NS.SCI.27

A STUDY OF THE DYNAMICS OF A SETTLING COLLOID

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Settling in particle suspensions formulate an important academic and industrial problem. In oil and gas, mineral processing, and effluent treatment plants, settling is the most desired. But in a host of other applications, especially those involving tiny particles, the challenge is to prevent settling. In either case, the knowledge of settling dynamics is imperative. Due to the complex dynamics of settling colloids, which is governed by the particle and fluid properties and geometries, the accurate prediction of settling rates has become very challenging. Besides, there exists no universal theory to tackle these scenarios. The popular Stokes settling theory is prescribed only for single-particle unhindered colloidal systems. Therefore it does not seem to fit densely-populated industrial colloids. In an attempt to fill the gap in knowledge, we recently conducted a systematic study on settling of polydisperse Al_2O_3-water colloids. We employed a combination of conventional setting-bed experiments, scanning electron microscopy (SEM) and MATLAB image analysis to examine the applicability of Stokes settling theory to predict the settling rates.

For materials, we used Al_2O_3 nanoparticles in the form of dry powder. The particles were spherical in shape and polydisperse in nature. By mixing them with distilled water followed by ultrasonic stirring, we obtained stable 0.5wt% Al_2O_3-water suspensions. Then we constructed a titration curve and discovered that the IEP (iso-electric point) occurred at pH=9.8. We prepared a series of samples at pH=7.8 and measured the settling bed height with time. At each instance where the bed height was taken, a droplet from the sample was extracted and saved for SEM imaging. A MATLAB code was developed simultaneously to measure the sizes and the count of particles on these images. Finally the particle sizes computed from Stokes equation and settling rates were compared with MATLAB measurements.

In conclusion we show that the Stokes settling theory can fairly accurately predict the settling rates of the studied colloid.