Investigating the Effect of the Injector Length/Diameter ratio on the Primary Breakup of Liquid Jets using X-ray Diagnostics

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Abstract

An investigation of the disintegration of turbulent liquid jets in gases was carried out by using x-ray diagnostics on injectors with a smooth entry (to eliminate cavitation) followed by straight passage with length-to-diameter ratio of 10 and 40. The test matrix is designed to maintain the same aerodynamic forces in order to isolate the effects of jet turbulence on the breakup process. The tests were conducted at the Advanced Photon Source (APS) facility of Argonne National Laboratory. The x-ray source at the APS has a unique combination of properties such as high brilliance, small size, broad energy spectrum and flexible time structure (hybrid-singlet mode). This allows the surface and internal topography of fuel jets to be visualized and the breakup mechanism in the dense-spray near-injector region to be revealed. The present x-ray images revealed the presence of bubbles near the ligaments formation locations when the jet was injected in sub-atmospheric pressure. These bubbles were absent when the jet was injected at atmospheric pressure, however. The present results also show that the separation distance of the ligaments is influenced by the ligament sizes; the larger the ligament the further away its neighbors.

Key words:
Turbulence, Bubbles, Cavitation, Primary Breakup, Dense Spray, X-ray Diagnostics.

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