and advanced numerical techniques we are able to attribute it to a hysteresis loop. The sharply deformed bubble shapes are caused by the large extensional stresses at the rear pole of the bubble. This shape favors the formation of a negative wake downstream and an intense shear layer and decrease of shear viscosity ahead of the bubble, which facilitate its translation at a critical volume. Our predictions are in quantitative agreement with published experimental results.

For several decades, Carbopol has been assumed to be the ideal viscoplastic material, exhibiting only yield phenomena without viscoelastic effects in yielded regions. Recently, it has been shown that (a) when stresses do not overcome the yield criterion, it behaves as an ideal Hookean solid and (b) a falling particle reveals phenomena, which can be attributed only to elastic properties of the fluidized region. Using the constitutive model for elasto-visco-plastic fluids proposed by Saramito (2007) and extracting material properties from data by Holenberg et al. (2012) via the LAOS method of Ewoldt et al. (2010), we predict recent experimental results. This confirms that Carbopol cannot be considered, as the ideal plastic material anymore. Moreover, when elasticity comes into play, the derived stoppage criterion for a sedimenting particle must be adjusted, because a complex stress field is developed around the particle and yielding near the rigid surface is favored. In a similar way, elastic effects in carbopol lead to the formation of bubble with a cusp, as seen in experiments, something that could not be predicted so far.