Future Engines & Fuels Laboratory

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Effect of Variations of Biodiesel Blends on Engine Combustion and Emissions

INTRODUCTION

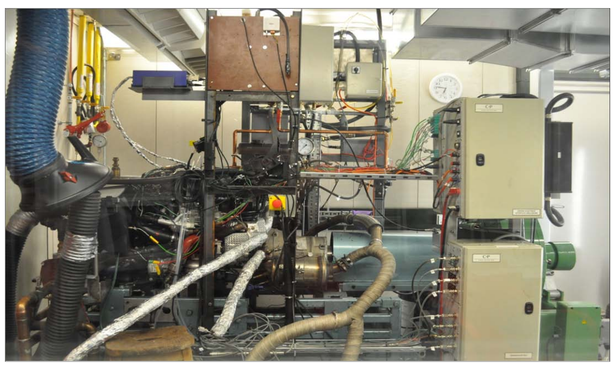
The increasing concerns of energy and CO_2 emissions drive the seeking of renewable energy source for future fuel. Although biodiesel has been commercially blended with fossil diesel for diesel engines over one decade, the lack of comprehensive understanding of combustion behavior and emissions using biodiesels from different feedstock becomes the main obstacle. In this research work, a variation of biodiesel blends have been used to investigate the effects of fuel properties on the engine performance and emissions using a modern 3.0L V6 Jaguar diesel engine. The experimental work involves 1st and 2nd generation of biodiesel.

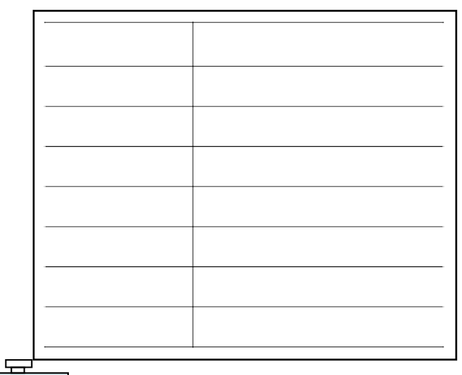
RESEARCH OBJECTIVES

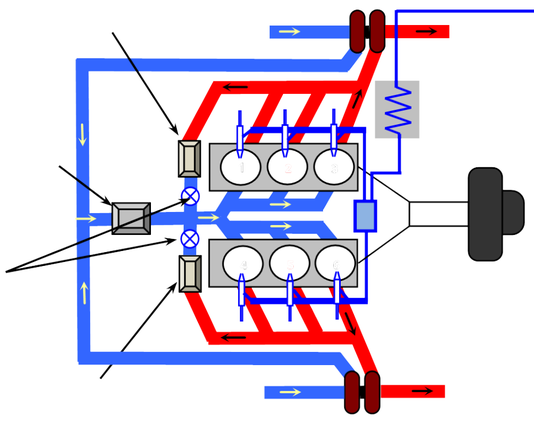
1. To investigate the effects of a variation of biodiesel on the engine performance and emissions.
2. To understand the combustion behaviour and emission characteristics for the 1st and 2nd generation of biodiesel.
3. To provide a general overview to the engine manufacturer for the optimisation of engine calibration with biodiesel-diesel blends.

