Fluidization of granular media wetted by liquid $^4$He

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Max Planck Institute for Dynamics and Self-organization — We explore experimentally the fluidization of vertically agitated PMMA spheres wetted by liquid $^4$He at temperatures around the $\lambda$ point. For wetting by normal fluid helium ($T > T_\lambda$), the critical acceleration for fluidization ($\Gamma_c$) shows a steep increase close to the saturation of the vapor pressure in the sample cell. For superfluid helium ($T < T_\lambda$) wetting, $\Gamma_c$ starts to increase already at about 75% saturation, indicating that capillary bridges are enhanced by the superflow of unsaturated helium film driven by “fountain effect”. Above saturation, $\Gamma_c$ enters a plateau regime where the capillary force between particles is independent of the bridge volume. The plateau value is found to vary with temperature and shows a peak at 2.1 K, which we attribute to the influence of the specific heat of liquid helium on capillary bridge formation and rupture.

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