Parametric Study of Fuel Impact on Spray Behavior using High-Speed-Visualization

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Abstract

In this work, fuel influence on spatial and temporal spray behavior is studied experimentally for a given Diesel-nozzle geometry. Fuels of different molecular groups with various physical and chemical properties are investigated by a parametric study. In addition to conventional Diesel, three alcohols, two alkanes, four silicon oils, two furans, two esters and one ether are used. The spray behavior of each fuel is analyzed for non-evaporating conditions utilizing fifteen different operation points with varied injection pressure and ambient density. The method of choice is high-speed visualization, providing a detailed temporal and spatial view on the spray propagation process. The spray evolution is analyzed with respect to characteristic macroscopic spray parameters such as spray cone angle, penetration length and integrated spray volume. It is found that the influence of fuel properties is reduced with increasing ambient density. An empirical correlation for the macroscopic cone angle as a function of Reynolds number and density ratio is derived and it is found that for non-evaporative ambient conditions mixture formation is mainly driven by density and viscosity. It is shown that the resulting air-fuel-ratio as the main influencing variable for resulting engine emissions is strongly influenced by fuel dependent spray behavior.

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