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Direct numerical simulation of particle alignment in viscoelastic fluids MARTIEN HULSEN, NICK JAENSSON, PATRICK ANDERSON, Department of Mechanical Engineering, Eindhoven University of Technology, Eindhoven, The Netherlands — Rigid particles suspended in viscoelastic fluids under shear can align in string-like structures in flow direction. To unravel this phenomenon, we present 3D direct numerical simulations of the alignment of two and three rigid, non-Brownian particles in a shear flow of a viscoelastic fluid. The equations are solved on moving, boundary-fitted meshes, which are locally refined to accurately describe the polymer stresses around and in between the particles. A small minimal gap size between the particles is introduced. The Giesekus model is used and the effect of the Weissenberg number, shear thinning and solvent viscosity is investigated. Alignment of two and three particles is observed. Morphology plots have been created for various combinations of fluid parameters. Alignment is mainly governed by the value of the elasticity parameter S, defined as half of the ratio between the first normal stress difference and shear stress of the suspending fluid. Alignment appears to occur above a critical value of S, which decreases with increasing shear thinning. This result, together with simulations of a shear-thinning Carreau fluid, leads us to the conclusion that normal stress differences are essential for particle alignment to occur, but it is also strongly promoted by shear thinning.

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