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Granular Flow of Fluid-Submerged Particles: Effects of Fluid Viscosity H. KING, D. ERTAS, A. KUSHNICK, F. ZHOU, ExxonMobil, P. CHAIKIN, NYU — Gravity-driven flows of granular materials are often influenced by interstitial fluids. Using the rotating half-filled drum geometry, we investigated particle and fluid velocities for granular flows of nearly monodisperse spherical glass particles with interstitial fluids of varying dynamic viscosity (air to 4 cP). We utilize direct particle imaging and PIV methods. For dry flows the fundamental time scale is set by the gravitational constant and particle size. We observe two primary influences of the interstitial fluid on the granular rheology. First, density of the fluid changes both the driving force (due to buoyancy) and the inertial response (due to added mass), increasing the characteristic time scale. Second, the intrinsic time scale is influenced by the dynamic viscosity of the fluid. As a result, the changes associated with the 1 cP viscosity increase in going from air-to-water are considerably larger than those for subsequent viscosity increments. We also see that the surface drag associated with the fluid boundary layer progressively affects the grain velocity profile near the surface as the viscosity increases, giving a several-particle-deep zone of constant velocity.

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