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High Velocity Droplet Rebound On Liquid Pools WILLIAM DOAK, DANIELLE LAIACONA, PAUL CHIAROT, GUY GERMAN, SUNY Binghamton
— Rebound of high velocity, periodic droplet streams off viscous liquid pools is studied experimentally. Droplets, approximately 60 micrometers in diameter, impact the oil surface at velocities up to 13 m/s and at angles between 2–25 degrees. The oil surface does not degrade or lose its ability to provide rebound even after millions of droplet impacts. The oil was varied to examine the effect that surface tension and viscosity had on droplet rebound. Stable rebound is achievable on oils varying in dynamic viscosity in the range 13–970 Pa.s and surface tensions in the range 19–28 mN/m. When rebound occurs, a consistent 29% loss of droplet kinetic energy is observed. This is a surprising relationship due to the fact that it holds true for all cases of stable rebound regardless of the oil used. We further observe an upper inertial limit where droplets no longer provide stable rebound and instead become fully entrained in the oil pool. This limit is governed by the Rayleigh-Plateau instability and can be characterized and predicted using a modified version of the Weber number. The droplet rebound presented in this study is unique due to the size, velocity, and frequency of the droplets used. Another unique feature is that the rebound manifests itself as an effectively static phenomenon. No motion of the interface – oscillations, waves, or otherwise – was observed during rebound. The quasi-static nature of rebound enabled distinctions to be made regarding energy dissipation and the transition from droplet rebound to entrainment.

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