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Influence of Elevated Fuel Temperatures on the Spray Characteristics of Gasoline - Ethanol Blends

In this study, the effect of elevated fuel temperatures on the spray characteristics of gasoline-ethanol blends were studied in an optically accessible constant volume spray and combustion vessel. MAHLE SmartHeat® is a fuel heater located directly upstream of the fuel injector. High speed images of the spray injected from a six-hole gasoline direct injection injector typical of a side-injection engine were captured with shadowgraph imaging technique. Two fuel blends, gasoline with 10% ethanol (E10) and 85% ethanol (E85) were investigated at ambient conditions of 1 bar, 45°C and 4 bar, 180°C respectively at an injection pressure of 100 bar. Fuel temperatures were varied from 75 to 250°C. A comparison of the near nozzle and the global spray characteristics was made for the two fuels at those temperatures.

Results showed that flash boiling leads to two primary effects for the two fuel blends: (i) an appreciable increase in spray angle near the exit of the nozzle followed by (ii) a decrease in spray angle downstream of the nozzle due to the interaction of the plumes and the collapsing of the spray. Furthermore, for both fuel blends, upon flash boiling, entrainment and mixing were reduced downstream of the nozzle because of the collapse of the spray. To reduce this effect, nozzle orientations and geometries should be modified.