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EXPERIMENTAL INVESTIGATION OF CRATER DYNAMICS AND JET EVOLUTION DURING DROPLET IMPACT ON A LIQUID POOL

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ABSTRACT

The dynamics of droplet impact on a liquid pool has significance in various natural and engineering processes such as oil spill cleanup, spray cooling and industry heat recovery systems. This paper investigates the impact dynamics of water, silicone oil (5cSt, 100cSt), and rapeseed oil on a water pool. The investigation captures the complex droplet dynamics using a high-speed camera to examine the critical parameters such as crater depth, horizontal span, and jet height. The experiments were conducted in atmospheric conditions. The effects of fluid properties in terms of surface tension and viscosity were investigated. During the experiments, Froude numbers varied from 0 to 700, and Weber numbers ranged from 0 to 2400. The results reveal that the maximum crater depth, horizontal span, and jet height increase with the Froude number. In general, silicone oil 5cSt exhibits the highest jet, followed by rapeseed oil, silicone oil 100cSt, and water, which exhibited the lowest jet. Similarly, silicone oil 5cSt showed the highest maximum crater depth, whereas water had the lowest depth. Water showed the highest horizontal span at a lower Froude number, whereas Silicone oil 100cSt depicted the highest horizontal span at a higher Froude number. An energy analysis was performed to quantify the impact energy relative to the jet energy, viscous dissipation, and others. Experimental results yielded new empirical correlations for the horizontal span and crater depth based on the Froude number, Weber number, and viscosity ratio of the droplet and the pool liquid.