Spray Characterization of Gas-to-Liquid Synthetic Aviation Fuels

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Abstract

Development of alternative aviation (jet) fuels is gaining importance in recent years to meet growing energy demand of the world and to reduce the environmental impact of aviation fuel combustion. Alternative fuels need to match the energy density as that of the conventional fuels and need to possess vital qualities such as rapid atomization and vaporization, quick re-ignition at high altitude and acceptable emission level. Gas-to-Liquid (GtL) synthetic paraffinic kerosene obtained from Fischer-Tropsch synthesis has grabbed global attention for its cleaner combustion characteristics due to the near absence of aromatics and Sulphur content in the fuel composition. Characterizing the atomization of the alternative liquid fuels is necessary as it affects evaporation process and mixing with air which, in turn affect combustion and emission characteristics of the fuel. As a part of an ongoing joint research effort between Texas A&M University at Qatar (TAMUQ), Rolls-Royce (UK), and German Aerospace Laboratory (DLR), an experimental facility is built at TAMUQ to study the spray characteristics of different GtL blends.

The main objective of this work is to investigate the influence of the change in fuel composition on the spray characteristics at different injection pressures using a pressure (simplex) nozzle. The GtL blends used in this work consist of varying degree of cyclic carbon content and iso-to-normal paraffin ratio that fit in between the commercial GtL kerosene and the commercial paraffinic solvents. A planar optical diagnostic technique, Global Sizing Velocimetry is used in this work to study the spray characteristics, such as droplet size, distribution and velocity, of three different GtL blends and the results are compared with that of the conventional Jet A-1 fuel. The droplet size distributions highlight the influence of fuel composition on the mean droplet size, distribution and spray structure among different blends.

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