IFP Powertrain Engineering

Effect of Fuel and Additives on Gasoline CAI & HCCI Engines

IFP International Consortium Study

A SOLUTION TO OVERCOME THE CO_2 / NOx DILEMMA

Future CO_2 environmental constraints will require more and more efficient engines for transportation with robust ultra-low pollutant emissions.

The stoichiometric four-stroke gasoline engine with 3-way catalyst has the potential to reach such ultra-low emissions levels for passenger cars as the 2005 Euro 4 level and even the future Euro 5 level. Nevertheless, its efficiency remains poor when compared to a lean-burn engine combustion system.

Visualization of fuel concentration by laser-induced fluorescence in a gasoline CAI engine - the dark zones correspond to burned gases (4 deg. CA ATDC - 1500 rpm – lambda 1.12 – CR=10)

One way recently considered to improve its efficiency is to adopt Direct fuel Injection (DI) technology, combined with stratified-charge combustion over a limited operating range.

To achieve ultra-low pollutant emissions, these systems require rather sophisticated and fuel-sensitive DeNOx after-treatment.
There is therefore a strong industrial need for an alternative gasoline combustion system that could at least provide the same high efficiency and low CO_2 advantages while solving the excessive NOx emissions problem, all without depending on such fuel-sensitive and expensive after-treatment.

In this sense, the gasoline Controlled Auto–Ignition (CAI) combustion system studied and developed notably by IFP during the last 15 years (and more recently by other companies) appears as a very promising solution to overcome the "CO_2-efficiency" versus "NOx" dilemma of stratified-charge gasoline engines.
IFP's earlier work and know-how already suggest a significant influence of fuel composition and physical properties on CAI combustion (especially in terms of operating range, pollutant emissions and noise, etc.), and that the benefits of such new combustion processes could be greatly enhanced with more appropriate fuel (and/or additive) formulations, which must be studied and developed.
With the level of development reached today on the combustion control side, it now appears deeply interesting and necessary to investigate in more detail the effects on CAI combustion of many fuel parameters, such as volatility, octane number, chemical composition, etc.

With its combined experience in the fields of controlled auto ignition combustion and of fuels and additives, IFP is therefore in a unique position to propose and undertake such a study.

THE OBJECTIVES OF THIS PROPOSED 3-YEAR CONSORTIUM PROGRAM

• To assess, on an engine, the impact on CAI combustion operating range, pollutant emissions, noise, etc. of a set of fuel parameters such as octane numbers (RON, MON), volatility, chemical composition (aromatics, olefins, paraffins, oxygenated compounds), etc.

• To find the best compromise in terms of the fuel (and/or additive) specification, in order to achieve the broadest CAI operating range without detrimental effect on knock.

THE FIRST 12-MONTH PROGRAM

• Preparation of the test engine for the study, specification and preparation of the fuel blends, and development of the fuel effect testing and discrimination procedures.

• Implementation of the testing procedure so developed to undertake engine screening tests with the specified fuel blends.

FOR FURTHER INFORMATION, PLEASE CONTACT:

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