

## Frictional effects in the flow of concentrated suspensions

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Concentrated suspensions are ubiquitous in applications, and these suspensions can flow in a way that is unusual in the context of classical fluid mechanics. In particular, suspensions of smooth non-colloidal spheres in a Newtonian suspending fluid will exhibit shear thickening (i.e., a viscosity that increases with shear rate), and in some cases discontinuous shear thickening, in which the viscosity jumps discontinuously at a critical shear rate or stress, followed by shear jamming. We describe here how particle-particle friction, which is excluded in classical fluid mechanics analyses, plays a central role in the flow behavior, with shear thickening the result of a transition between mostly lubricated contacts to predominantly frictional contacts as the stress increases. The full shear rheology for a given concentration can be described by two parameters: a characteristic interparticle repulsive force and a friction coefficient. The precise nature of the frictional interactions, as well as other surface force and particle size effects, remain open subjects.