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Combustion and performance studies on DI diesel engine with biodiesel and additive

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ABSTRACT

The need of the day is search for the alternate fuel such as bio diesel. Biodiesels have different properties to pure diesel especially higher viscosity. This research studied the effect of using biodiesel and additive on engine performance and emissions. Pure diesel and biodiesel (MOME) blends with additive (DMC). Mahua Oil Methyl Ester (MOME) with Di Methyl Carbonate (DMC) is promising fuel combination to reduce emissions in DI diesel engine due to high oxygen content of the additive as well as the oxygen content of neat bio diesel. DMC is special solvent to most of the methyl esters of vegetable oil. The blends of MOME with 6% DMC is observed to yield maximum thermal efficiency at full load. DMC and MOME blends have fewer effects on NOX emission because of surplus molecular oxygen available. HC,
CO and Smoke were considerably reduced.

Introduction

Emissions from the diesel engines seriously threaten the environment and are considered one of the sources of air pollution .These pollutants cause environmental problems and carry carcinogenic components and significantly endanger the health of living things. They can cause serious health problems, especially respiratory and cardiovascular problems to human beings. Diesel engines are mainly used in automobile, industrial and agricultural applications due to their high efficiency and reliability .Due to price hike and rapid depletion of fossil fuels researchers concentrated their research on alternate fuels. Bio diesel which is produced from renewable sources receives more and more attention as an alternate energy source. The main advantage of Bio diesel is that it can be used in diesel engines without any modifications. However there are some drawbacks like lesser shelf life and crank case oil dilution at higher temperatures.

Experimentation

The experimental setup consists of the following equipment:

1 Single cylinder DI engine loaded by eddy current dynamometer

2 Engine Data Logger

3 Exhaust gas Analyzer

4 Smoke Analyzer

5 Vibration Analyzer

The schematic diagram of Fig. 1.represents the instrumentation arrangement for the experimental setup. Piezo electric transducer is fixed (flush type) to the cylinder body (with water cooling adaptor) to record the pressure variation in the combustion chamber. Crank angle is measured by using crank angle encoder. Exact TDC position is identified by the value timing diagram and fixed with a sleek mark on fly wheel and the same is used as a reference point for the encoder. With respect to this point signals of crank angle will be transmitted to the data logger. The data logger synthesizes the two signals and final data is presented in the form of a graph on the computer using C7112 software

