A Comparison of Jatropha Methyl Ester and Diesel Non-evaporating Sprays

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Abstract

Recently, bio-fuels are being considered as important alternatives for petroleum-fuels because of their renewability. In particular, jatropha, pongamia and rapeseed methyl esters are being actively considered as petroleum-diesel alternatives. Many researchers have studied and reported various effects of using biodiesels on spray, combustion and emissions with respect to compression ignition (CI) engines ranging from very broad engine level tests to fundamental studies on liquid properties, spray structure and its implications.

The present experimental study compares various spray characteristics of diesel and jatropha methyl ester (JME/ jatropha biodiesel) non-evaporating sprays. These sprays are studied in a specially fabricated high pressure chamber with optical access. The fuels were injected at injection pressures of 500, 1000 and 1500 bar into a nitrogen environment maintained at 20, 25 and 35 bar, respectively. First, the spray structure in terms of spray tip penetration and spray plume angle are compared. It is observed that the spray tip penetration is around 2 to 5% higher and the spray plume angle is around 7 to 17% smaller for JME as compared to diesel. This indicates a slower breakup for the jatropha biodiesel sprays. Droplet diameters are measured using the particle/droplet image analysis (PDIA) technique. For JME, around 5% higher droplet diameters are observed. Detailed probability distribution of droplets showed that jatropha biodiesel has more probability for larger droplet diameters (>18µm) and lesser probability for smaller droplet diameters (<18µm) which explains the overall SMD trend. The main reason for larger droplet diameters is the higher viscosity and surface tension of JME compared to diesel. The effect of fuel properties on the near nozzle structure is studied. A longer unbroken liquid length and narrower spray plume is observed for JME as compared to diesel indicating slower breakup.

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