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Investigation of the Physics of Flocculation in Algal Systems[1]
FLINT PIERCE, JEREMY LECHMAN, JOHN HEWSON, Sandia National Laboratories — Algae biofuel production has gained a great deal of interest in recent years due to the high photosynthetic efficiency of various algae strains and the ability of stressed algae populations to produce large quantities of lipids within their cells. Separation of the algae from the background aqueous medium engenders large energetic costs for standard separation techniques including filtration, centrifugation, and dissolved air flotation since algae cells are small (microns to 10s of microns), have densities similar to the surrounding fluid, and normally occur at low volume fractions (1E-4 -> 1E-3). Flocculation is one possible route to reducing the cost of collecting the algae biomass, since large algae flocs can easily be removed from the aqueous environment through either differential settling or standard filtration. To this end, We model flocculating systems of algae cells using discrete particle dynamics techniques which incorporate a recently developed adhesive granular potential to govern the cell interactions. This potential is shown to reproduce morphological characteristics, kinetics, and size distributions that agree well with known results for flocculation in the diffusive regime (DLCA). We further investigate flocculation under steady shear and compare our results to both experiment and predictions from various orthokinetic models.

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