

Viscoelastic characterization of a solid projectile impact onto a dense potato starch suspension

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Dense suspension of non-Browning particles (e.g. mixture of water and potato starch) shows complex rheological properties such as discontinuous shear thickening (DST) [1]. Usually, DST is defined by the sudden jump of viscosity at a certain shear strain rate. The viscosity jump is observed in steady-state rheometry. However, in a very recent study, elasticity of DST fluid has also been measured by a steady penetration of a rod into a DST fluid [2]. In addition to the steady penetration, various impact experiments onto DST suspensions have also been performed to reveal the fundamental physical process of DST. The solid-like and/or peculiar behaviors have been found in the impacted DST fluid as well (e.g. dynamic jamming [3], dynamic fracturing [4], and negative pressure pulse [5]). Moreover, peculiar surface deformation and/or stable hole structure of the vibrated DST fluid has also been found under the influence of vibration [6]. Nevertheless, the origin of DST has not yet been understood well. Much more detail analyses of the transient rheological properties of DST fluid is necessary. The impact response is a useful way to approach the transient dynamics, Therefore, in this study, we perform a simple solid-projectile impact onto a DST fluid target (dense potato starch suspension), in order to observe the penetration and rebound dynamics. From the experimental results, the rebound timescale and restitution coefficient are measured. To characterize the transient viscoelasticity, we assume a simple linear viscoelastic model. Using the model, the effects of impact inertia, boundary conditions, and mechanical vibration on the rheological properties of the impacted DST fluid are systematically studied. Besides, to investigate the effect of vibration to the rheological properties of DST fluid, mechanical vibration is also used. Namely, the transient viscoelasticity of the vibrated DST fluid is experimentally measured. These results will be presented.

References:

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