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On Evaluation of Influence of Sedimentation on Colloidal Aggregation

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Abstract

A great deal of effort has been devoted to the influence of gravitational fields on the coagulation process. The Peclet number is commonly used for estimating the importance of the sedimentation influence on the aggregation in comparison to diffusion. González *et al.*^{1,2} chose a particle diameter as the characteristic length in their Peclet number evaluation and derived $Pe = m_0(1-\rho/\rho_0)ga_0/K_B T$, where m_0 is mass of the particle, T is room temperature and K_B is Boltzmann constant. They found that Pe is of the order of unity if the particles are $1\ \mu\text{m}$ in diameter, $(1-\rho/\rho_0)$ is less than but of the order of unity, see^{1,2}. And then they concluded that “ $1\ \mu\text{m}$ marks the transition between diffusive and drifting for individual particles”. However, we testify that when dealing with the influence of sedimentation on coagulation, taking particle diameter as the characteristic length may be problematic. Our Brownian dynamics simulation shows that the degree of sedimentation influence on the coagulation decreases when the dispersion volume fraction increases. Therefore using a fixed length, such as the diameter of particle, as the characteristic length scale for Peclet number evaluation is not a good choice when dealing with the influence of sedimentation on coagulation. Our simulations demonstrated that several factors in the coagulation process, such as dispersion volume fraction and size distribution, should be taken into account for more reasonable evaluation of the sedimentation influence.