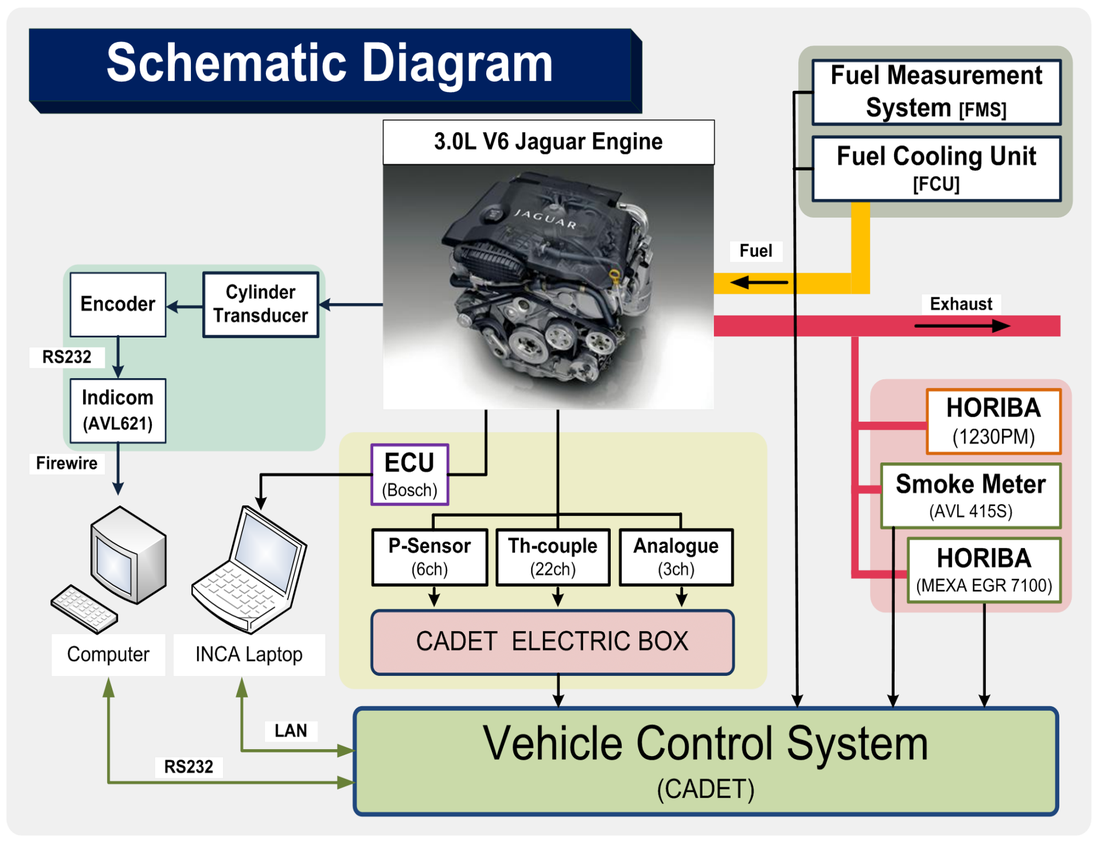
ENGINE SPESIFICATIONS

A 3.0L V6 Parallel Sequential Twin Turbocharged Diesel Engine

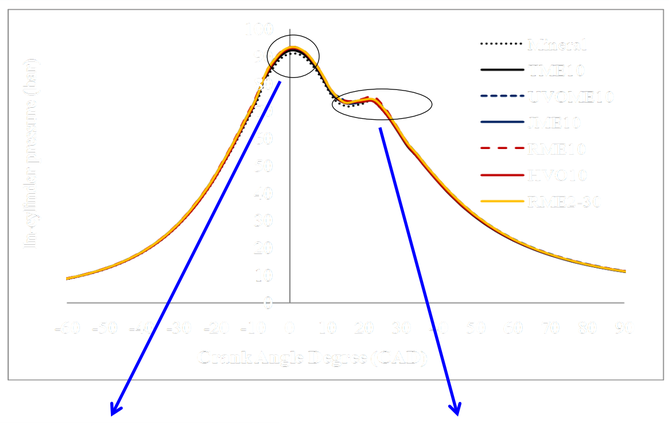


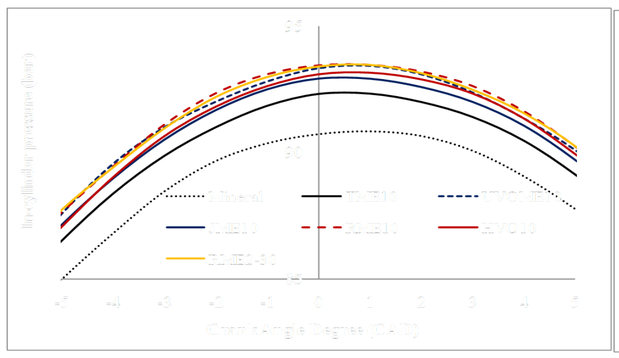


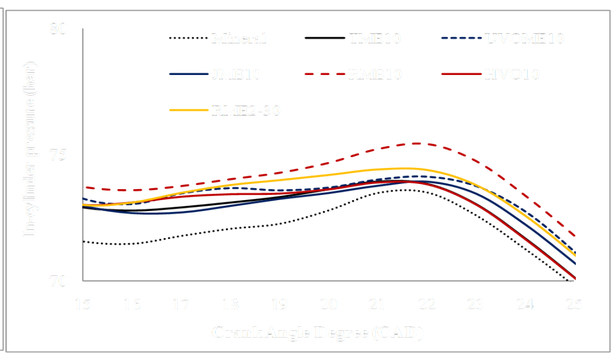




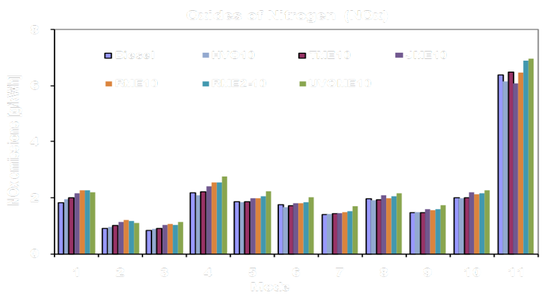
RESULTS ANALYSIS

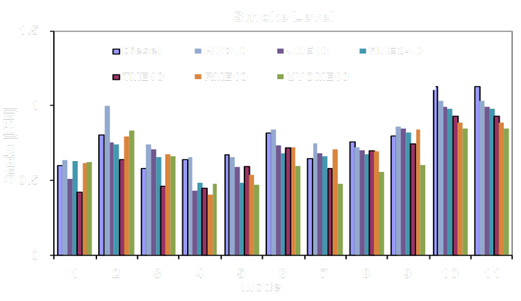


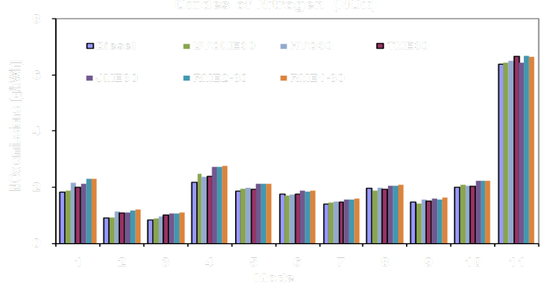


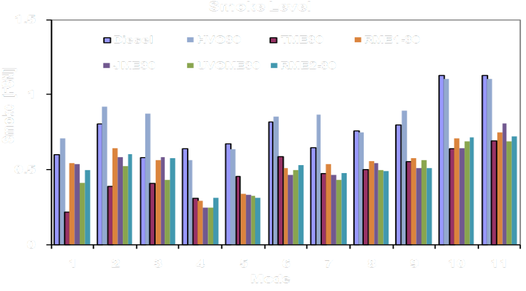


RESULTS OF ENGINE EMISSIONS









DISCUSSION AND CONCLUSION

In-cylinder pressure profile (bar)

The higher peak in-cylinder pressure with biodiesel-diesel blends fuelling is attributed to the higher cetane number and reduced ignition delay. This is also attributed to the higher oxygen content of the biodiesel-diesel blends that lead to the improved combustion process as mentioned by previous studies [1, 2].

Oxides of nitrogen emissions (g/kWh)

The key influence of higher NO_x emissions from the biodiesel-diesel blends combustion is a result to high peak in-cylinder pressure, temperature and oxygen content [1]. This is due to higher cetane number than reduced the ignition delay and more fuel burnt at premixed combustion [3].

Smoke level (FSN)

