Emission characteristics of Madhuca Indica (mahua oil) biodiesel and its blends after treatment with turpentine oil in a CI engine.

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ABSTRACT

In the present work, a practical work has carried out to check the performance properties of a diesel engine charged by the mineral diesel, B10 blend of mineral diesel with mahua oil bio diesel and B10 blend of mineral diesel with mahua oil methyl ester (MOME) after treatment with turpentine oil. The performance characteristics which are to be measured is break power (BP), break mean effective pressure (BMEP), break thermal efficiency (BTHE), break specific fuel consumption (BSFC), mechanical efficiency. The outcomes would be compared to the mineral diesel in the same conditions. It has been observed that at higher load B10 blend of MOME and turpentine have higher break power, while there is no change in the break mean effective pressure [9]. Its thermal efficiency is less than mineral diesel but more than the more than the B10 blend of mineral diesel with MOME only. On the other hand, the fuel consumption has also decreased at higher load if treated MOME is used in engine. Mechanical efficiency of mineral diesel is quite low at higher loads as compare to the bio diesel however treated bio diesel is having comparable mechanical efficiency to the MOME.

Keywords: Bio diesel, Mahua Oil, Turpentine oil, Performance Characteristics.

INTRODUCTION

Biodiesel make use of several biological sources like animal fat or vegetable oil. Around 100 years ago, a lot of research was in process to use vegetable oil in place of mineral diesel fuel but with time this interest started decreasing due to the reason that petroleum fuels were available in plenty amount and very less cost. But with time, demand of petroleum products started increasing and due to increase in its demand, its prices also started increasing [5]. Eventually it is leading to shortage and depletion of fuels, production of carbon dioxide is increasing. Now from 1970's due to drastic increment in cost, alternative fuels are found with the purpose of providing replacement to petrol products. Earlier the main concern for replacement was only to secure the petroleum fuels, but with time along with security new concern area was to reduce production of carbon dioxide. Vegetable oils help in taking away carbon dioxide (CO_2) at the time of production in much more amounts in comparison to the amount that is added by combustion later on [7]. Many investigations revealed that crude vegetable oil leads to many problems when it is used as a fuel in compression ignition engine. In CI engine lubricating oil layer starts thickening and lot of deposits are formulating, due to these main reason's problems start arising at very early and the main reason for all these problems is viscous oils. Many solutions are there to reduce the viscosity, blending can be done, emulsification can also be done. But these solutions are not that efficient [8]. There are several other ways to use vegetable oil by preparing monoester and this ester product is produced by the process of transesterification.

Hemant et al [2]

In this paper, biodiesel is prepared from methyl ester of castor oil. Which type of oil is usually we have in INDIA edible or non- edible oil. Then which oil is having low cost or high cost and the yearly production of the oil. Mainly in INDIA, edible oils are not used for bio diesel production only non-edible oils are used for the production of biodiesel because price cost of edible oil is higher than the non-edible oil. Castor oil found the best out of the non-edible oils. Because the production is very large and the oil produced from the seeds are also in large quantity.

Edible oil	Oil output (oil/ha)	Oil output (wt %)	Non-edible Oil	Oil output (Oil/ha)	Oil output (wt %)
Soya bean	375	20	Castor	1180	53
Palm	5000	20	Jetropha	1590	50-60
Rapeseed	1000	37-50	Rubber seed	80-120	40-50

Table 1: Represents output of edible oil and non-edible oil in India

Atul Dhar at el [1]

In this paper, biodiesel is prepared from neem oil and characteristics of biodiesel are checked on the basis of thermal properties, emission and combustion characteristic. After checking through the properties, the FFA neem oil is found marginally low quality than the mineral diesel (as shown in table). The performance checked at constant speed on CI engine and found that the blend is having BSFC is greater than the diesel. These properties are checked at the same BSFC. If the biodiesel blend taken in higher concentration combustion gets delayed slightly. Table 2 shows the Combustion duration for the same blend is little shorter than the fossil diesel.

	B05	**B10**	**B20**	**B50**	**B100**
BSFC	- (1.5 to 4.8)	- (2.6 to 9.6)	+ (3.2 to -2.6))	+ (1.3to11.1)	+ (2.3to13.5)
BTE	+(5.8 to -0.8)	+[12.2 to (-1.2)]	+(5.7to -0.3]	+(6.1 to -3)	+(2.4 to 13.5)

Table 2 shows the BSFC and BTE value as per the blend

N. Saravanan et al [6]

In this paper, performance of MOME on the engine is tested and found.

