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Performances emissions behaviors of Compression ignition engine by mahua oil

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ABSTRACT

The project works deal with the bio-diesel which formed from the Mahua oil by esterifications and follow by the transesterifications. The kinetic study of optimizes the research of Mahua oil Methyl Ester was taken at various parameters as methanol % of surplus alcohol, reactions time and oil molar ratio, concentrations of acid channel and temperature. The output shows that the 4.2% H_2SO_4, 0.35% alcohol ratio, 1.15 h reactions time and the temperature of 60 ^{0}C is optimal condition to the esterifications. The most favorable condition to the production of the bio-diesel is 2.2% sodium Methoxide, 0.1% alcohol oil ratio, 1.15 h reactions time, 60 ^{0}C of temperature and 140% excess alcohol the best condition to the tranesterifications. In this work, the investigation is taken to revision then performances, emissions and combustions properties of mahua Methyl ester. The output was checked by diesel and chosen mahua methyl ester as fuel blend. The setup having single cylinder forced water cooled C.I engine is utilized. At first, engine is run by methyl ester mixed by the volume basis and the corresponding reading is taken. The results are taken entire series of engine operations for different load condition. The performance parameters of engine are like SFC, exhaust gas emissions, break thermal efficiency were cheap with raise in biodiesel concentrations.

Selection and peer-review under responsibility of the scientific committee of the International Conference on Newer Trends and Innovation in Mechanical Engineering: Materials Science.

1. Introduction

Because of the current energies crisis and declining assets of the crude oil supply and demand to alternate liquid fuel especially diesel is raising. The bio fuel is giving the serious thoughtfulness as possible source of the energy in upcoming years, mainly in developing country India. The usage of the edible-oil give bio-diesel in the India is not possible apparent of huge gap of supply and demand of the oil [1–3]. The India is lacking in the edible oil few improved work has taken by the government for producing bio diesel. The bio-diesel from the mahua seed are essential due to the majority of the places as tribal where is noted plentifully. Mahua seed consists of 25 to 40% of fatty oil. The mahua tree is start attitude seed as of the 7th years of plant. The Mahua seed oil is general ingredients of the hydrogenated fats [4–6]. These can get from seed of kernels at room temperature. It is also used to produce of different namely, crude mahua oil, glycerin soap etc. The characteristics of the bio-diesel depend on the esterifications. During chemical compositions noted the mahua oil is approximately same to the non-edible oil. The main reason behind it, choosing the mahua oil as raw material. The transesterifications are the present method of option study, where the result in same to the diesel. The transesterifications were action between the triglyceride and the alcohol available in alkali catalyst for form the glycerol as well as ester. The modulator weight of the ester molecule 1/3 of the oil and less viscosity [7–10]. Though high ratio of the alcohol to oil basically working for get bio-diesel of less viscosity as well as more conversion. An Alkali catalyzed transesterifications are speed when compare to the acid catalyzed. The Methanol mostly use for transesterifications [11]. The method, the mahua oil methyl ester is equipped by alkali catalyst to the sodium methoxide by the transesterifications processes [12] (Table 1).

1.1. Mahua seed

The main type of the genus Madhucaindica and Madhuca long folia was established in India. These are aware consequently strongly connected to no distinctions can be complete in trade of

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Table 1
Properties of bio-diesel.

Properties of bio-diesel	Diesel fuel	B100
Viscosity at 40 °C	4.2	4.95
Flash point (°C)	50	155
Fire point (°C)	60	202
(kJ/kg)		
Density (kg/m^3)	0.8	0.87

Fig. 1. Mahua seed crop and seeds.

the seed. The drying, decortifications give way around 70% kernels seed weight. The kernel seed consists around 50% of oil. This yield is expeller is nearly to 33% – 36%. Hence fresh oil from the correctly store seed in yellow colour [13–16]. The Mahua oil is underutilized non edible vegetable oils and is obtainable in huge quantity. The Mahua oil fuel property of biodiesel was finding within the restrictions of bio-diesel [17–18]. The fuels property of diesel blends and mahua oil is comparable. The mahua oil C.V is around 96.30% on the volume basis. It is noted the mahua can easily substitute upto 25% in the diesel lacking any change in yield, BSFC and brake thermal efficiency [19].

The performances of the engine the mahua oil blend raised with increases of compression ratio changes from 16 to 20. Based on this method, it is noted esters of mahua oil can use as substitutes to the diesel. The bio-diesel chemical reaction is shown in image Fig. 1.

2. Esterification

The Mahua oil products free from the contaminant as well as water is took in three necked round bottom flask. The heat is supply and stirred constantly maintain a steady temperature in the arrangement. The calculated amount of the sulphuric acid and methanol is mixed with oil [20–23]. The reaction time is considered for 1.5 hrs. Occasionally the samples are together at regular interval and acid values are noted. Then the verification of entire reduction of the acid values from 0.1 to 0.5, then heating is controlled. These oil samples are more treated to the transesterification process for get methyl esters [24] (Fig. 2).

