Abstract Submitted
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Expansion flows in suspensions MANUJ SWAROOP, JOHN BRADY, Caltech — Suspension flows can lead to variations in particle volume fraction, thus making the particle phase compressible on a macroscopic scale. The stress in such a flow is characterized by an effective bulk viscosity (κ_{eff}) in addition to the effective shear viscosity of the suspension. The bulk viscosity of a suspension of particles relates the deviation of the trace of the macroscopic or averaged stress from its equilibrium value to the average rate of expansion. The equilibrium stress is the sum of the fluid pressure and the osmotic pressure of the suspended particles. Variations in particle volume fraction are modeled by having a compressible fluid expand uniformly at a constant rate, causing the particles suspended in it to move apart. The rigid particles cannot expand, and create a disturbance flow that contributes to the total mechanical pressure in the system, thereby changing the effective bulk viscosity. Explicit formulae have been derived to compute the bulk viscosity for all volume fractions of suspended rigid particles and for all expansion rates. The hydrodynamic forces between particles including the strong lubrication interactions near contact play an important role at high concentrations. The bulk viscosity of concentrated suspensions with full hydrodynamic interactions is determined via direct simulation by adapting the Stokesian Dynamics paradigm to allow for a uniform rate of expansion.

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