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Spray droplet size control using an oil-in-water emulsion STEVEN A. FREDERICKS, Winfield United, CHENG LI, RUICHEN HE, ZILONG HE, S. SANTOSH KUMAR, CHRISTOPHER J. HOGAN JR., JIARONG HONG, University of Minnesota — This study examines the effects of using oil-in-water emulsions to control droplet size in flat fan sprays. Using high speed digital inline holography, droplet size, eccentricity, and in-plane velocity measurements were performed at multiple spanwise locations of a flat fan spray of varying pressures. The spray includes water and water mixed with 0.1% volume fish oil. Results show the emulsion initiates hole formation on the lamella at a higher rate than water alone, causing earlier spray breakup and with associated quantitative changes. First, the water only spray size distributions are inherently bimodal, possibly resulting from the two distinct breakup mechanisms, i.e. droplet generated from film and ligament breakup. The addition of oil significantly dampens the smaller droplet mode and the integral droplets size increases significantly due to the earlier breakup and formation of thicker, and thus more stable, ligaments. Second, the eccentricity of the droplets decreases at almost all size ranges for oil-in-water emulsion sprays. This is due to the significant decrease in the characteristic relative velocity for the breakup event due to earlier breakup. Third, the mass flux for small droplets less than 500 μm decreases with the addition of oil.

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