

Mode of settling of solid particle in viscous fluid: experiments using low-cost commodity

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We used low cost commodity to observe mode of sinking of solid particle in viscous fluid to investigate the parameters that control Stokes sinking of individual particle versus Rayleigh-Taylor instability (+convection) of two phase flow. We used glass bottle (250-300ml, used jam jar) as container, syrup (relative density 1.4-1.5) as viscous fluid and glass beads (1,2,4mm in diameter with string hole, relative density 2.5) as solid particles. The syrup and glass beads are packed in the bottle and repeatedly turned over for more than 10 times before the experiment to confirm the homogeneity of the sample. Starting by inverting the bottle, upper particle-concentrated layer may initially cause Rayleigh-Taylor instability, which subsequently induce dispersion of particles in viscous fluid and Stokes settling may occur. When we use large (4 mm diameter) and small (1 mm diameter) particles together, initial phase show streaky mass sinking of particles, which is followed by massive fall of particles with relatively high speed. After the massive sinking, dispersed small particle sinks more of Stokes sinking mode. The massive sinking in the middle stage may be caused by coming off as a mass of concentrated particles from the ceiling which occupied the middle layer of higher particle concentration (mixed 4mm+1mm particles) between the upper and lower layers of more single-size dominated layers. Although the present experiment is qualitative, the transition from Rayleigh-Taylor instability to Stokes settling of particle is intuitive to understand mode of ash fall from Plinian or co-ignimbrite umbrella cloud and mode of crystal setting from crystallizing magma reservoir.

Keywords: mode of particle settling, Stokes settling, Rayleigh-Taylor instability, settling mode of volcanic ash, crystal settling in magma reservoir