IFP Powertrain Engineering

Effect of Fuel and Additives on Diesel HCCI Engines

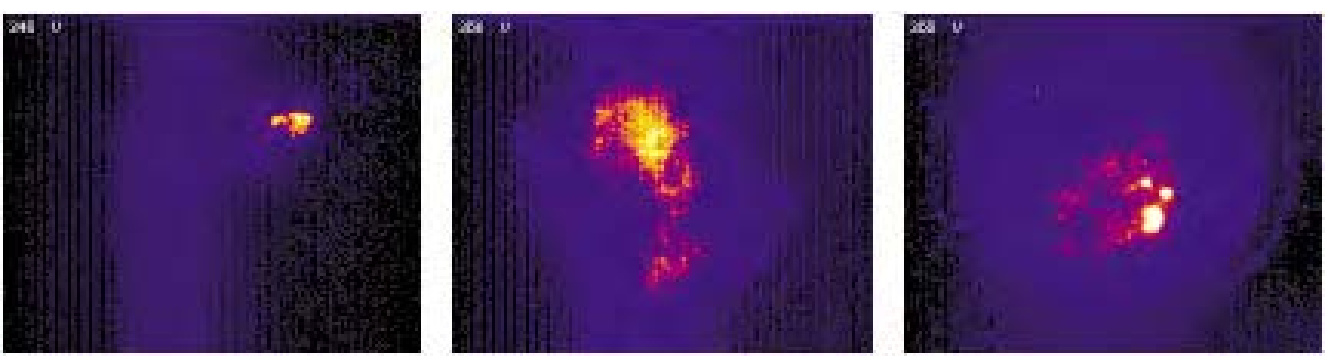
IFP International Consortium Study

A SOLUTION TOWARDS NEAR ZERO EMISSIONS

The state of the art diesel engine is now regarded as one of the lowest well-to-wheel CO_2 propulsion systems for transportation, thanks to significant evolutions of its technology (especially high-pressure common rail direct injection).

Nevertheless, to be a long term solution, the diesel engine will have to face the coming challenge of stringent near zero emissions legislation. One possible way to meet such a challenge is to implement a complex and fuel-sensitive after-treatment strategy.

A very promising alternative combines the Homogeneous Charge Compression Ignition (HCCI) combustion process with a much less



Direct flame emission imaging in diesel HCCI combustion mode at different degrees CA

sophisticated after-treatment strategy. This attractive solution, with near zero NOx and PM emissions from the combustion itself, is the subject of extensive studies world-wide.
Such a combustion process can be achieved by an appropriate control strategy of air and fuel mixing, highly diluted by EGR.
However, some key challenges must still be overcome to attain the full benefit of successful HCCI combustion in diesel engines. One is precise control of the combustion timing and heat release rate. Another is reducing the relatively high level of HC and CO emissions typical of diesel HCCI engines.
Consequently, current research work must be focused on study of the parameters used to control HCCI combustion, in order to enhance its operating range and to facilitate the transition between part-medium load HCCI operation and high-load conventional diesel combustion.
In such a context, the fuel is obviously one of the key parameters. It is expected that the study and development of more appropriate fuel formulations with modified physical properties and/or chemical composition may help significantly improve the benefits of HCCI engine operation.
With its combined expertise in HCCI diesel combustion and in fuels and additives, IFP is therefore in a unique position to propose and undertake such a study.

THE OBJECTIVES OF THIS 3-YEAR CONSORTIUM PROGRAM

• To assess on an engine the impact on HCCI combustion operating range, pollutant emissions, noise, etc. of a set of fuel parameters such as cetane number, volatility, density and viscosity, chemical composition (aromatic, naphthenic, paraffinic, and oxygenated compounds), etc.

• To evaluate, by spray visualisations, the impact of these parameters on fuel injection spray characteristics adapted to HCCI.

• To check the impact of the fuel formulations developed for HCCI on engine fouling (valves, EGR system, injector, etc.) and on the behaviour and robustness of the injection system.

• To find the best compromise in terms of fuel (and/or additive) specification to achieve the broadest HCCI operating range while retaining the possibility of operating in conventional diesel combustion mode at high load.

THE FIRST 12-MONTH PROGRAM

• Preparation of the test engine for the study and specification, preparation, and supply of the fuel blends.

• Development of the fuel effect testing and discrimination procedures.

• Implementation of the testing procedure developed for combined engine and spray visualisation screening tests with the specified fuel blends.

FOR FURTHER INFORMATION, PLEASE CONTACT:

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