Generation and Pressure Atomization of Water-in-Oil Emulsions for Gas Turbines

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Abstract

This manuscript describes how the generation of interfacial area in a water-in-oil emulsion influences the pressure atomization of fuel for typical conditions in gas turbine applications. The role that shear plays in initiating the interaction between phases is first identified experimentally in pipe flow. Then, in order to analyze the resulting distribution of water droplets, surface stabilizing agents (surfactants) and a controlled shear device are utilized to control the droplet statistics in emulsions created with similar shear forces. The change in rheological and fluid properties due to the surfactants is then correlated using dimensional analysis to desired flow conditions of a surfactant free emulsion in actual turbine hardware. This approach led to an understanding of the emulsion composition and properties that can be applied to explain the emulsion breakup as it exits a pressure atomization nozzle. Spray properties and discrete phase drop size are measured using laser diagnostic methods and high-speed cinematography.

Key words: Emulsion, Oil/Water, Gas Turbine, Atomization, Shear, Size Distribution

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