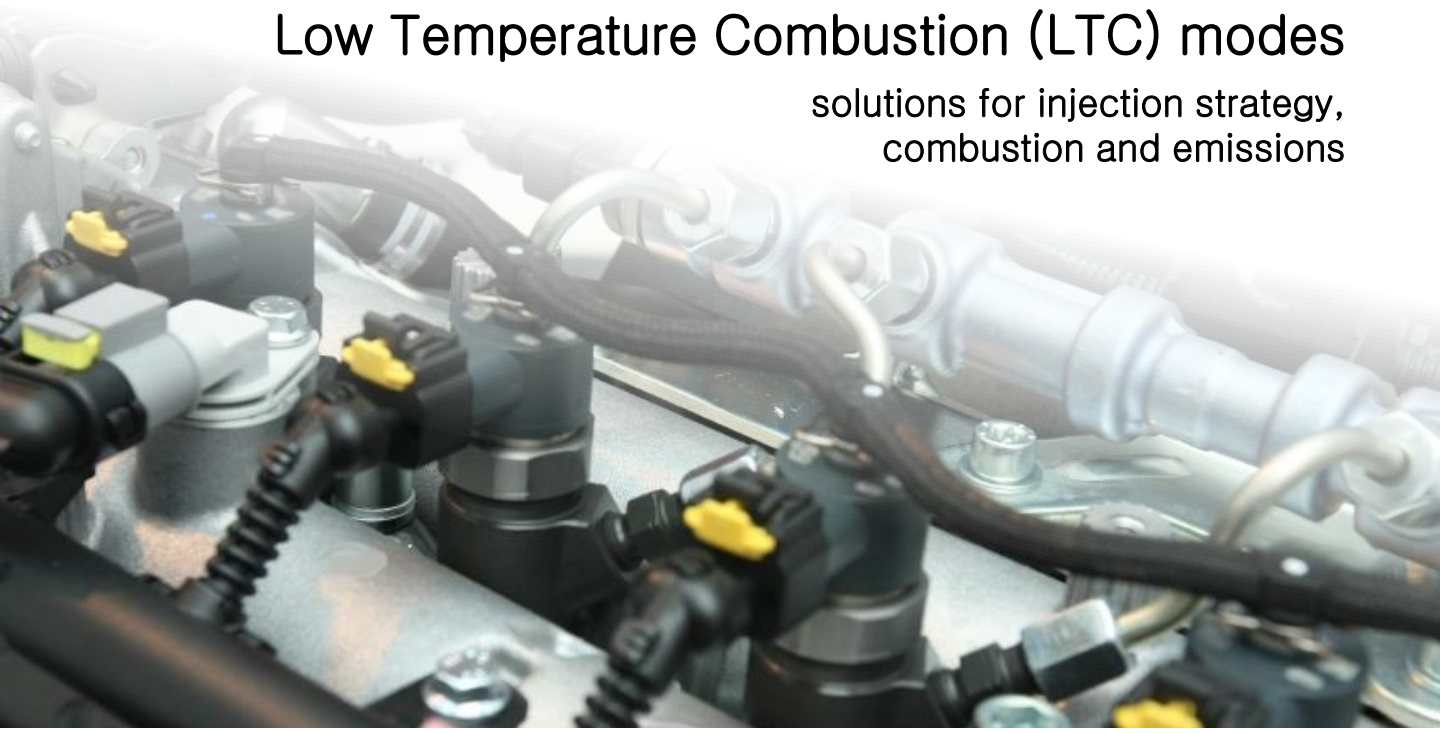
user story

Partially-Premixed Compression Ignition (PPCI) and Low Temperature Combustion (LTC) modes

solutions for injection strategy, combustion and emissions



THE CHALLENGE

Simulate multiple injection strategies in PPCI combustion mode and identify sources of emissions.

THE SOLUTION

Using the srm suite software to simulate fuel stratification in PPCI engine combustion mode using chemical kinetics

THE RESULTS

•A validated combustion model for PPCI applications

•The degree of mixture temperature and equivalence ratio stratification were observed

•Sources of emissions were identified

Regulations on emissions from diesel engines are becoming more stringent in all parts of the world. Hence there is a great deal of interest to develop engine combustion systems that offer the efficiency of a diesel engine, but with low smoke and NOx. One promising approach is that of Partially-Premixed Compression Ignition (PPCI) or Low Temperature Combustion (LTC) mode. Using this approach, smoke can be reduced in compression ignition engines by promoting the mixing of fuel and air prior to combustion. NOx levels can be reduced by reducing combustion temperatures by burning leaner, in pre-mixed mode or using exhaust gas recirculation (EGR).