Power	↓ 13%
Fuel consumption	↑ 20%
CO emission	↓ 26%
HC emission	↓ 20%
NOx	↓ 4%

Due to higher fuel consumption or lesser calorific value the space require on vehicle is large. If we inject fuel at higher pressure then we can overcome this problem. Although its emission contents are environment friendly and we can use its blend with mineral diesel as an alternative.

Experiment Test Machine

The experimental test machine setup consists of one cylinder, 4 strokes. It is a VCR (Variable Compression Ratio) diesel engine connected eddy current type dynamometer for loading. The compression ratio can be varied without changing the geometry of combustion chamber and without stopping engine. By specially designed **tilting cylinder block** arrangement [3]. This set up is capable to analyze the VCR engine performance for the brake power (BP), indicated power (IP), frictional power (FP), Break Mean effective pressure (BMEP), Indicated Mean Effective pressure (IMEP), Break thermal efficiency (BTE), Indicated thermal efficiency (ITE), Mech. Eff., Vol. Eff., SFC, Air/Fuel ratio and heat balance sheet. Lab view based Engine Performance Analysis Software Package "Engine Soft LV" is provided for line performance evaluation [4]. A computerized diesel injection pressure measurement is optionally provided.

Picture shows the experiment test rig

RESULT ANALYSIS OF EMISSIONS ON CI ENGINE

Effect of Load on CO emission: In this chart we can see that CO emission of mineral diesel is very high as compare to the blends. But CO emission of B10 of MOME and B10 of MOME + T is having very similar CO emission. There is no such variation in the CO emission of both the blends but there is huge variation between the blends and mineral diesel. At lower loads variation is high but at higher load blends and mineral diesel is having similar CO emissions.

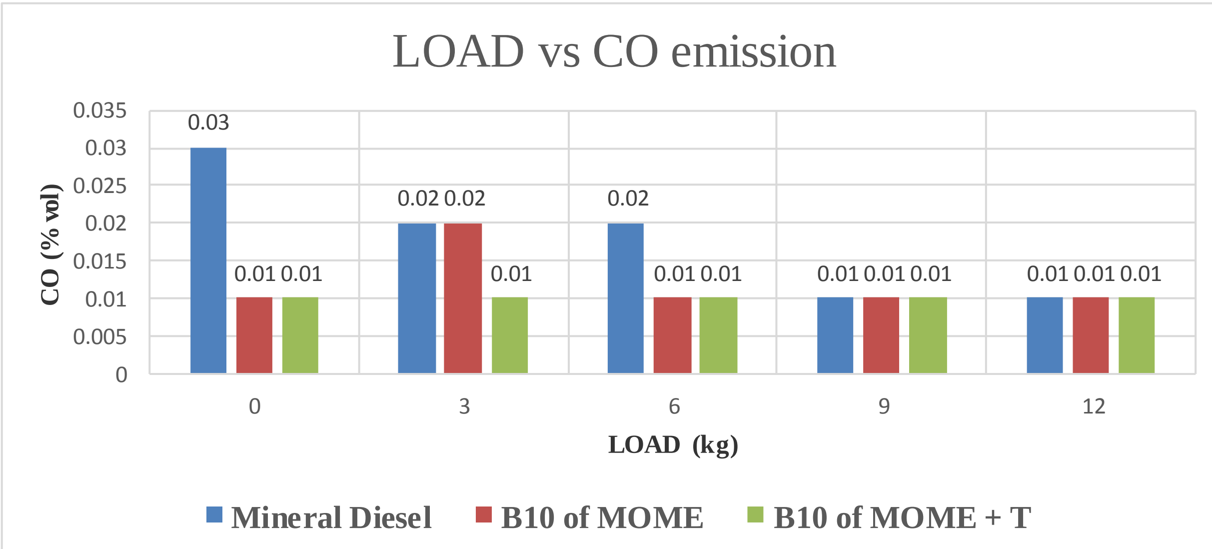

Figure: Plot shows the variation of CO emission with Load of Blends

Effect of load on Hydrocarbon emission: In this plot we can observe that mineral diesel is having very high HC emissions. As the load increases HC emission decreases but not as much the biodiesel. Blends are having very less HC emissions because it is not having long chain of carbon and hydrogen and it is having one oxygen atom which decreases the HC emissions. If we analyze the blends then there is no such variation in the emission of HC.