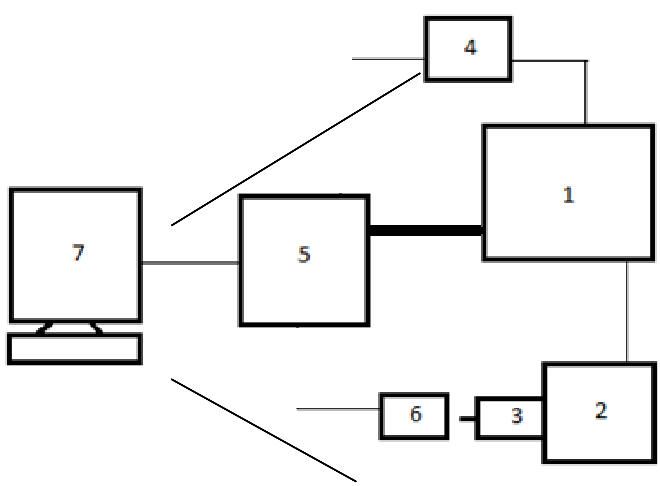

Fig.1

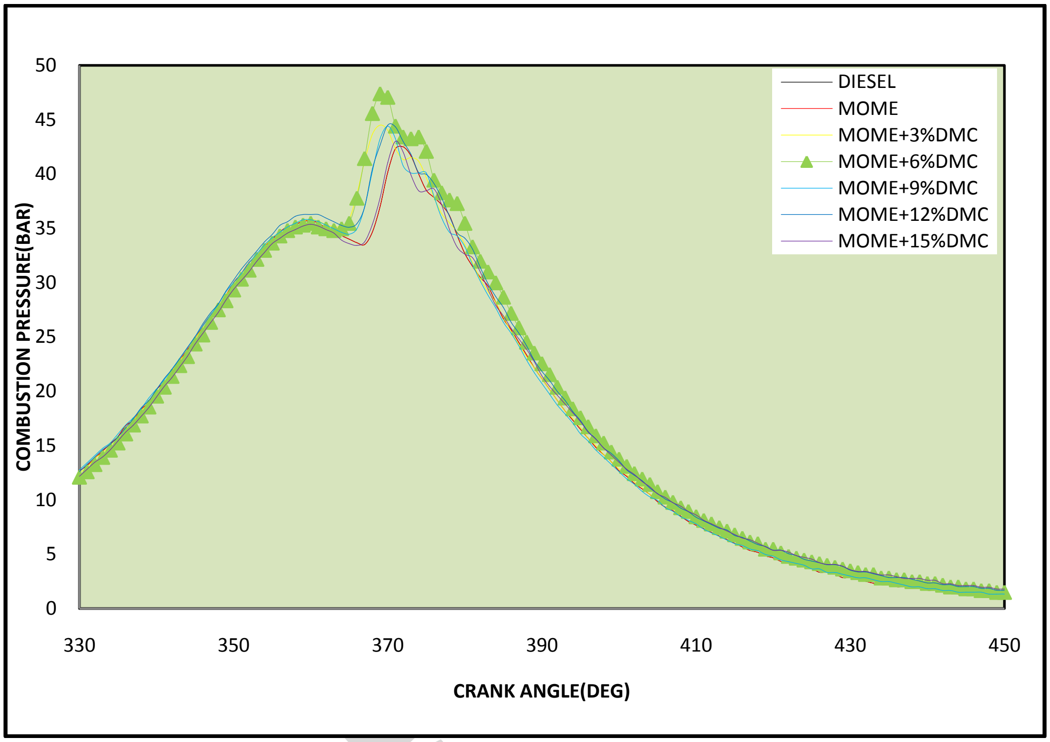

Fig.2. COMBUSTION PRESSURE VARIATION FOR DIESEL, MOME, MOME DMC BLENDS AT NO **LOAD**

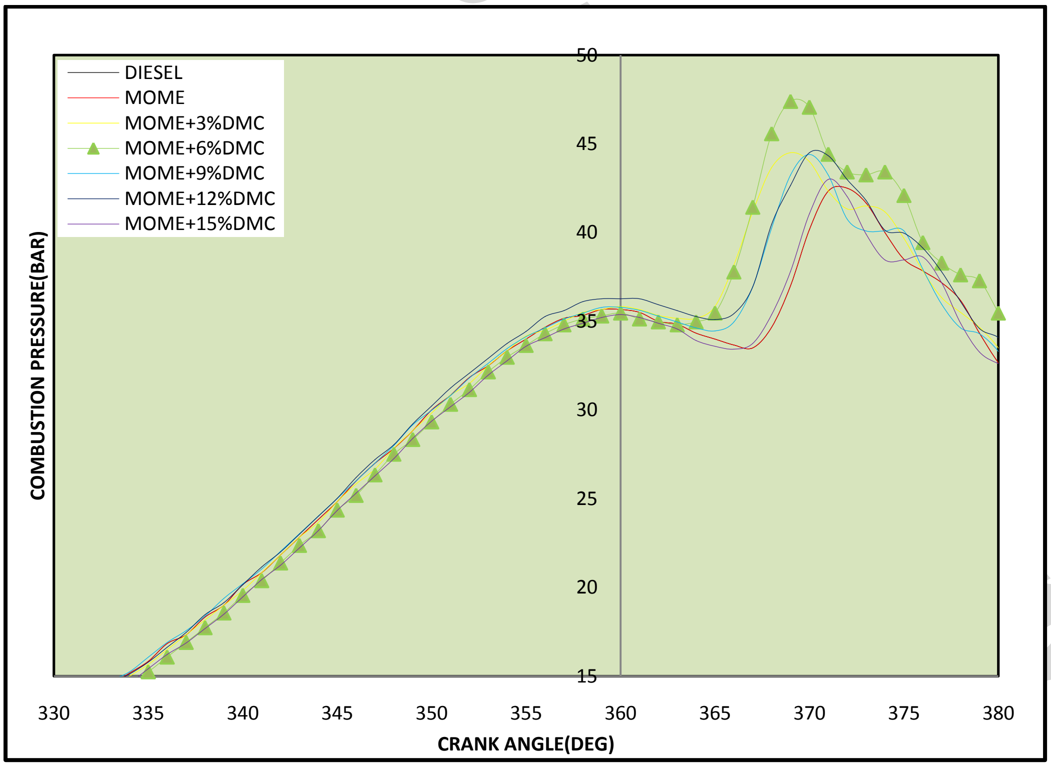

Fig.3.DELAY PERIOD PLOT FOR DIESEL, MOME, MOME DMC BLENDS AT NO **LOAD**

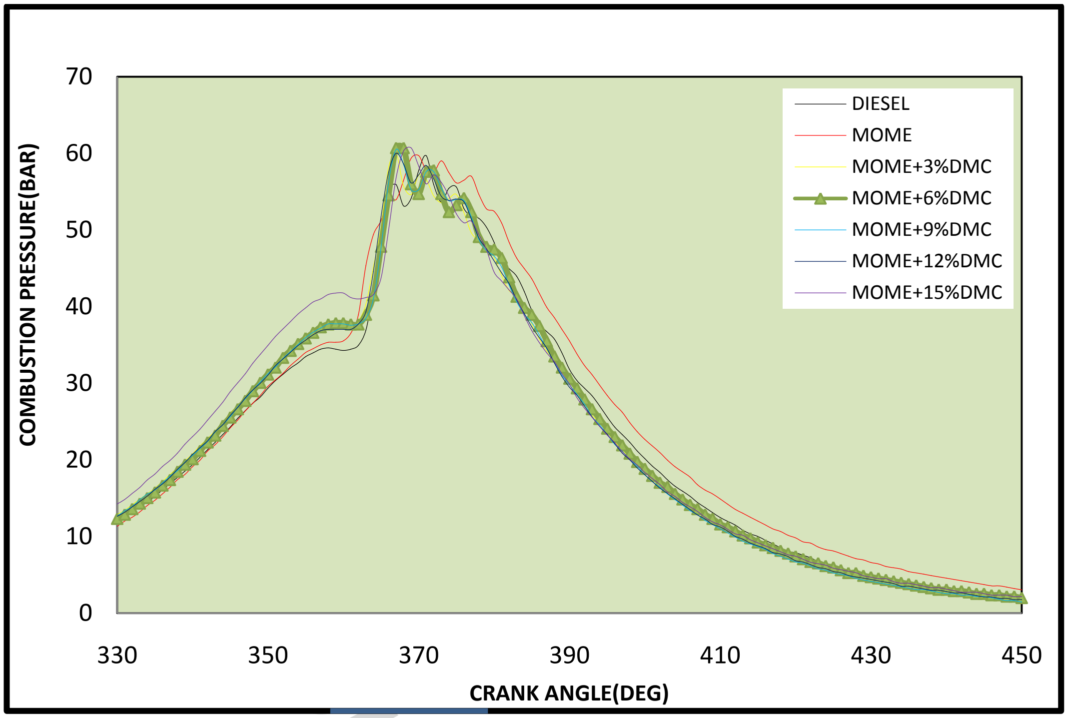

Fig.4. COMBUSTION PRESSURE VARIATION FOR DIESEL, MOME, and MOME DMC BLENDS AT **FULL LOAD**

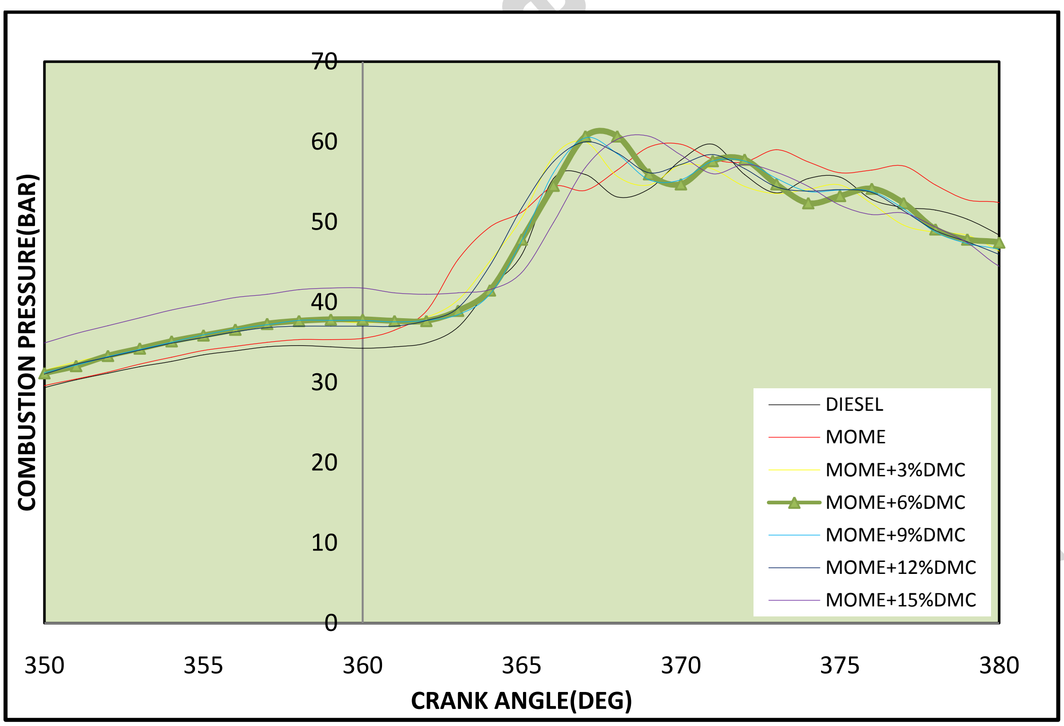

Fig.5.DELAY PERIOD VARIATION FOR DIESEL, MOME, and MOME DMC BLENDS AT **FULL LOAD**

Results & discussion

Pressure variation with crank angle shown in figure 2 and figure 4.Delay period with crank angle is clearly visible in figure 3 and 5 at no load and full load respectively. These four graphs indicate the peak