Experimental and Numerical Analysis of the Impact of Flash-Boiling on Auto-Ignition Quality of Hydrocarbon Fuels

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2002 JSAE Annual Congress
(25, July, 2002)

This research intends to develop a fuel and it's direct-injection concept utilizing flash-boiling to achieve a predominantly homogeneous charge in a compression ignition engine, thereby lowering the NOx emissions considered to arise from the high temperature regions of heterogeneous mixtures. As a part of this the ignition delays of pure n-alkanes and two- component mixtures of n-alkanes were measured by injection into a constant volume chamber at pressures and temperature similar to the compression end of an actual compression ignition (CI) engine. The ignition delays of pure n-alkanes provide a basis for comparison with mixtures in varying ratios of n-pentane and n-tridecane. The low boiling point of n-pentane results in flash-boiling and rapid charge mixing, while the high cetane number of n-tridecane aids ignition. Based on the experimental results an empirical equation has been proposed to calculate the ignition delays at the non-flash boiling zone. Therefore the proposed equation is applied in the flash-boiling zone to confirm the effect of flash boiling on ignition delay. It was found that for mixtures of n-pentane and n-tridecane, the ignition delay depends primarily on the mixture carbon number and ambient temperature at constant temperature, apparently affected by the flash-boiling phenomena by the analysis of the proposed equation.