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Particle resolved simulations of a sphere settling in simple shear flows of yield-stress fluids[1] MOHAMMAD SARABIAN, Ohio university, MARCO E. ROSTI, LUCA BRANDT, KTH Mechanics, SARAH HORMOZI, Ohio university — We perform 3D numerical simulations to investigate the sedimentation of a single sphere in the absence and presence of a simple cross shear flow in a yield-stress fluid. In our simulations the settling flow is considered to be the primary flow, whereas the linear cross shear flow is a secondary flow. To study the effects of elasticity and plasticity of the carrying fluid on the sphere drag as well as the flow dynamics, the fluid is modeled using the elastoviscoplastic (EVP) constitutive laws proposed by Saramito. We find that the drag on the sphere settling in the absence or the presence of cross shear flow is an increasing function of material plasticity at constant elasticity, while it is a decreasing function of material elasticity at constant plasticity. Furthermore, the drag on a sphere settling in a sheared yield-stress fluid is reduced significantly as compared to an otherwise quiescent fluid. More importantly, the sphere drag in the presence of a secondary cross shear flow cannot be derived from the pure sedimentation drag law owing to the non-linear coupling of simple shear flow and the uniform flow. The total drag is decomposed into its components and we find that the form drag is the primary cause of drag enhancement by material plasticity in EVP fluid.

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Mohammad Sarabian
Ohio university

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