

Experimental Investigation of Emission Reduction by Blending Methanol, Ethanol and Biodiesel with diesel on C.I. Engine

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Abstract

This research paper, the performance and the emission testing's carried out on a single cylinder diesel engine. The experiment involves the blending of diesel with methanol, ethanol and biodiesel by some definite proportion by volume, in order to obtain the maximum blending at which the engine performs its best and also the emission of harmful gases get reduced. Biodiesel is obtained by transesterification of castor oil. Here the blending is done with 5%, 10% and 15% of methanol, ethanol and with 20% and 40% of biodiesel with that of diesel. By blending, improved efficiency of the diesel engine and consequently reduced emission of harmful gases can be obtained than diesel. Also the blended fuel has many other advantages. This blended fuel can be used in an automobile at lower cost than that of diesel and also with improved efficiency and reduced emission of gases.

Keywords

Bio-diesel, Diesel, Transesterification, Emission

fuels are the most efficient one, it has some deficiencies too. It has lower calorific values and higher shipping cost. Fossil fuels such as diesel, petrol etc; produces harmful gases such as oxides of carbon, sulphur and nitrogen as a result of combustion. These harmful gases disturb the ecological balance. The rising price of oil has brought a considerable strain to the economy of the world. Moreover developing countries does not possess oil reserves to satisfy the increasing need of energy. According to the recent studies fossil fuels are available for about 100 more years. While using fossils as a main source of thermal power, there is a fear that will get exhausted in the recent centuries. The present crisis demands the need of an alternative fuel. The need of an alternative fuel can be fulfilled by a processed fuel derived from biological sources called biodiesel. Advances in technology have allowed development of alternative energy sources. Alternative energy sources are renewable, cleaner, and more dependable than traditional fuels. Methanol, ethanol and biodiesel are an alternative energy sources.

1. Introduction

The world of century 2000 presents many critical challenges. One of the most important challenges concerns the environment. As population increases and the standard of living improve, there is an increasing concern that there will be shortage of energy to heat our homes and power the vehicles we so heavily depend on. We must also remember the need for clean air, clean water, clean fuel and biodegradable renewable materials. The demand for energy increases day by day. The world mostly depends on fossil fuels. Even though fossil

2. Experimental Setup

These experiments are done in a single cylinder diesel engine. The main components of the experimental setup are:

1. Single cylinder diesel engine
2. Fuel supply line
3. Exhaust gas analyzer

The single cylinder diesel engine is connected to the fuel tank through a pipe. Through this pipe the fuel is supplied continuously to the engine cylinder. The engine is having a cam shaft which is to be rotated to start the engine. The fuel tank is fitted with a burette having the divisions in centimeter. This

is used to measure the time taken to consume 10 cc of fuel by the engine. Also the engine is having one manometer which shows the readings to measure the pressure in the pipe. The whole engine is supplied with water that acts as coolant which is circulated using a pump. The coolant takes away the heat from the engine and discharges it outside and is again circulated using the pump. The exhaust gas analyzer is used to measure the emission of harmful gases. This analyzer is fitted to one probe whose other end is connected to the exhaust pipe of the engine. Because of this, some exhaust gas will flow into the analyzer and thus it will show the readings. Care should be taken while draining out the excess fuel out of the engine in order to prevent air lock before doing the other sets of experiment.

3. Engine Specification

The biodiesel produced is made to run on an IC engine and its performance is recorded.

1. Type of engine : Vertical, C.I. four stroke cycle
2. Speed: high speed.
3. Number of Cylinders: One
4. Brake Power: 3.7 KW
5. Speed: 1500 rpm
6. Bore: 80mm
7. Stroke: 110mm
8. Compression Ratio: 16:1
9. Cooling: Water cooling
10. Orifice diameter: 0.02m
11. Coefficient discharge: 0.62m
12. Type of loading: brake drum dynameters.
13. Radius of brake drum: 0.1524m

4. General Procedure before Starting

1. Check cooling water supply and fuel supply to engine before starting.
2. Then change the position of the decomposition lever.
3. Shaft the engine of rotating the constant manually and change the position of the de-combustion lever to normal position

5. Set of observation

1. Speed of camshaft (to calculate the speed of crank shaft.).
2. Manometer difference (to calculate the amount of air blow)
3. Time taken for 10cc of fuel consumption in the burette.

6. Experiment Procedure

The fuel tank is first filled with the diesel using which the engine performance tests and emission testing is to be done. Then the cam shaft of the engine is rotated to start the engine at zero load. As the engine started, it is left for 5 mins. Then the readings are taken for the time taken to consume 10 cc of fuel. Gradually the load is being increased on the engine by adding 1, 2, 3, 4 & 5 Kg. Similarly the readings are taken for the time taken to consume 10 cc of fuel. Also the manometer readings are taken to find out the pressure inside the pipe. Consequently the emission values of the exhaust gas at different load conditions are obtained. Using this exhaust gas analyzer NOX, CO₂, CO & Hydrocarbon have been found out.

