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A REVIEW PAPER ON PERFORMANCE OF DIFFERENT BLENDS ON CI ENGINE

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ABSTRACT
Compression engines play an important role in daily life. On the other hand it releases the hazardous pollutants which cause the affect on environment. Also the existence of fossil fuel is the question for the future generation. So many researches are conducted to find the alternative fuels for the fossil fuel to enhance the performance & emission characteristics of the engine. As renewable, biodegradable, and nontoxic fuel research has continued into present development of next generational fuels, biodiesel has attracted significant amount of attention over the past decade, Many researches carried out on biodiesel made up from edible and non edible oils. The experiments carried on the diesel engine to analyze and compare the emission and performance characteristics of engine purely running on diesel and by use of biodiesel. In this paper different methodologies are discussed to compare the variable properties of biodiesel. Response surface methodology (RSM) is prefer for the comparison of variable properties. Charge dilution is another way of increasing the engine performance by using biofuels. Over the past years, blending of alcohols (methanol, ethanol and butanol) with diesel fuel has been found to have significant effects on the emissions from diesel engines. Viscosity, volatility, calorific value, cetane nos, flash point is the important properties for of biodiesel fuel, which affects on the engine performance and emission characteristics. However, the biodiesel has a slightly higher viscosity and lower volatility compared to the diesel fuel.

INTRODUCTION
Biofuels are generally obtained from oil seeds and vegetables by transterification process using alcohol as a additive. There are many research works which are conducted to determine the efficiency of biofuels but only several works gives the information about modification in the engine and optimization of combustion parameters. Research are carried out by varying the blending parentages of bio fuel along with diesel as a base fuel. Basically viscosity of biofuel is very high so it is needed to use the biofuel by reducing its viscosity, as it affects the combustion performance and emission characteristics. In the various studies the blends were taken as 80 % diesel and 20 % biofuels i.e BE20 and the effect on engine torque, power, brake specific fuel consumption, brake thermal efficiency, exhaust gas temperature, and CO, CO2, NOx and SO2 emissions were investigated.

Some studies are focused on optimization of operating factors and combination of blends In this study the effect of operating factors of engine load and speed as well as blended levels of biodiesel and ethanol in diesel fuel on the emission characteristics of DI diesel engine were investigated. The experiments were designed using a statistical tool known as Design of Experiments (DoE) based on central composite rotatable design (CCRD) of response surface methodology (RSM). The resultant quadratic models of the response surface methodology were helpful to predict the response parameters such as oxides of nitrogen (NOx), carbon monoxide (CO), carbon dioxide (CO2) and total hydrocarbon (THC) and smoke opacity and further to identify the significant interactions between the input factors on the responses.

In some studies the INHN effects on the performance and emissions of a diesel engine using biodiesel and its blends were experimentally investigated by running the engine at four different engine loads in terms of brake mean effective pressure. Also the injector nozzle hole size and number included are varied and results obtained shows that the brake specific fuel consumption (BSFC), carbon dioxide (CO2) and nitrogen oxides (NOx) emission increased, smoke opacity (SO), hydrocarbon (HC) and carbon monoxide (CO) emissions reduced due to the fuel properties and combustion characteristics of biodiesel. Some study reports the influence of compression ratio (CR) and injection parameters such injection timing (IT) and injection pressure (IP) on the performance and emissions of a DI diesel engine using biodiesel (%5, 20%, 50%, and 100%) blended-diesel fuel. Tests were carried out using different CRs The results showed that brake specific fuel consumption

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(BSFC), brake specific energy consumption (BSEC), and nitrogen oxides (NOx) emissions increased while brake thermal efficiency (BTE), smoke opacity (OP), carbon monoxide (CO) and hydrocarbon (HC) decreased with the increase in the amount of biodiesel in the fuel mixture. The best results for BSFC, BSEC and BTE were observed at increased the CR, IP, and original IT. For the all tested fuels, an increase in IP, IT and CR leaded to decrease in the OP, CO and HC emissions while NOx emissions increase.