The influence of fuel has also proven significant; **Those fuels which have proven more resistant to ignition i.e. gasoline rather than conventional diesel, have more time to mix prior to ignition thus lowierng rates of soot formation in these modes**. This opens up the possibility of adopting gasoline or fuels with lower cetane numbers within conventional diesel engine technologies.

However, by expanding the number of injections, varying the volume of fuel within each injection event and changing the fuel type, further insight into the impact of these variations must be obtained in terms of their impact on the knock limit and emissions.

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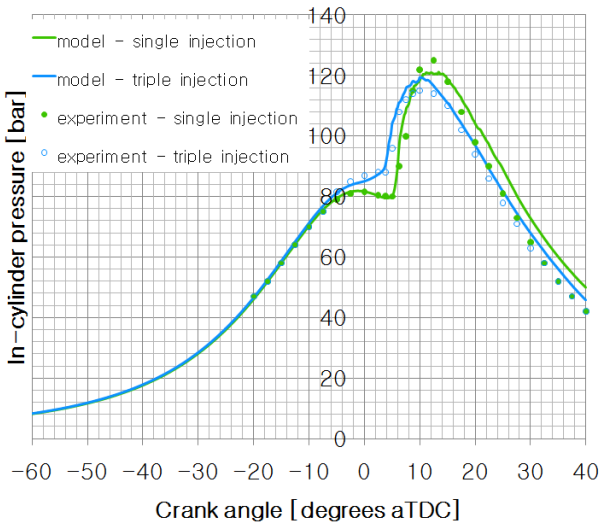


In-cylinder pressure versus crank angle of a 0.537 litre single cylinder diesel engine with a compression ratio of 15.8:1 operated using an 84 RON gasoline fuel. Bosch injectors were adopted with seven holes of 0.13mm diameter. Single injection SOI =-11.2 CAD aTDC, Triple injections a) 25% SOI @ -180 CAD aTDC, b) 15% @ - 76 CAD aTDC and main @ -7 CAD aTDC.

APPLICATION AREAS

- PPCI and LTC combustion
- alternative fuel injection strategies
- gasoline or diesel fuelling
- emissions

PRODUCTS USED

- srm suite

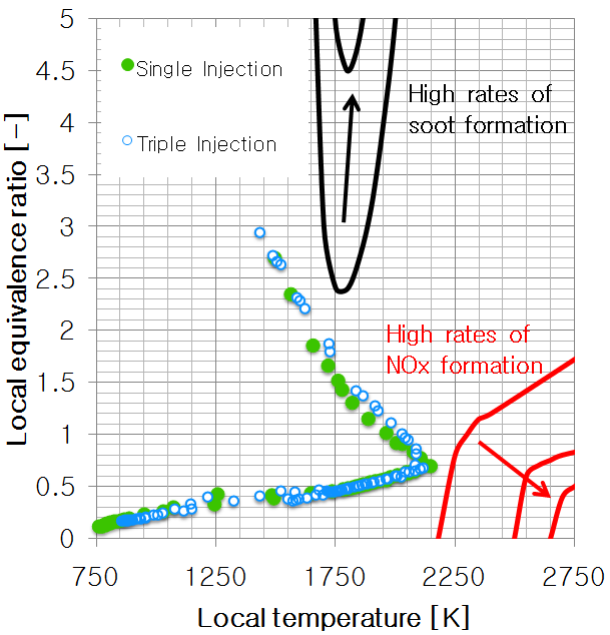
THE RESULTS

•The srm was used to simulate PPCI combustion

The process of injection, fuel mixing and subsequent auto-ignition were simulated using srm suite. Results were consistent with those observed in the experiments.

•Further insight into sources of emissions

This work has demonstrated that low emissions are observed due to the adoption of high EGR concentrations and optimal injection timings. The figure below highlights how intelligent injection strategies can be employed to control the in-cylinder composition such that those regions expected to generate high rates of soot and NO_X formation are avoided.



In this diagram, the mixture temperature and equivalence ratio are plotted at peak pressures for both cycles. The regions of high rates of soot and NO_x formation are also presented. The marks in blue and green represent the local compositional state of the in-cylinder mixture, demonstrating the degree of mixture stratification in terms of both equivalence ratio and temperature. All areas of the combustion chamber avoided those regions of excessive formation rate of soot and NO_x.

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