Once the experiment is done using diesel then we use the blended diesel with methanol, ethanol & biodiesel by varying the amount by volume. At first 5% methanol is blended with diesel and the performance and emission values are compared with that of diesel. This M5 (5% methanol) blending is then poured into the fuel tank only after draining out the entire earlier diesel left after the experiment. Care should be taken at the time of draining to prevent airlock of the engine. After that the same process is repeated as above.

Similarly the same procedure is done with other blending such as M10 (10% methanol), M15 (15% methanol), E5 (5% ethanol), E10 (10% ethanol), E15 (15% ethanol), B20 (20% biodiesel) & B40 (40% biodiesel). All the values are noted down and the performance and emission graphs are plotted with respect to diesel. The optimum blending has been found out after the experiments at which the engine performance is best and the emission of harmful gases are lesser.

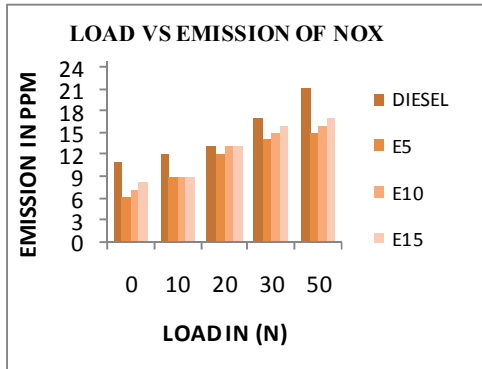
7. List of Observation

1. Emission & performance test using diesel
2. Emission & performance test using 5% methanol blending
3. Emission & performance test using 10% methanol blending
4. Emission & performance test using 15% methanol blending
5. Emission & performance test using 5% ethanol blending
6. Emission & performance test using 10% ethanol blending

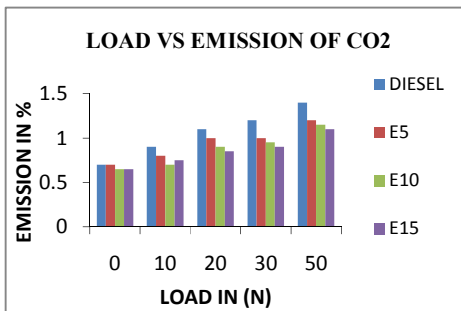
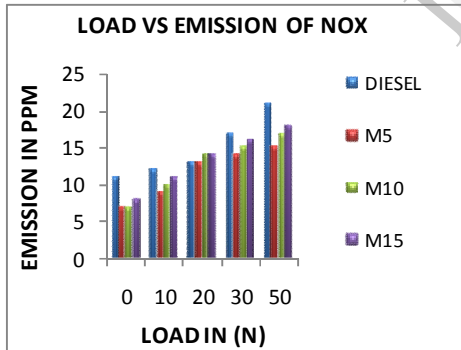
7. Emission & performance test using 15% ethanol blending
8. Emission & performance test using 20% biodiesel blending
9. Emission & performance test using 40% biodiesel blending

8. Results and Discussion

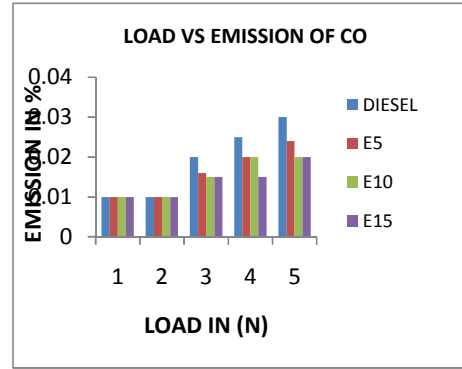
Emission Graphs



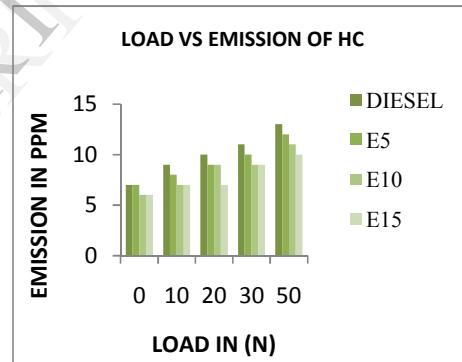
This graph is drawn between the load and the emission of NO_x. It is found out that after blending the emission reduces. Here E5 is optimum blending for emission since after this the NO_x emission increases.



Here the emission of CO₂ decreases after blending. After E5, emission decreases further.



