

Experimental Study of Oil-Water Emulsions Injected into a Subsonic Crossflow

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Abstract

The current study investigates the influence of introducing water and diesel fuel oil as an emulsion on the penetration of a liquid jet into a gaseous crossflow. Tests are conducted at atmospheric pressure, with momentum flux ratios spanning 30 – 120 with water addition of up to 40 percent. Liquid and gas velocities up to 20 and 80 m/s, respectively are considered. Nozzle Reynolds numbers ranged from 3,000 - 11,000 and aerodynamic Weber numbers spanned from 200 – 1,400. The spray morphology, in conjunction with edge filtering and intensity thresholding, was utilized to establish the spray plume edge. Existing liquid jet trajectory equation framework successfully correlates the penetration of the spray plume without modification to account for characteristics of emulsions. It is also observed that, for the conditions studied which span between column and shear mode breakup, the breakup mode itself also influences the ability of the correlations to describe penetration.

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