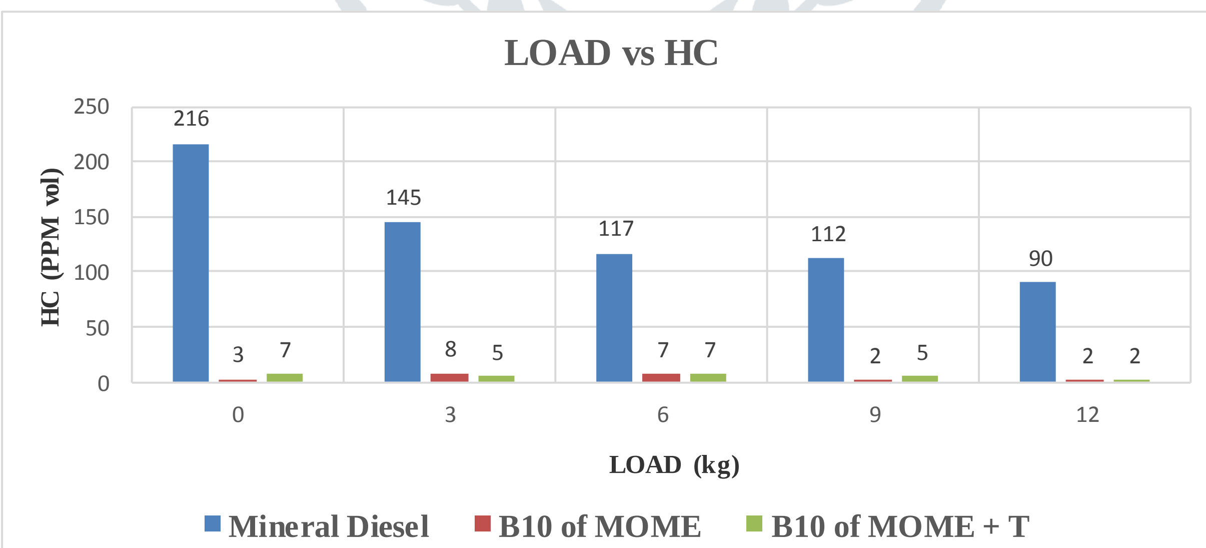

Figure: Plot shows the variation of HC emission with Load of Blends

Effect of load on Carbon dioxide emission: In this chart we can observe the CO_2 emission of mineral diesel is very high as compare to blends at no load there is high emission of CO_2 in B10 of MOME + T it is decreasing as the load increasing from zero.