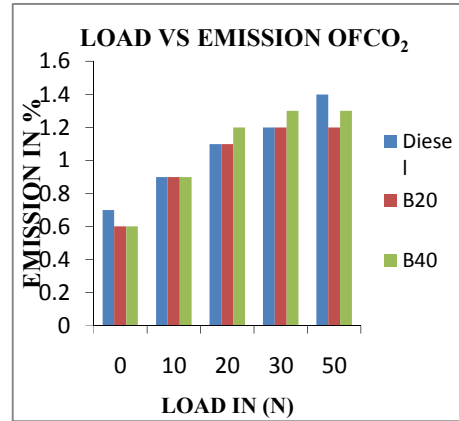
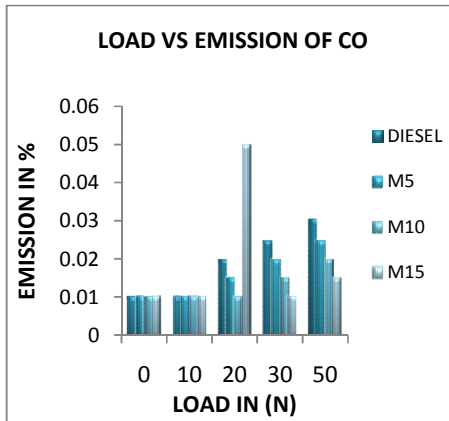
This graph shows the load vs emission of CO. Here also same behavior is shown, emission decreases after blending up to E15.



In this the emission of HC decreases as we increase the percentage of blending up to E15.

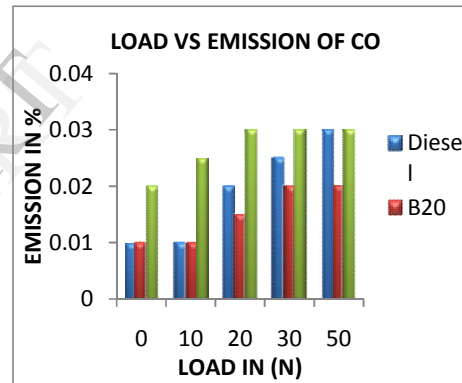
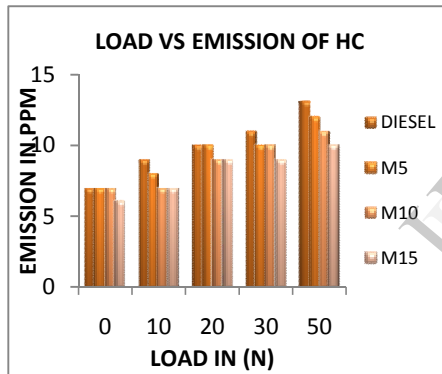
Here also the emission characteristics are same like ethanol blending. The NO_x emission decreases after blending but after E5 the emission increases.

Here the emission of CO₂ decreases after blending. After E5 emission decreases further.



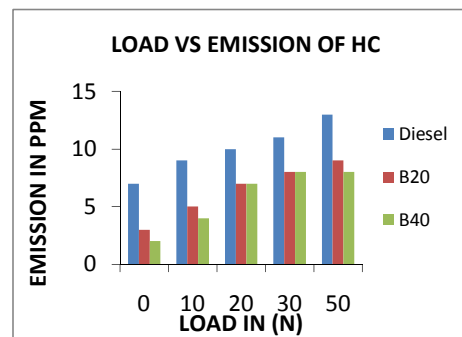
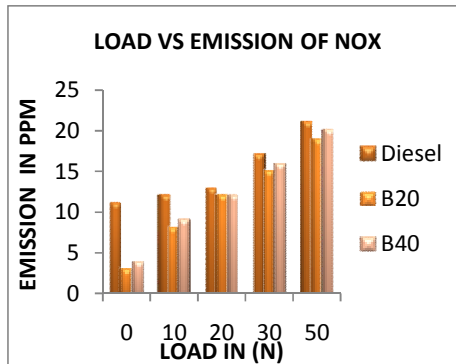
This graph shows the load vs emission of CO. Here also same behavior is shown, emission decreases after blending up to E15.

Here the emission of CO₂ decreases after blending up to B20. At B40 blending there is again an increase in emission.



In this the emission of HC decreases as we increase the percentage of blending up to E15.

From this graph it is found out that the CO emission decreases after blending to B20. But after that it increases at B40 blending.



This graph shows the emission of NO_x with the load. After blending the emission decreases for B20 but again increases at B40 blending.

From this graph it is found out that the emission of HC decreases after blending from B20 to B40.

Conclusion

Based on my experimental analysis of emission and performance testing, the following conclusions are drawn -

1. The level of NO_x was found to be considerably less after blending with methanol, ethanol and biodiesel.
2. Also other gases like CO₂, CO and HC were found to be less after blending with methanol, ethanol and biodiesel.
3. Emission of CO is reduced by 40-50%.
4. Emission of NO_x is reduced by 25-40%
5. Emission of HC is reduced by 8-10%
6. Emission of CO₂ is reduced by 9-12%

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