Stretching and compression instabilities of viscoplastic fluid filaments

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Abstract :

Stretching of fluid filaments to form either drops or broken threads as well as compression to induce bending and/or coiling instabilities (figure 1) are sensitive to filaments geometry, rheology, inertia and surface tension. In this study, we explore experimentally these various instabilities for viscoplastic model fluids and propose a theoretical analysis of the onset and development of each of them. We will show that plastic dissipation can significantly change the breakup profile (figure 2) of stretched filaments as well as the final helical shape of compressed ones. Additional direct numerical simulations of stretched and compressed Bingham and HerschelBulckley viscoplastic fluids provide a deeper understanding on the non-linear dynamics of the instabilities.

Mots clefs : filament deformation, breakup; bending and coiling; Newtonian and yield stress filament simulations; surface tension

Figure 1 - Experimental bending (top) and coiling (bottom) of a compressed silicone oil sample (right) and corresponding numerical simulation (left).

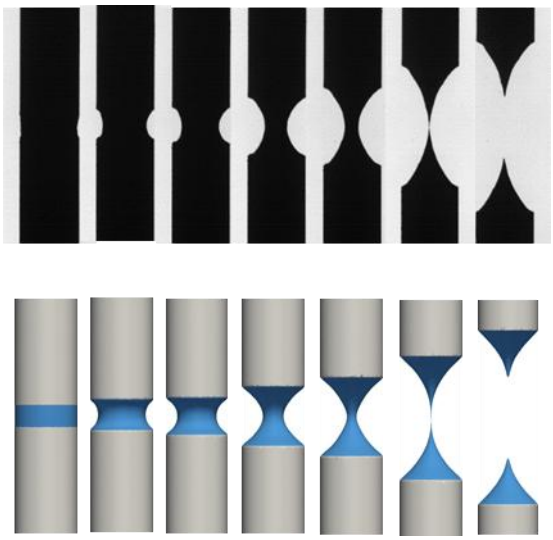

Figure 2 - Experimental stretching of a Nivea cream sample (top) and corresponding viscoplastic numerical simulation (bottom) [1]

Références

[1] R. Valette , E. Hachem, M. Khalloufi, A.S. Pereira, M.R. Mackley, S.A. Butler, The effect of viscosity, yield stress, and surface tension on the deformation and breakup profiles of fluid filaments stretched at very high velocities, Journal of Non-Newtonian Fluid Mechanics, 263 (2019) 130-139