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Transient and steady sedimentation of flocculating non-Brownian suspensions ALEXANDER ZINCHENKO, University of Colorado at Boulder — Evolution to the steady state is rigorously simulated for a monodisperse non-Brownian suspension of spheres (initially unaggregated and well-mixed) with short-range van der Waals attraction and electrostatic repulsion in the realistic range of colloidal parameters. Flocculation is mostly affected by the maximum net attractive force near the secondary minimum relative to the effective gravity force. An economical high-order multipole algorithm, combined with geometry perturbation (Zinchenko A.Z. Phil. Trans. R. Soc. Lond. A(1998), v.356, 2953) to include lubrication, fully resolves hydrodynamic interactions in simulations with up to 1000 spheres in a periodic box and millions of time steps. Averaging over many initial configurations is used to predict the transient sedimentation rate U(t) for suspension volume fractions c=0.1-0.4 in a wide time range. The results are convergent and system-size independent. For particles of 10-15 micron size, flocculation is ubiquitous and has a large effect, allowing U(t) to grow several-fold or more before it reaches the statistical steady state, as the balance is achieved between the formation and breakage of aggregates. In contrast to the precise many-body solution, the far-field Rotne-Prager approximation predicts much faster growth of U(t).

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