Characteristics of 3000 bar Diesel Spray Injection under Non-Vaporizing and Vaporizing Conditions

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Abstract

Increasing fuel injection pressure has enabled continuous reduction of diesel emissions while sustaining the high thermal efficiency advantage of diesel engines. Current production diesel injectors operate in the range from 300 to 2000 bar. The ongoing trend for fuel injection systems is to higher injection pressures and smaller nozzle hole diameters for further emissions reduction and fuel efficiency improvements. Fundamental understanding of diesel spray characteristics including liquid penetration and cone angle is imperative to improve model development and facilitate the integration of elevated injection pressure systems into future diesel engines.

Studies were conducted in an optically accessible constant volume combustion vessel under non-vaporizing and vaporizing conditions. A 7-hole injector, currently being developed for high injection pressure applications, was studied between 2000 and 3000 bar injection pressures with ultra-low sulfur diesel fuel. The study included two part-load charge density conditions of 7.4 kg/m^3 and 14.7 kg/m^3 along with an elevated density boosted condition of 34.8 kg/m^3. Diagnostics used included Mie back scatter imaging for liquid phase penetration. Experimental results were compared to spray penetration relationships to extrapolate these relationships to the elevated injection pressure conditions. Thus, an improved understanding of the influence of elevated injection pressure on fundamental spray characteristics was gained.

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