2.1. Transesterification

The well identified quantity of oil is charge to the three-necked round bottom flask. The excess alcohol is usually used to make sure conversion of oil to the esters [25–26]. The spotted sample is developed in the solvent systems by glass chamber by solvent. The completions of transesterification are noted by the spray the developed plates with the iodine. These steps are following to the entire sample received by usual interval of time [27] (Fig. 3).

Fig. 2. Constant heating equipment.

Fig. 3. Separation process.

3. Description of setup

The experiment contains of single cylinder four stroke and forced- water cooled C.I engine with attached by eddy current dynamometer and it mount on the balanced base frame. The arrangement has fully powder coated panel boxes consists of an air box, manometer, tank, transmitter and fuel measuring unit etc for the purpose of measures the various parameter. It also consists of sensors for measure crank angles and combustion pressures measurement. These signals were noted by computer. The engine is set with preheat arrangement with the thermo stator (Fig. 4).

3.1. Specifications of test rig

- Kirloskar engine
- Eddy current dynamometer
- Rated speed: 1400 rpm
- Swept volume: 562 cc
- Rated power: 3.6 kW
- Bore diameter: 80 mm
- Stroke length: 110 mm
- Connecting rod length: 234 mm
- Compression ratio: 16.5:1

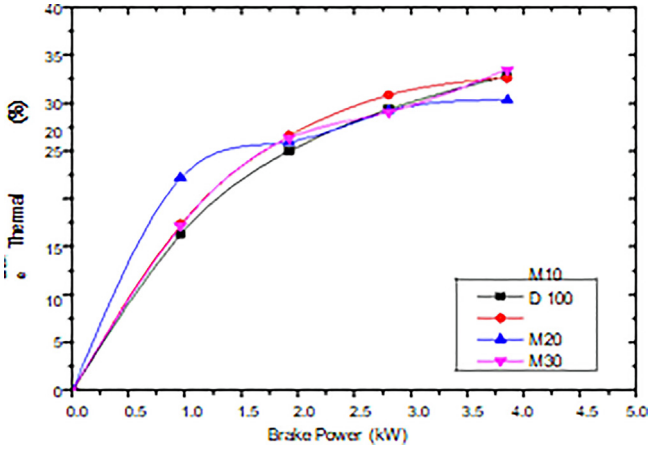

Fig. 4. Brake thermal efficiency vs. BP.

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4. Results and discussion

The experiment setup is run on the 4-stroke single cylinder, forced - water cooled C.I engine at the constant speed of 1500 rpm and changeable load 0 to 100% with the diesel and various blends MSOME like B5, B10, B20, and B30. The performances parameter like BSFC and brake thermal efficiency is noted from constraint and shown in results. The emission parameters like CO; Oxides of Nitrogen is shown in the graphs from the noted values. The fuel additives like 1-Hexanol are mixed to most favourable blends in various proportions for developing performances parameter and minimizing an emission.

4.1. Brake thermal efficiency

It is with BP for various fuels as shown in Fig. 5. These cases, clearly shows the raised with increase BP. It is due to the reductions of loss of heat and raise in the power with raise in load condition. The highest thermal efficiency of M30 during full load condition is 33.49% which was greater than that the diesel of 32%. The increases in thermal efficiency because of oxygen percentage available in the bio-diesel and more oxygen lead to cause good combustion take place in combustion chamber. The engine thermal efficiency was increased by raising concentrations of bio-diesel in blend and furthermore of lubricate given by the bio-diesel. The cause behind is leaner combustions of the diesel and extensive ignitions delay which shows a larger amounts of the fuel burn.

4.2. Bsfc

The deviation in BSFC with BP to various fuels is shows in the Fig. 6. The BSFC is ratio of fuel mass consumption and BEP and it is inversely proportional to the thermal efficiency. The BSFC reduced harshly with raise with the BP to the all the fuel. The reasons for it can percentage increases in the fuel need to operate the engine at lower than % raise in the BP due to comparatively low portions heat is lost during heavier load.

4.3. Co

The comparison of CO to different bio-diesel blend with esteem to BP is shown in Fig. 7. The CO occur in the engine exhaust gas and this is the product of unburned combustions due to the inadequate quantity of air or lacking time in the cycle complete combustions.

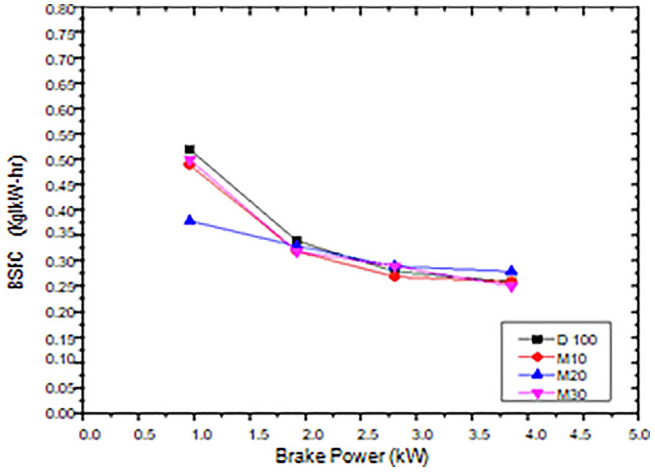

Fig. 5. BSFC vs. BP.

