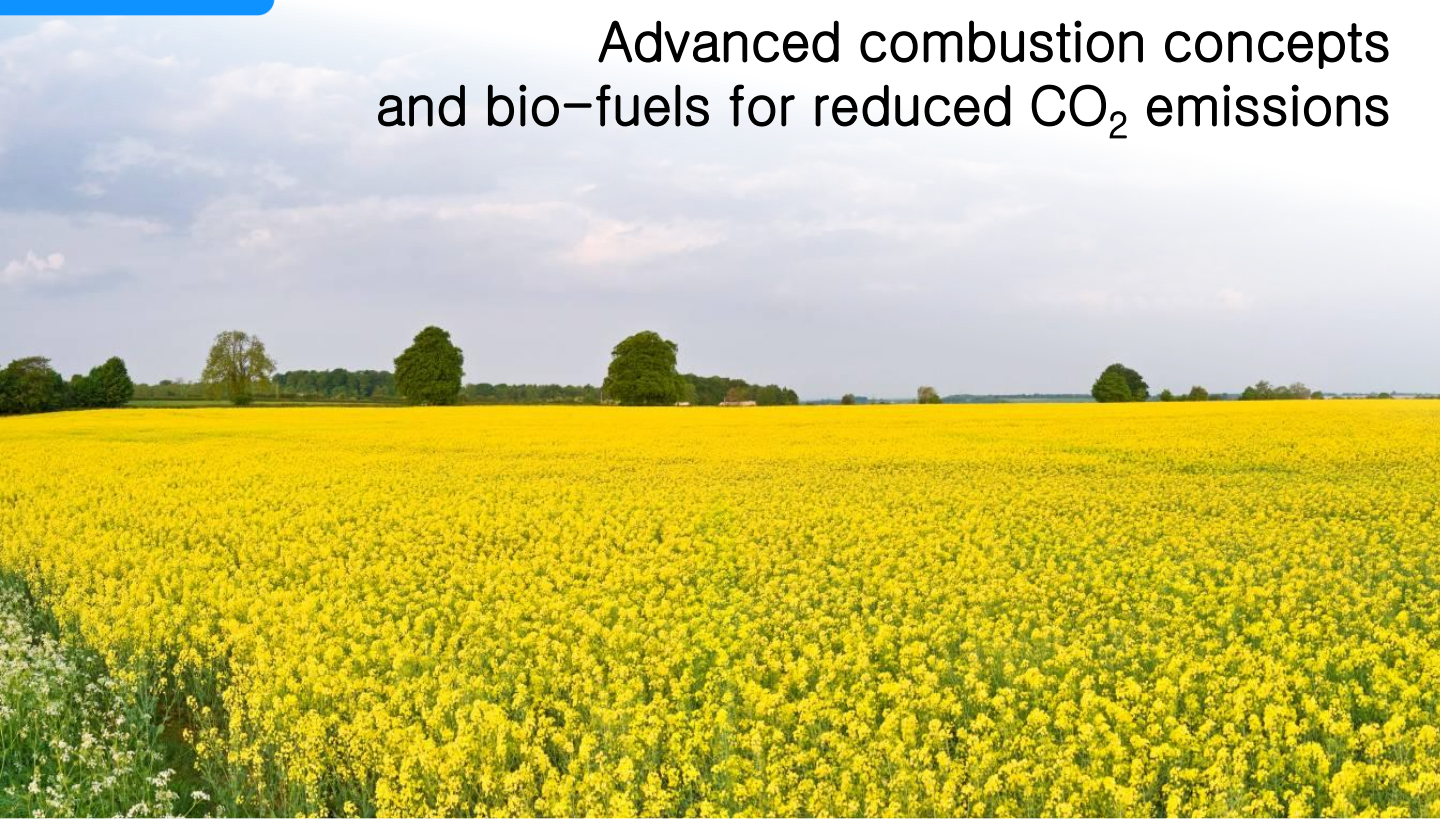
user story

Advanced combustion concepts and bio-fuels for reduced CO_2 emissions



THE CHALLENGE

Develop a model for the simulation of the combustion and emissions of bio-fuels

THE SOLUTION

Using the srm suite software to simulate HCCI engine combustion with detailed chemical kinetic model of diethyl ether (DEE) and ethanol (EtOH).

