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Taylor-Couette flow of shear-thinning and viscoelastic polymer solutions[1] NEIL CAGNEY, School of Engineering and Materials Science, Queen Mary University of London, Mile End Road, London, E1 4NS, UK, TOM LACASSAGNE, STAVROULA BALABANI, Department of Mechanical Engineering, University College London, Torrington Place, London, WC1E 6BT, UK — We study Taylor-Couette (TC) flow of a glycerol-water mixture containing xanthan gum (0 to 2000 ppm concentration). Both shear-thinning and viscoelasticity are induced, to assess the effect of the changes in rheology on various flow instabilities. The Reynolds number is slowly increased, and the flow is monitored continuously using flow visualisation [Cagney and Balanbani, Phys. Fluids, 2019]. Shear-thinning is found to suppress many phenomena observed in previous studies of viscoelastic TC flow (e.g. diwhirls, disordered oscillations [Groisman and Steinberg, Phys. Rev, 1997]). The addition of polymers reduces the critical Reynolds number for the formation of Taylor vortices, but delays the onset of wavy flow. In the viscoelastic regime, the flow becomes unsteady soon after the formation of Taylor vortices, waviness changing with Reynolds number. Vortices are found to merge as Reynolds number increases, with the number of mergers increasing with polymer concentration. These changes in wavelength are hysteretic and occur in both steady and wavy regimes. Vortices in moderate and dense polymer solutions undergo a gradual drift in both their size and position, which appears to be closely linked to the splitting and merger of vortices.

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