This study investigates the applicability of adaptive neuro-fuzzy inference system (ANFIS) approach for modeling the performance parameters and exhaust emissions of a diesel engine employing various fuels. In order to gather data for developing the proposed ANFIS model, a single-cylinder direct injection diesel engine was fuelled with diesel fuel, biodiesel and their blends, and steady-state tests were performed by varying the biodiesel content, engine speed and engine load. Then, using experimental data, engine performance parameters, namely engine power, brake specific fuel consumption, brake thermal Efficiency, exhaust gas temperature, and emissions of HC, CO and NO were determined. After an ANFIS model for the prediction of the performance parameters and exhaust emissions of the engine was developed using some of the data acquired in the experiments, the model results were compared with experimental ones for determining the accuracy of the ANFIS predictions.

LITERATURE REVIEW

Huseyin Aydin studied on the Effect of ethanol blending with biodiesel on engine performance and exhaust emissions in a CI engine)In this study, they used ethanol as an additive to research the possible use of higher percentages of biodiesel in an unmodified diesel engine. Commercial diesel fuel, 20% biodiesel and 80% diesel fuel, called here as B20, and 80% biodiesel and 20% ethanol, called here as BE20, were used in a single cylinder, four strokes direct injection diesel engine. He got some results Torque of engine obtained for BE20 was higher BSFC for BE20 lower highest exhaust temperature With blend of BE20. CO2 decrease was obtained for B20 about 67% and 67.5% when compared to diesel and BE20 fuels, respectively.

A comparative study on influence of fuel additives with edible and non-edible vegetable oil based on fuel characterization and engine characteristics of diesel engine studied by Pinkesh R. Shah. This paper aims to compare the behavior of edible and non-edible crude vegetable oil on engine characteristics of existing diesel engine under similar operating condition with cognitive elaboration. The main purpose of the paper to investigate how commercially available fuel additives for diesel fuel, influence the edible and non-edible vegetable oil, by comparing the combustion, emission and performance characteristics under similar operating condition. He get the result Both edible oil (SF) and non-edible oil (KO) showed longer ignition delay, This in turn leads to higher cylinder pressure, HRR, higher NOx and CO emissions KO oil exhibited lower NOx and CO emissions when compared to SF. Both additives were found effective in reduction of ignition delay, HRR and NOx formation with KO. whereas increased NOx and CO emissions with SF.

The effect of intake charge dilution with carbon dioxide on the combustion and emission characteristics of a 4-cylinder direct-injection diesel engine fueled with biodiesel, ethanol-biodiesel and methanol-biodiesel were investigated. The study shows that With increase of intake CO2 concentration, CO, HC, particulate mass concentration, particle number concentration and geometric diameter (GMD) of all fuels increased while NOx decreased obviously. After addition of methanol and ethanol in biodiesel, the NOx, particulate mass concentration and particle number concentration decreased at each intake CO2.

Experimentally investigate and compare the performance, combustion characteristics, NO emissions, and stability of a diesel engine fuelled by five different fuels, which included diesel, biodiesel, and different blends of diesel-biodiesel-butanol mixtures. All the tests were conducted using a single-cylinder direct-injection diesel engine at a speed of 1500 rpm and different engine load conditions. It was found that the optimum alternative fuel among all the tested fuels was the B50 fuel blend as its use increased the maximum engine thermal efficiency by 6.5% and decreased the lowest engine brake specific fuel consumption by 5% compared to the diesel fuel NO emission increased significantly with increasing the engine load and increased slightly with using oxygenated fuels.

Po-Ming Yang studied about Emission evaluation of a diesel engine generator operating with a proportion of isobutanol as a fuel additive in biodiesel blends. This study investigates the emissions of carbonyl compounds and regulated pollutants that are produced from diesel engine combustion in idle mode. Varied mixtures of diesel, biodiesel (up to 40 vol.%), and isobutanol (10 vol.%) components are compared with premium diesel

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fuels in terms of their combustion emissions. Results indicate that major carbonyls in the exhaust, In order, are formaldehyde, acetaldehyde, and acrolein, and they account for 77.7% to 83.8% of the total Carbonyl compound concentrations emitted from a diesel engine fueled with all test fuels including diesel.With the increase of the biodiesel proportion in the blends of diesel-biodiesel-isobutanol, carbon monoxide(CO), nitrogen oxide (NOX), and particulate matters (PMs) are decreased.

