Experimental Measurements of a Liquid Droplet Impinging on a Corrugated Cardboard Surface

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Abstract

In order to provide data suitable to validate a water-based fire protection model, measurements were conducted to study the impingement process of a liquid droplet upon a corrugated cardboard surface. The amount of mass converted to secondary droplets due to splashing was measured by a weighing balance. The size, velocity and number density of the splashed droplets was measured by a laser-based Shadow-Imaging system. The impact surface was dry unheated cardboard of the kind that is widely used in corrugated boxes and shipping containers. Two liquids, with different surface tension, three droplet sizes, three impact angles and different impact velocities were investigated. Based on the measurements, a critical Weber number was introduced to determine the transition from deposition to splashing. The splashing fraction was expressed as a function of Weber number and impact angle. The distribution of cumulative volume fraction of splash droplets versus a normalized droplet size was correlated as a Rosin-Rammler function. The volume-median droplet diameter was expressed as a function of Weber number and impact angle. The maximum velocity magnitude of a splash droplet was correlated to its diameter and Weber number. These empirical correlations can be incorporated into a numerical model to simulate the splashing fraction, size and velocity distributions of the splashed droplet.