user story

Models for simultaneous optimisation of engine and fuel

Models for Premixed and Homogenous Charge Compression Ignition (PCCI and HCCI), conventional diesel and SI engine "knock" all require reliable fuel models for simulating the characteristics of auto ignition.

THE CHALLENGE

Develop a model for the simulation of real fuels such as gasoline and diesel

THE SOLUTION

Using the srm suite software to simulate HCCI engine combustion with detailed chemical kinetics

THE RESULTS

•A robust and fully validated chemical kinetic mechanism

•Insight into combustion characteristics of practical fuels

•Simultaneous engine operating mode and fuel design optimisation

These models are becoming ever more critical as they are required to determine the onset of potentially catastrophic "knocking" combustion which limits the maximum achievable engine efficiency. However the characteristics of real fuels have proven difficult to simulate over the wide variety of engines and operating modes without significant model "tuning". This is largely caused by the adoption of inadequate autoignition models which do not carry the physical characteristics observed in real fuels.

THE CHALLENGE

Modern automotive fuels are characterised by the cetane, research octane and motor octane numbers (CN, RON and MON). The challenge was to develop a methodology to generate models of practical fuels on the basis of these numbers, enabling engineers to mimic real fuels over a wider range of relevant conditions.

The task was then to identify the benefits of improving fuel characteristics on powertrain efficiencies and thereby optimise both fuel and engine designs simultaneously.

THE SOLUTION

A series of octane tests and experimental engine studies were carried out and the fuel model was validated against these data using srm suite.

The model performance was tested against practical fuels.

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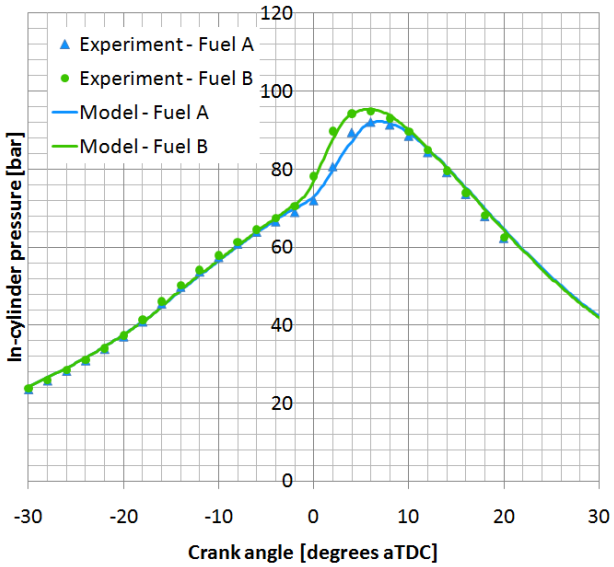


In-cylinder pressure-crank angle for model and experiment. Here srm suite has successfully been employed to simulate HCCI combustion of two gasoline surrogate fuels.

APPLICATION AREAS

- HCCI
- PCCI
- Conventional diesel
- SI "knock"

PRODUCTS USED

- srm suite
- fuel model development

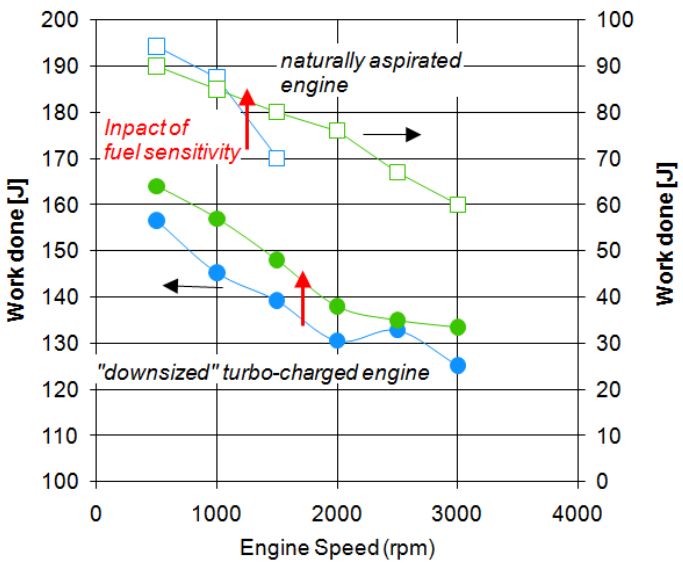
THE RESULTS

•A robust and fully validated fuel model for a wide range of applications

The srm suite was used to solve the fuel model during the validation phase. Significant model robustness was noted for this mechanism in a number of tests. The fuel model has broad scope for application to a variety of real fuel applications such as SI engine "knock", PCCI, HCCI and diesel. Yielding improved combustion and emissions computational results.

•Insight into combustion characteristics of practical fuels

This work has highlighted that the peak load operating limit of the HCCI operating mode is influenced by the fuel; specifically, designing fuels with greater fuel sensitivity can increase the peak operating load by up to 60%.



In this diagram, srm suite has been used to optimise engine and fuel characteristics simultaneously to obtain the highest safe operating load in HCCI operating mode for two engines. The results show that when the engines were operated with a fuel with sensitivity ((RON-MON)≠0), higher loads can be achieved.

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