pressure is more for MOME with 6%DMC blend and close to TDC. It is an indication for higher work output and hence higher thermal efficiency. Engine performance and exhaust emissions for diesel, MOME, MOME with 3%, 6%, 9%, 12% and 15% of DMC have been recorded, without any modifications to the engine. The results are compared with conventional diesel fuel and discussed. Brake thermal efficiency with brake power from no load to full load for neat diesel, MOME and MOME with DMC. It is observed that thermal efficiency for MOME increases with brake power compared to diesel at any load. However, MOME with 6% DMC, even though the mean calorific value is low, the efficiency is observed maximum because of the solution properties with the DMC. BSFC increases with increase in DMC, due to low mean calorific value but MOME with 6% DMC the results are better probably, reacting with acids and bases in the biodiesel which is exothermic in nature and excess over 6% DMC is not regulating diffused combustion. Exhaust gas temperature with MOME, MOME with DMC compared to neat diesel. This may be because of lower heat release rates at higher percentages of DMC as the resulting calorific value is low.

Conclusion

- In all blended fuel versions, MOME with 6%DMC leads to maximum peak pressure close to TDC.
- There is a fall in exhaust gas temperatures in the engine at higher percentages of DMC. This may be due to lower heat release rates in diffused combustion zone by virtue of lower calorific value of the blended fuel.

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