THE RESULTS

•Insight into combustion characteristics of bio-fuels

•Reduced CO_2 emissions

Progress toward a low carbon future can be facilitated through the adoption of low carbon or carbon neutral fuels, e.g. second generation bio-fuels. Bio-fuels have different characteristics to conventional fuels some of which can be exploited for improved engine efficiency such as a higher octane rating and charge cooling etc. whereas others must be overcome such as increased NO_x and fuel injector deposition.

THE CHALLENGE

To gain further insight into the combustion characteristics of bio-fuels in order to facilitate engine development using robust computational models. These models should predict the combustion characteristics and emissions of bio-fuels. These can enable engineers to carry out virtual engine design optimisations thus reducing development timescales.

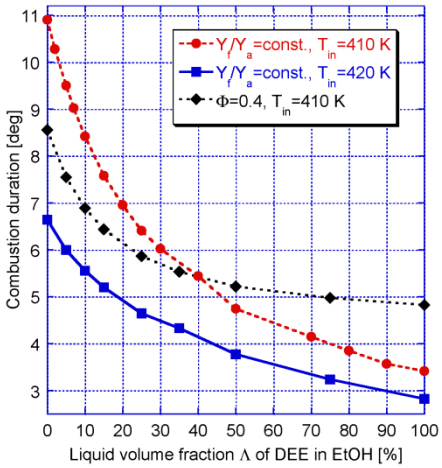
THE SOLUTION

The adoption of srm suite and a detailed chemical kinetic fuel model to simulate an engine converted to run on bio-ethanol in a low temperature combustion mode. Specifically by examining the performance of blends of diethyl ether (DEE) and ethanol (EtOH), the characteristics of these fuels can be exploited to extend the operating ranges of the engine while improving the overall engine efficiency and lowering NO_x emissions.

cmcl innovations

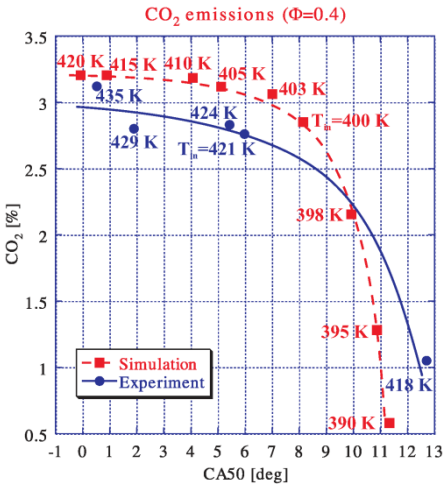
e-mail: enquiries@cmclinnovations.com web: www.cmclinnovations.com

user story



Above: Demonstrates the influence of the fuel blend upon the combustion duration. Longer combustion durations enable higher load operation as they avoid engine knocking.

Below: The response of the model compared to experiment in terms of CO_2 emissions



APPLICATION AREAS

•HCCI/PCCI/LTC

•Bio-fuels

PRODUCTS USED

•srm suite

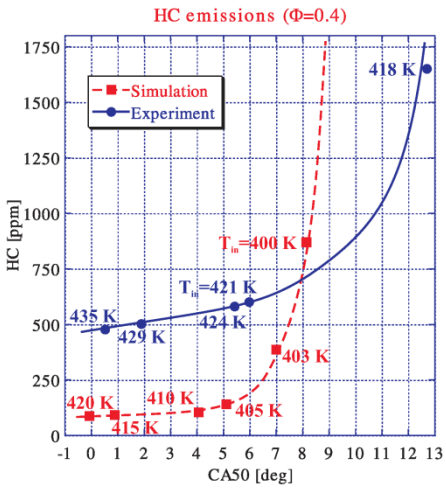
THE RESULTS

•Insight into the combustion characteristics of bio-fuels

The combustion duration proved highly sensitive to the proportion of DEE in the ethanol blend. Various operating strategies were employed however those blends with reduced concentrations of DEE proved to have longer combustion durations allowing for increased load to be met without engine knock.

•Reduced CO_2 exhaust emissions

Since the bio-fuels were (or were closer to) carbon neutral when compared to equivalent conventional fuels, the net CO_2 emissions caused by their formation and combustion were reduced. In terms of the engine emissions, the model mimicked the trends observed in the experiments. The emissions were predicted with a great deal of quantitative agreement, enabling engineers to identify which operating regions resulted in higher emissions.



Above: The performance of the model in terms of unburned hydrocarbons, HCs.

cmcl innovations
e-mail: enquiries@cmclinnovations.com web: www.cmclinnovations.com