Investigations on the effect of methanol blend on the combustion parameters of dual fuel diesel engine. Ignition delay, maximum rate of pressure rise, heat release rate, temperature and cylinder peak pressure of a 4-cylinder (turbocharged and intercooled) 62.5 kW gen-set diesel engine using methanol blend were experimentally investigated. As amount of methanol in diesel fuel is increased ignition delay increases as compared to pure diesel operation.

Lei ZhuLei Zhu focus on combustion, gaseous and particulate emissions of a diesel engine fueled with biodiesel -pentanol (BP) blends under different engine loads. This study tells that) pentanol-biodiesel can be considered as an acceptable alternative fuel for diesel engines due to its improved combustion performance and reduced particulate emissions. BP blends have fast combustion process at high temperature. BP blends improve brake thermal efficiency of biodiesel.The addition of 10% pentanol is recommended as a suitable replacement ratio.
Pongamia, Mahua, Neem and waste vegetable oil (WVO) have been examined including soybean oil, sunflower oil, cotton seed oil, rapeseed oil, in addition to waste (used or fryer) vegetable oil. The vegetable oils can be safely burned for short periods of time in a diesel engine. However, using raw vegetable oil in a diesel engine for extended periods of time may result in severe engine deposits, piston ring sticking, injector coking, and thickening of the lubricating oil. The high viscosity of raw oil reduces fuel atomization and increases fuel spray penetration. Higher spray penetration is thought to be partly responsible for the difficulties experienced with engine deposits and thickening of the lubricating oil. However, these effects can be reduced or eliminated through transesterification

Experiments on the diesel engine are performed and it was found out that by using various blends of biodiesel from Pongamia and WCB, brake specific fuel consumption (BSFC) is increased. The finding indicates that there is an increase in the BSFC when using biodiesel as compared to diesel for the
same power output.

Measurement methodology
The PB and WCB samples were analyzed for (methyl esters) ME formation at a predetermined interval of time by Gas Chromatograph (metal make) equipped with a flame ionization detector and a capillary column for injecting the sample [30]. The GC oven was kept at 230 _C (5 _C/min). Nitrogen was used as carrier gas. Quantitative analysis of % ME was done using European standard EN 14,103:2003 (DIN EN,1410). For the purpose of error analysis, 3 tests were conducted for single sample and then the average of the 3 readings was taken for further investigation purpose.

Viscosity
Digital rotational viscosity meter (Model-Brookfield) was used for the measurement of viscosity. A rotational speed was preset and the flow resistance of the sample was measured, i.e., the torque maintaining the set speed was proportional to the viscosity. The viscosity, shear stress and the shear rate were calculated from the torque required, the set speed and the geometry factors of the applied sensor.

Density
Density is a measure of the compactness of matter within a substance and is defined by Eq.

$$\text{Density} = \text{mass} / \text{volume}$$

Cloud point and pour point
At low temperatures, higher-melting point (MP) components in the fuel, nucleate and grow to form solid crystals. The temperature where the crystals become visible and form a hazy or cloudy suspension is defined as the cloud point (CP).

Pour point (PP) of the fuel is defined as the lowest temperature where the fuel flows or can be pumped. Both CP and PP should be closely monitored by the user to ensure trouble free operation in cold climatic condition.

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Biodiesel and fuel properties

The measurement of fuel properties of PB, WCB, ternary blends of WCB:PB:D and diesel are shown in Table 1. The calorific values of all the biodiesel and their blends are lower than that of diesel because of their oxygen content. The presence of oxygen in the biodiesel helps for complete combustion of fuel in the engine. The high viscosity of pure biodiesel makes it unsuitable to be used directly as fuel for engine operation, therefore it is to be blended with some other biodiesel with low viscosity or preparation of ternary blend can be done with diesel to improve the fuel property.

Fig. 1 shows that ternary biodiesel blend of (WCB10:PB10: D80) has cloud point and pour point of 6.5 ℃ and 6℃, respectively which are comparable to cloud and pour point of diesel 6℃and 5℃, respectively which make it best suited for diesel engine as it can be operated in cold weather conditions. As the concentration percentage of biodiesel increases, the cloud point and pour point also increase which will make difficult for fuel to flow in engine, ultimately resulting in choking of engine and incomplete combustion of fuel. The amount of various fatty acids present in biodiesel, results in gum formation and crystallization of fuel causing fuel to cease.

