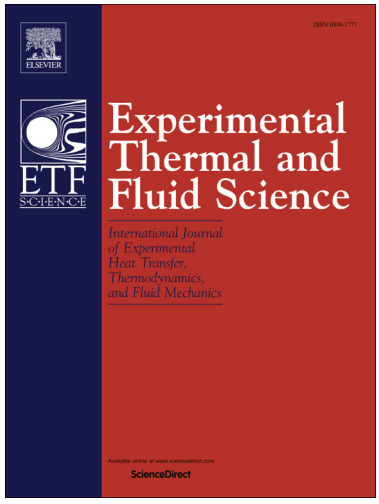

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PII: S0894-1777(17)30130-9
DOI: http://dx.doi.org/10.1016/j.expthermflusci.2017.04.027
Reference: ETF 9089

To appear in: *Experimental Thermal and Fluid Science*

Received Date: 14 July 2016
Revised Date: 12 April 2017
Accepted Date: 24 April 2017

Please cite this article as: K. Kannaiyan, R. Sadr, The Effects of Alumina Nanoparticles as Fuel Additives on the Spray Characteristics of Gas-to-Liquid Jet Fuels, *Experimental Thermal and Fluid Science* (2017), doi: http://dx.doi.org/10.1016/j.expthermflusci.2017.04.027

The Effects of Alumina Nanoparticles as Fuel Additives on the Spray Characteristics of Gas-to-Liquid Jet Fuels

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ABSTRACT

The use of metal nanoparticles as fuel additives have gained interest due to its positive influence on liquid fuels' combustion and emission performance. Nanoparticles dispersion affects the hydrodynamic and thermo-physical properties of the liquid fuel, and in turn, its atomization, mixing and evaporation characteristics. This work investigates the influence of nanoparticles dispersion on the spray performance of alternative gas-to-liquid (GTL) jet fuel under atmospheric ambient conditions. The spray characteristics of GTL fuel with dispersed alumina nanoparticles are compared with those of the pure GTL fuel. The spray characteristics at the macroscopic and microscopic levels are measured using the optical diagnostic techniques of shadowgraph and phase Doppler anemometry, respectively. The nanoparticles dispersed in liquid fuel tend to slightly alter the transient nature of the spray formation, enhance the liquid sheet instability and reduce the liquid sheet breakup length when compared to those of the pure GTL fuel. Furthermore, the mean droplet sizes of GTL fuel dispersed with nanoparticles are smaller than those of the pure GTL fuel.

KEYWORDS - Nanofuels; Alumina nanoparticles; Spray characteristics; Sheet breakup length; Phase Doppler Anemometry; Gas-to-Liquid jet fuel.

Highlights

- Increase in nanoparticle concentration increased base fuel viscosity and density
- Base fuel surface tension decreased with nanoparticle concentration
- Sheet breakup length decreases with increasing nanoparticle concentration
- Nanoparticle dispersion decreases the droplet diameter size of the GTL fuel

1. INTRODUCTION

Over the last decade, increasing concerns about the environmental impact and the supply security of oil resources have been the major driving factors for the aviation industry to find

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