

Multi-Particle Sedimentation under Vibration

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Abstract

In the aluminum smelting process in production of aluminum, the anodes used are formed through compaction of a paste composed of coarse particles of petroleum coke and binder matrix. The latter is a non-Newtonian material. One of the rheological features of the binder is the presence of a yield stress, which is the focus of our work. One of aspect of the complicated process of vibro-compaction can be seen as sedimentation of numerous particles (coke) in a yield stress material (binder), through applying vibration to the container. In this work, the effects of the vibration of container on the sedimentation of multiple particles in yield stress fluids are numerically studied, and the results are compared with the Newtonian counterparts. It is found that in Newtonian fluids vibration of the container does not necessarily cause the particles to fall faster. Indeed, the vibration may cause the particles to fall slower at higher frequencies. In yield stress fluids, vibration of the container may have a significant effect on the speed of the sedimentation of the particles in a way that higher frequencies cause the particles to fall faster. This effect becomes more pronounced in yield stress fluids with higher yield stresses.

Keywords: Aluminum smelting process; vibro-compaction; yield stress; numerical simulation.1