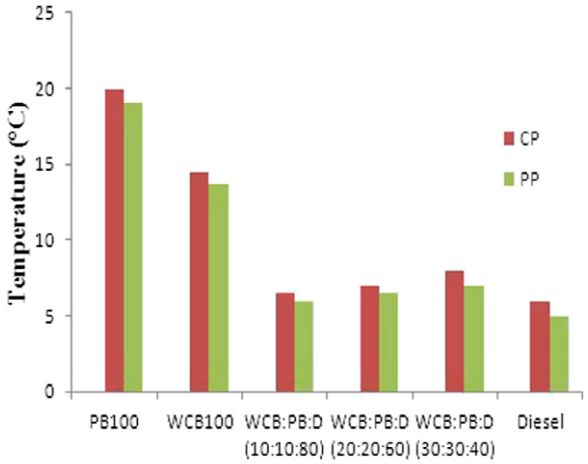

Figure 1 Variation of cloud point and pour point for Pongamia biodiesel blend, waste cooking biodiesel blend and ternary blend of WCB, PB and diesel.

Experimental setup for engine test:

The blend of biodiesel is tested on engine to check the performance of engine. The experimental setup of engine is given in Fig. 2.

Table 1 shows the specification of diesel engine. There is no engine modification when PB and WCB and ternary blends are tested on it.

Table 1: engine specification

Parameters	Details
Make and model	Kirloskar, AA35
Type of engine	Vertical, 4-stroke, single acting high speed compression ignition diesel engine
Rating @1500 rpm	2.6 kW (3.5 bhp)
Base	30 mm
Stroke	76 mm
Compression ratio	15.6:1
BMEP @1500 rpm	5.5 kg/mm^2
Rated speed	1500 rpm
Nozzle opening pressure	190–210 kg/cm^2
Fuel oil tank capacity	3.75 L

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Methodology for performance testing

The engine was directly coupled to alternator and loaded by electrical resistance. The separate fuel measurement unit was connected with engine. A resistive load panel was attached with the output of the generator. The engine-generator set was run initially using diesel for 10 min each for 25%, 50%, 75% and 100% load. The fuel consumption was measured by using stopwatch. At the same time the readings of voltmeter, current meter and energy meter were also noted down. Different blends of PB, WCB with diesel were prepared. The filter of diesel engine was opened and complete mixture of biodiesel

and diesel was drained so that it could not mix with the next blend. The experiment was repeated for each blend to enhance the accuracy of the blend.

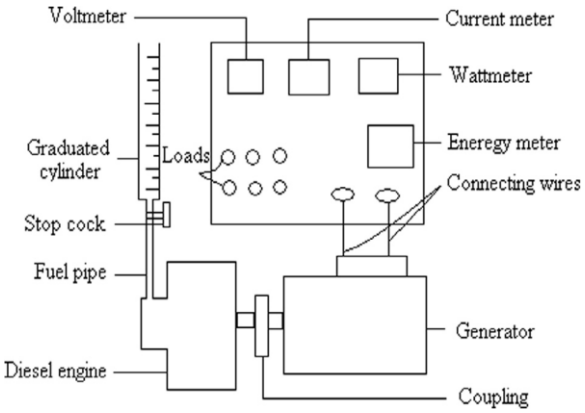

Figure 2 Schematic of experimental setup.

Result and Discussion

The load test results were processed to compare the BSFC of all the biodiesels considered in the study. Fig. 3 shows the variation of BSFC of PB100, WCB100, WCB10:PB10:D80, WCB20: PB20:D60 and WCB30:PB30:D40 with load**.** BSFC of PB100 is highest at all loads from other biodiesels while WCB100 has much lower BSFC than that of PB100. When the load is 25%, BSFC of PB100 is 10.8% higher than that of WCB100 but at 50% loading the BSFC gap between PB100 and WCB100 gets wider with PB100 BSFC being 46.8% higher. The BSFC of WCB100 is higher than ternary blend of WCB20:PB20:D60. At 25% loading BSFC of WCB10:PB10:D80 is 24% higher than that of diesel. The BSFC of WCB10:PB10:D80 is comparable to diesel at all loading conditions. The result of BSFC for PB100 and WCB100 is in agreement with previous work done by various researchers .

