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An Optical Study of Spray Development and Combustion of Ethanol, Iso-Octane and Gasoline Blends in a DISI Engine

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ABSTRACT

In recent times regulatory pressure to reduce CO_2 emissions has driven research towards looking at blending fossil fuels with alternatives such as crop-produced alcohols. The alcohol of interest in this paper is ethanol and it was studied in mixtures with gasoline and iso -octane in an optical spark-ignition engine, running at 1500 RPM at low-load operation with 0.5 bar absolute intake plenum pressure. Specifically, tests involved fuels of 100% gasoline and 100% iso -octane, so that differences between multi and single-component fuels could be compared within this environment. A mixture of 25% ethanol with 75% iso -octane was also tested and compared. Finally, mixtures of high-percentage of ethanol (85% ethanol) in gasoline and in iso -octane were used in the study and compared. Tests were undertaken using a standard port injection system as well as a direct injection system so an appraisal of both mixture preparation methods could be made. Initially, a high-speed imaging study of the in-cylinder spray formation was undertaken with the direct injection system for different injection timings and engine-head temperatures under motoring engine conditions. The engine was also run with continuous firing using all fuels. In-cylinder pressure data were collected at 0.2° crank angle resolution for each cycle and synchronized with simultaneous high-speed flame imaging at 1° crank angle resolution for a series of 100 consecutive cycles for all test points. The flame images were processed to quantify the evolution of an equivalent flame radius.