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Numerical study of inertial effects on the rheology of filament suspensions.[1] ARASH ALIZAD BANAEI, MARCO EDOARDO ROSTI, LUCA BRANDT, KTH Mechanics, Stockholm, Sweden — Significant work has been devoted to modeling fiber suspensions as they occur in many applications such as paper and food industries. Most of the works are limited to the motion of rigid cylindrical rods in low Stokes flows. Here, we investigate the rheological properties of flexible filament suspensions by means of numerical simulations. We considered the filaments as one-dimensional inextensible slender bodies obeying the Euler-Bernoulli equations and study the effect of flexibility, flow inertia and volume fraction on the rheology of the suspensions. The numerical simulations are performed using the Immersed Boundary Method to model the fluid/structure interaction. The results indicate that the inertia has significant effect on the relative viscosity of the suspensions. The effect is larger for less deformable filaments. The filament suspensions exhibit viscoelastic behavior and the first normal stress has a maximum for moderate flexibilities. The relative viscosity increases with volume fraction of the filaments and it is more sensitive to the volume fraction for larger Reynolds numbers. For a constant flexibility, the mean end-to-end distance of the filaments decreases with Reynolds number and the mean velocity fluctuations of the fluid increases with the Reynolds number.

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