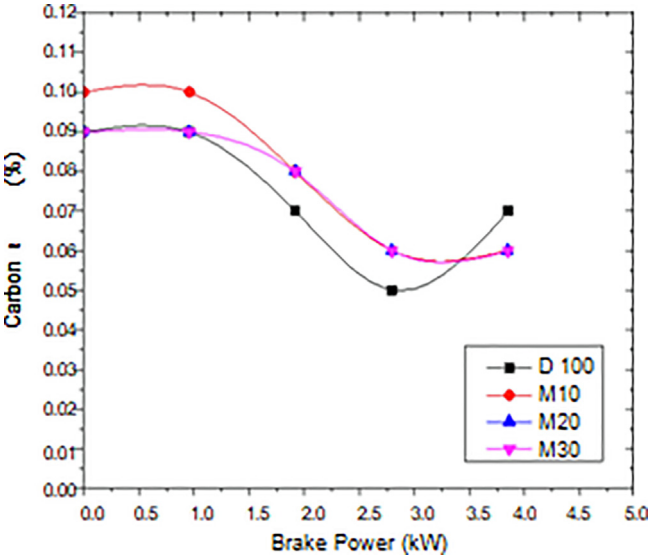

Fig. 6. CO vs. BP by MSOME blends.

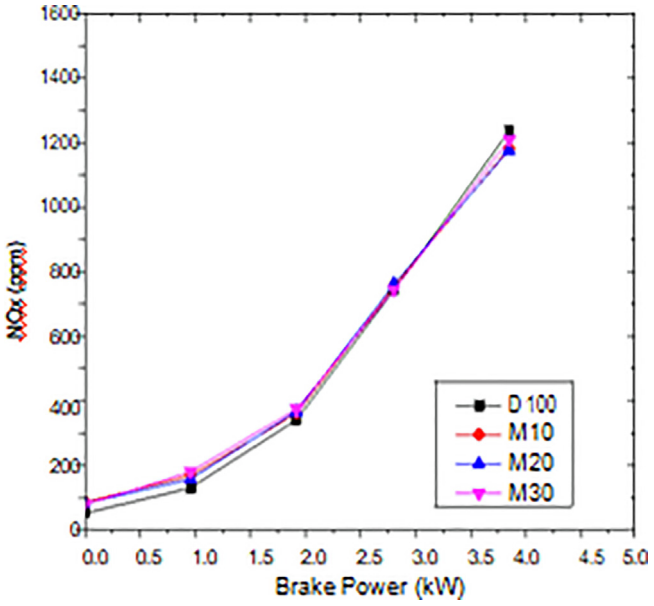

Fig. 7. NOx vs. BP U=using MSOME blends.

In C.I engines the combustions take place usually at superior air fuel ratio, hence the enough oxygen obtainable to burn and it noticed that the CO emissions of 0.07% volume for the diesel and 0.06% volume to M10, M20 and M30. The MSOME CO emissions level low than the diesel and provide 10 to 20% more oxygen. Due to attendance of more oxygen, the extra oxidations reaction takes places between CO and O_2.

4.4. Oxides of nitrogen

The difference in NOx with the engine BP to various fuels shown in the figure 8. The nitrogen oxide emission developed are huge needy on the combustion temperature and concentration of the oxygen available in the combustion product. The NOx formed for M30 is 1210 ppm, where in diesel is 1236 ppm. The graph shows that the raising the proportions of the bio-diesel in blend is noted to minimize the NOx emission of 2.1% for M30 during full condi-

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tion, which compare to diesel. The M20 showing the less quantity of the oxides of the nitrogen of 1177 ppm during full load.

At low combustions temperature inside the cylinder during high load. The NOx concentrations changes linearly with load. When BP raises, overall A/F ratio raise which leads the raise in average of gas temperature in combustion chamber and the NOx formations increases.

5. Conclusion

The emission and performances character of the diesel, biodiesel blends and most favourable blends with 1-Hexanol as the fuel additives was studied in single cylinder C.I engine. The following conclusions were derived:

- The brake thermal efficiency rise with enlarges biodiesel percentages. From these, M30 show the good performances. The utmost brake thermal efficiency around 32% in M30 blend.
- In diesel engine the fuel, the M30 blend result in average decrease of 19.62% smoke density, CO emission minimized around 14.38% with minor reduce in the NOx emissions compared to the diesel. The BSFC is minimized in blend fuel. M30 fuels the BSFC is less than diesel about 0.76%. The reduction in incomplete HC emission was 12.06% when compared to the diesel.
- The maximum reduce in CO emission is get with M30 around 14.28% when compare to the diesel. The NOx emissions was minimized with the M30 when compare to the diesel. The NOx emissions were minimized 2.20% with the M30 compared to diesel.
- The ignition poor of 1-hexanol of 10 ml show better performances in sense of BSFC and brake thermal efficiency. The highest brake thermal efficiency around 32%.
- The augmented quantity of ignition incomplete to M30 blend is raised brake thermal efficiency and reduce emission of NOx, CO, HC, CO_2 are noted. Hence ignitions improver to best blends its performances raised and emission are reduced.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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