

Title: Spray and combustion characteristics of biodiesel: Non-reacting and reacting

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Abstract: The cold spray and spray combustion characteristics of palm biodiesel were investigated and compared with baseline Jet-A1 fuel. Both fuel sprays were generated from an airblast type atomizer and compared under the same atomizing air-to-liquid mass ratio (ALR). Under non-reacting spray condition, droplet velocity profiles for both sprays peak at the centerline due to high atomizing air momentum, while the droplet size is smallest at the spray core. Palm biodiesel generated slightly larger droplet size compared to Jet-A1 due to the effect of higher viscosity and lower volatility. Utilising an airblast atomizer-based swirl burner, spray flames of Jet-A1 and palm biodiesel were established and compared under continuous, steady swirl conditions. The droplet velocity and diameter distributions within the reacting spray flames were significantly different compared to non-reacting spray due to interaction with swirl air flow and flame within the combustor. Spray flame reaction zones obtained via OH* chemiluminescence imaging showed that fuel droplets evaporated rapidly within 20 mm from the burner outlet. Reacting Jet-A1 flame showed smaller droplet size compared to biodiesel due to higher vaporisation rate and close proximity to flame reaction zone. Palm biodiesel showed consistently lower NO_x but slightly higher CO emissions per unit energy compared to Jet-A1 under a range of ALR tested.