As per the test results shown in Fig. 4 BTE of WCB100 remains higher than PB100. At 25% load the BTE of WCB10: PB10:D80 12.63% is almost equal to the BTE of diesel 12%. The BTE of PB100 and WCB100 are lower than ternary blend and diesel in all loading conditions. The engine performance results show that ternary blend performance is comparable to that of diesel.

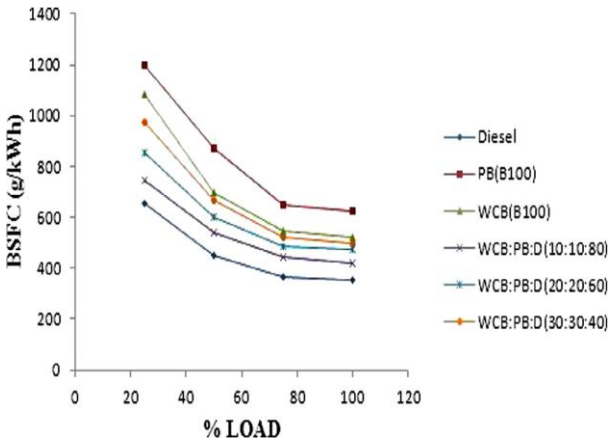

Figure 3 Comparison of BSFC (g/kWh) of biodiesels and their blends.

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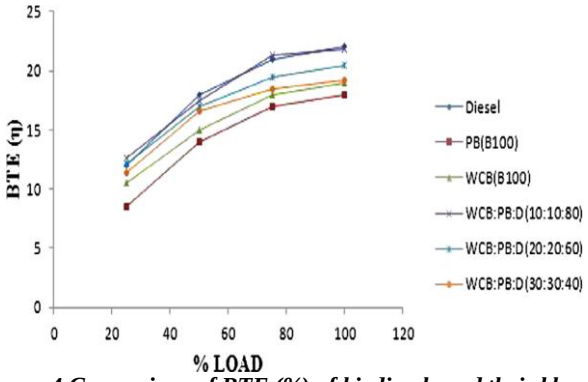

Figure 4 Comparison of BTE (%) of biodiesels and their blends.

Findings

The result of investigation of PB100, WCB100, diesel and their ternary blends reveals that:

(1) High viscosity and lower calorific value of PB100 and WCB100 as compared to diesel are main obstacles in the development of these biodiesels as an alternative fuel to diesel.
(2) Poor cloud and pour point make it difficult to use PB100 and WCB100 to be used as fuel in cold climatic condition.
(3) The cold flow properties of ternary blend WCB10:PB10: D80 are comparable to diesel and make it suitable to be used as fuel in cold climatic condition.
(4) The BSFC and BTE of ternary blend are higher at 25% loading comparable to diesel and it is much better as compared to PB100 and WCB100.

PROBLEM STATEMENT

Experimental investigation and performance analysis of diesel engine by using various types of blends.

1. Check & compare the chemical properties of the various blends.
2. Performance evaluation of different blends on CI engine.
3. Compare the different blends performance characteristics on the CI engine.

PROPOSED METHODOLOGY

1. Review of available blends from research paper and industry.
2. Visit to small industry and discussion regarding updated technology.
3. Select the blends and compare the performance characteristics of the engine.

CONCLUSION

By taking review of previous studies we can conclude the following points

a) Performance and emission characteristics are varies with different bio fuel characteristics.
b) It was found that when ethanol is blended with diesel Torque of engine obtained was higher BSFC lower highest exhaust temperature and CO2 decreases.
c) On the optimization of engine parameters while using biodiesel and ethanol, could reduce CO and HC emissions as well as smoke opacity and enhance CO2 which indicated a more quality in fuel combustion over adding Of bio-fuel in diesel dominants over advantages of biodiesel and ethanol and as result emissions tended to increases. Optimization carried out with response surface methodology to minimize CO, THC, NOx and smoke opacity and maximizing CO2. We can carried out the test to compare the performance of bio diesel blending with the diesel engine.
d) The experiment investigation shows that biodiesel from Pongamia and waste cooking oil can be developed as alternate fuel for future. The fuel properties like density, viscosity and calorific value of ternary blend of PB and WCB and diesel are more or less comparable to diesel. The cloud point and pour point of various biodiesel blends are higher than those of diesel. As the percentage increases in biodiesel concentration, it will further result in an increase in cloud and pour point of biodiesel due to the presence of various fatty acids in it.

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