Experimental investigation of spray characteristics of fuel blends having low cetane number and high volatility in a diesel fuel injection system

M. J. Cárdenas*, D. Cordes, R. Kneer
Institute of Heat and Mass Transfer, RWTH Aachen University, Germany
cardenas@wsa.rwth-aachen.de and kneer@wsa.rwth-aachen.de

Abstract

High speed images were used to experimentally investigate the spray characteristics of fuel blends having low cetane number and high volatility properties using a common diesel fuel injection system. Low cetane-number fuels have been chosen, as their resistance to autoignition provides a sufficient ignition delay enabling improved mixing of air and fuel. As the mixing rate depends on the local fuel vapor concentration, high volatility, which assures faster vaporization, also tends to improve the mixing. Therefore, an ethanol-diesel blend and a gasoline-diesel blend have been investigated. One fuel blend was composed of 29.4% ethanol and 68.6% diesel fuel and 2% 1-dodecanol to improve miscibility and the other blend consisted of 40% gasoline and 60% diesel fuel. For Both blends a standard diesel fuel was used, which also served as reference for comparison.

Single injections have been visualized using a high speed camera and compared to standard diesel fuel sprays at different ambient conditions and injection pressures. Typically, 50 injections were recorded to extract the penetration length and spray cone angle of the spray liquid phase from the images.

For all ambient conditions and injection pressures diesel presented the highest spray penetration length values for the same injection time. The results showed that at lower ambient pressures the spray penetration length values of both blends were similar. Once either the ambient or the injection pressure was increased, the ethanol-diesel blend showed higher penetration length values than the gasoline-diesel blend.

For the ambient temperature variation the penetration length values for each fuel were almost equal, while the values of the spray cone angle decreased with increasing ambient temperature. In any other cases, the behavior of the spray cone angle values was inverse to the behavior of the penetration length values for all fuels.

* Corresponding author: cardenas@wsa.rwth-aachen.de