user story

Impact of EGR on combustion and emissions in a CNG engine

THE CHALLENGE

Simulate combustion and emissions of a CNG fuelled combustion engine operating in HCCI mode at high EGR rates.

THE SOLUTION

Using the srm suite software to simulate HCCI engine combustion with a detailed model of natural gas oxidation chemical kinetics

THE RESULTS

•Insight into combustion characteristics of natural gas

•Analysis of natural gas combustion for increasing rates of EGR

The homogeneous charge compression ignition (HCCI) engine has attracted a lot of attention in the combustion community for its low NOx emissions and high thermal efficiency characteristics. A major means of delivering reduced NOx is obtained through the adoption of increased exhaust gas recirculation (EGR). However due to the lower combustion temperatures and reduced oxygen concentration, EGR reduces the combustion rate more than excess air does this can lead to increased emissions of HC and CO. In addition, active components within the exhaust gases such as NO can promote ignition.

THE CHALLENGE

To gain further insight into the combustion characteristics of natural gas in HCCI engine operation through the development of computational models. These models should predict the combustion characteristics and emissions from a CNG engine at various EGR rates. In particular, reliable prediction of CO emissions which is a combustion intermediate.

THE SOLUTION

The adoption of srm suite and a CNG fuel model to examine the impact of EGR.

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

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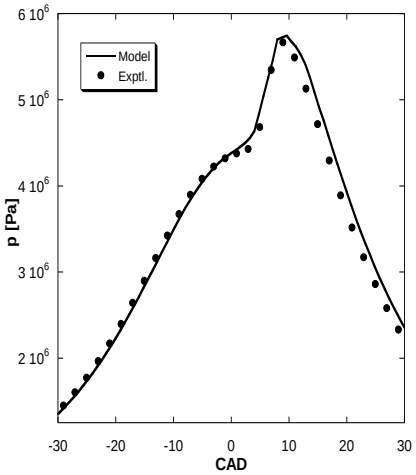
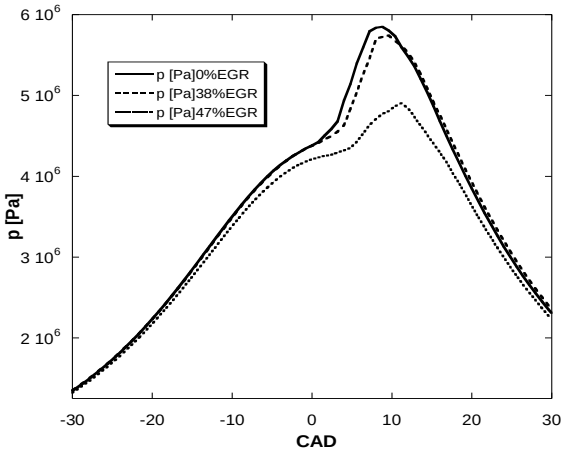


Above: The model compared with the experimental observation in terms of pressure versus crank angle for a Volvo TD 100 engine with 38% EGR

Below: The response of the model for various EGR rates.



APPLICATION AREAS

- HCCI
- Compression Ignition
- CNG
- High EGR

PRODUCTS USED

- srm suite

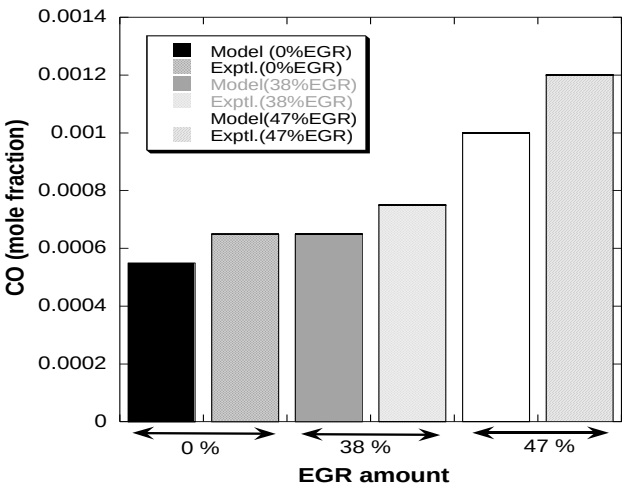
THE RESULTS

•Insight into the combustion characteristics of natural gas

With increase in the amount of the EGR, the compressed gas temperature reduces thereby slowing the rate of reactions and delaying the auto-ignition and reducing the peak pressure. The thermal influence (e.g. charge heating effect) of EGR also can be accounted using the srm suite, however in this study the external EGR was cooled down to the room temperature..

•CO and uHC exhaust emissions

The CO emissions were found to be influenced by fluid-wall interactions, mixing of hot and cold air-fuel particles, and the wall temperature. Furthermore, the inhomogeneities persisting in the expansion stroke dictated the level of CO emissions obtained at EVO. The prediction of the rapid rise in CO and HC emissions and their sensitivity to the EGR rates agreed with the test cell observations.



Above: The influence of EGR rates on exhaust gas

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