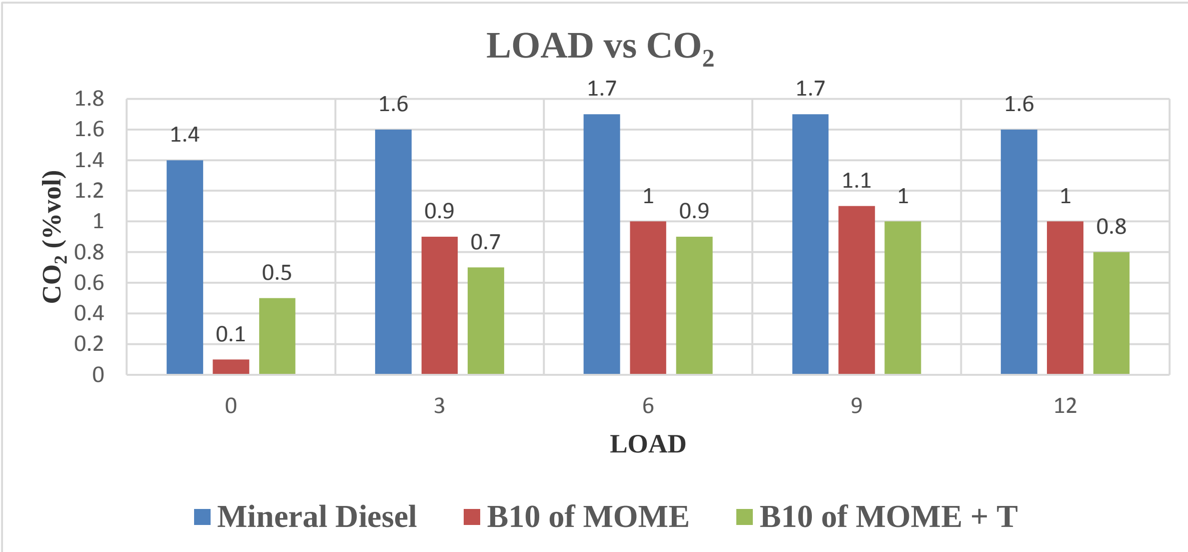

Figure: Plot shows the variation of CO_2 emission with Load of Blends

Effect of load on Nitrogen Oxides emission: In this plot results are very complex because NO_x emission of mineral diesel is very less as compare to both blends. But if we analyze the blends, then NO_x emission of B10 of MOME is higher than the B10 of MOME + T. overall mineral diesel is having less NO_x emission. At higher loads both blends having nearly similar NO_x emission this we can also conclude from the given data.

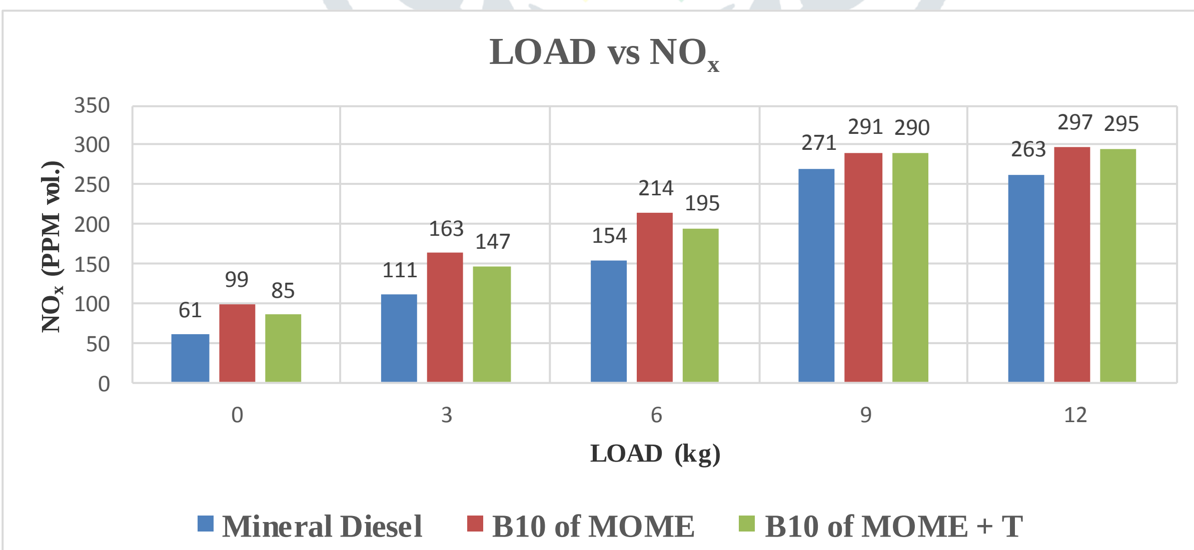

Figure: Plot shows the variation of NO_x emission with Load of Blends

CONCLUSION:

- At a load of 12 kg **CO** emission of blend and mineral diesel is in the following order

B10 of MOME+ T = B10 of MOME = Mineral Diesel

- At a load of 12 kg **HC** emission of blend and mineral diesel is in the following order

B10 of MOME+ T = B10 of MOME < Mineral Diesel

- At a load of 12 kg **CO_2** emission of blend and mineral diesel is in the following order

B10 of MOME+ T < B10 of MOME < Mineral Diesel

- At a load of 12 kg **NOx** emission of blend and mineral diesel is in the following order

B10 of MOME+ T > B10 of MOME > Mineral Diesel

- For the further study different blends of MOME + Turpentine with mineral diesel can be tested on the CI engine.
- Energy and Exergy analysis can be done on the engine using the blends of MOME + Turpentine to identify various losses and efficiencies.
- Blended bio diesel of mahua oil treated with turpentine oil can be used on the compressed ignition engine without any modification on engine

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