It is observed that when the engine is fuelled with biodiesel-diesel blends, results in significantly less smoke as compared to diesel. This is due to improvement in combustion efficiency with biodiesel-diesel blends. The higher oxygen content in biodiesel is favorable for the soot oxidation process (complete combustion) [2,3], and it is well accepted that biodiesel soot can oxidize up to six times faster than the soot emitted by diesel fuel.

PUBLICATION

1.Tsolakis, A. and A. Megaritis, *Partially premixed charge compression ignition engine with on-board H2 production by exhaust gas fuel reforming of diesel and biodiesel.* International Journal of Hydrogen Energy . **30**(7): p. 731-745.2005.
2. Chuepeng, S., H.M. Xu, A. Tsolakis, M.L. Wyszynski, P. Price, R. Stone, J.C. Hartland and J. Qiao, *Particulate Emissions from a Common Rail* Fuel *Injection Diesel Engine with RME-based Biodiesel Blended Fuelling Using Thermo-gravimetric Analysis.* SAE Paper, 2008-01-0074, 2008.
3. Mamat, R., N.R. Abdullah, H. Xu, M.L. Wyszynski and A. Tsolakis, *Effect of Fuel Temperature on Performance and Emissions of a Common Rail Diesel Engine Operating with Rapeseed Methyl Ester (RME).* SAE Paper, 2009-01-1896.2009.