Droplet Impact Dynamics of Aqueous Polymeric Solutions

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Abstract

An experimental investigation of impact, spreading, and recoil of droplets of aqueous polymeric solutions on a horizontal hydrophobic (Teflon) surfaces is presented in this paper. The non-Newtonian aqueous polymer solutions are prepared by mixing the water-soluble hydroxyethyl cellulose (HEC) with different degrees of polymerization (QPC 300, 250 HR and 250 HHR) at different concentrations. The solution rheological and interfacial properties are characterized to understand the role of wettability, surface tension, and viscosity on the droplet surface interactions. For each polymer solution, the surface tension is measured by the maximum bubble pressure method and the static contact angle is measured using a contact angle/wettability analyzer. Intrinsic viscosities of the three polymers are determined from the viscosity measurements of their dilute solutions carried out using a capillary tube viscometer. A high speed digital camera is used to capture the droplet impact behavior at 4000 frames per second. The captured images of the droplet are analyzed by image processing and the temporal variations of the spreading factor and the flattening factor of the droplet are determined. Results show that the higher viscosity coupled with lower surface tension of the polymer solutions leads to larger spread compared to a water droplet and inhibits strong recoil on a hydrophobic surface.

Key words: Impact, wetting, polymeric solutions

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