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Evaluation Of Gas-to-Liquid Aviation Fuel Cold Spray In Qatar For Gas Turbine Combustion

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Abstract

Increase in energy demand and strict emission norms have always been the driving force to find clean-alternative energy sources. Gas-to-liquid (GTL) fuel, a liquid fuel synthesized from natural gas, has grabbed the global attention in recent years for more fuel source diversity and its cleaner combustion characteristics, due to the absence of aromatics and Sulphur. The scope of synthetic fuel has widened further with the recent ASTM approval for blending it with conventional jet fuels. Furthermore, the successful maiden flight from London, UK to Doha, Qatar using a 50-50% blend of GTL fuel and conventional Jet A-1 fuel by Qatar airways has also enhanced the global interest on synthetic fuels derived from non-oil feedstocks. Under these circumstances, an academia-industry research consortium was formed under the auspices of Qatar Science and Technology Park to evaluate the feasibility of using GTL as an alternative jet fuel in aviation gas turbine engines. This presentation briefly discusses the role and objectives of different research collaborators involved under the research consortium with specific emphasis on the GTL spray research activities performed at TAMUQ.

The GTL fuel physical and chemical properties are different from those of the conventional jet fuels. This difference can potentially alter the atomization characteristics of the fuel which in turn affects the fuel evaporation, mixing with oxidizer, combustion, and emission aspects. Therefore it is essential to have a thorough knowledge on the atomization characteristics of GTL fuels in order to better understand their latter processes. In this work, the microscopic spray characteristics such as droplet size, distribution, and velocity, of GTL fuels are measured at atmospheric conditions at global and local levels using Global Sizing Velocimetry (GSV) and Phase Doppler Anemometry (PDA) techniques. Details about the experimental facility, measurement techniques, experimental conditions, fuel properties, and their spray characteristics will be discussed and the results of GTL spray study are compared with those of the conventional Jet A-1 fuel.

The results of this test campaign indicates a clear difference in spray characteristics between GTL and Jet A-1 fuel in the near nozzle regions and similar patterns for further downstream. Although the spray characteristics measured at atmospheric conditions may be considered as a merit of the GTL fuel study on its own, it may not provide direct conclusion on the spray characteristics of the fuel at actual combustor operating conditions. However, it further highlights the importance of the newly awarded NPRP research work at TAMUQ to study spray characteristics of GTL at actual combustor operating conditions as the volatilization characteristics play a much larger role. Such results combined with the results of this work enables engineers to separate the hydrodynamic effects of spray from those more closely related to chemical characteristics.