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Effective Viscosity of an Inhomogeneous Dilute Suspension Flowing Along a Wall

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The classical result of Einstein for the effective viscosity of a dilute suspension of solid spheres in an arbitrary infinite Stokes flow is extended to account for the effect of a nearby wall. It is found theoretically that the presence of a wall amounts to a slip velocity for the suspension on a macroscopic scale. This slip velocity is obtained in term of the stresslet on a sphere, which is calculated analytically with the method of bipolar coordinates. Because of walls, the effective viscosity is reduced in a homogeneous suspension, in qualitative agreement with experiments. For a bounded suspension, the expression for the viscosity depends on the flow field, even in the first order in volume fraction. Moreover, the sensitivity of the effective viscosity to the inhomogeneity of the suspension is higher for a Poiseuille flow than for a shear flow.

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