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Extraction of Biodiesel from Palm Oil: Performance Analysis of Diesel Engine Using Various B-Blends

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Abstract - The utilization of biodiesel as an alternative fuel has gained significant attention due to its renewable nature and potential to reduce greenhouse gas emissions. In this review paper, we explore the extraction process of biodiesel from palm oil, a widely available feedstock. The focus is on analyzing the performance of a diesel engine using various B-blends of biodiesel, which are blends of biodiesel with conventional diesel fuel. The study investigates the effects of different blend ratios on engine performance parameters such as fuel consumption, power output, emissions, and combustion characteristics. Furthermore, the review examines the impact of biodiesel properties, including viscosity, density, and cetane number, on engine performance. The findings of this review provide insights into the viability of palm oil-derived biodiesel and its potential for enhancing the performance of diesel engines. The knowledge gained from this study contributes to the ongoing efforts to promote sustainable and efficient energy solutions in the transportation sector.

Key Words: Biodiesel, oil, B-Blends,

NTRODUCTION

Energy conservation is a pressing global concern as the demand for petroleum-based refined products continues to rise while their reliability decreases. This situation has raised awareness about the need for alternatives to diesel oil and petrol, particularly considering the significant environmental impact and the expanding emissions leading to environmental depletion. Developing countries like India and China are experiencing a steady increase in demand for these products, exacerbating the issue. In reality, according to the U.S. Energy Information Administration (EIA), the global demand for petroleum and other liquid fuels is expected to reach 92.2 million barrels per day (b/d) by 2020. To combat greenhouse gas emissions, several countries, including India, have set targets to eliminate the use of gasoline and diesel by specified deadlines, which forbids the sale of brand-new gasoline and diesel vehicles by 2030.

India, being the world's third-largest crude oil importer and relying on imports for 84 percent of its oil requirements, faces significant challenges. The domestic stock of petroleum oil can only meet a quarter of the country's demand, leading to heavy reliance on imported petroleum products. However, the availability and market price of petroleum oil are highly volatile due to geopolitical factors and international relationships. This heavy dependence on crude oil imports places immense strain on India's foreign exchange reserves. Furthermore, the extensive use of fossil fuels, primarily in industries, transportation, and households, is a major contributor to global warming and the emission of greenhouse gases. The consequences of global warming are evident in extreme weather events like super cyclones, heatwaves, and cold waves occurring worldwide. Transitioning to electric vehicles would significantly reduce greenhouse gas emissions, contributing to the preservation of the earth's environment.

While oil will still be necessary for various purposes such as running industries, power generation, and transportation modes like ships, airplanes, trains, etc., transitioning to electric vehicles would substantially reduce pollution in cities and towns. By reducing the widespread use of fossil fuels like oil, gas, and coal, we can achieve a cleaner and fresher earth, ultimately rejuvenating our ailing planet. Alternative biodiesel, derived from vegetable oils, offers a promising replacement for petrol or diesel. CI engines, widely utilized in India's thermal power plants, are well-suited for biodiesel applications due to factors like mechanical efficiency, torque attributes, and versatility across various sectors. The cost factor of diesel oil in transportation has reached unsustainable levels, influencing market rates and impacting the country's economic progress.

Developing countries like India face the challenge of meeting the increasing demand for fuel, which is crucial for transportation, cultivation, and energy generation. It is imperative to explore viable fuel sources with reduced emissions and decreased dependency on non-renewable crude oil products. By promoting the use of renewable energy sources, such as locally cultivated biofuels, developing countries can bolster their economy and create employment opportunities. India, for instance, ranks fifth globally in fossil fuel consumption and has launched the "National Mission on Biodiesel" to explore economical and sustainable liquid fuels derived from vegetable oils. Biodiesel and bioethanol, due to their compatibility with existing engines and minimal modifications required, are viable alternatives to diesel and petrol. These biofuels can be blended with non-renewable diesel oil to significantly reduce emissions. With careful chemical treatment, fuels suitable for rural applications can be processed, easing the issue of crude oil imports.

In summary, the need for energy conservation and alternatives to petroleum-based products is a global concern. Countries like India, heavily dependent on crude oil imports, face economic and environmental challenges. By transitioning to electric vehicles and exploring alternatives like biodiesel, we can reduce greenhouse gas emissions, alleviate the strain on foreign exchange reserves, and promote sustainable economic growth. Developing countries have the opportunity to harness renewable energy sources and create a cleaner and more prosperous future.

MATERIALS AND METHODS

Materials

In this project we investigated the potential use of Palm oil methyl ester mixed together as a biodiesel. The duel biodiesels were prepared in such a way that for blend **PB10**: the diesel is 90%, Palm biodiesel 10% by volume. For Blend **PB30**: diesel is 70%, Palm biodiesel 30% by volume & for Blend **PB50**: diesel is 50%, Palm biodiesel 50% by volume various experiments were conducted on the mixture of Palm oil methyl esters with various blends (PB10, PB30, PB50, PB70 and PB100) on diesel engine at different loads. The results were recorded and compared with the conventional diesel and biodiesel.

Palm oil

Palm oil is an edible vegetable oil that comes from the fruit of oil palm trees, as shown in Fig. 1. It's the most widely used vegetable oil in the world and usage is growing due to its low price and efficiency. The properties of palm oil as per the standards of ASTM are shown in the table. 2. Margarine, cooking oils, cake, chocolate, cookies, and other foods are all made with palm oil. The oil from Palm carcasses is mainly converted into biodiesel for use in diesel engines. The cake can be converted into high-quality organic fertilizer, biogas, high-quality fish or animal feed (after detoxification), or biomass fuel for power plants. While making oil is as simple as seeing it, prepare the land for oil palm plantings for at least 3 months before transplanting the seedlings to the main field. In soils with low permeability, drainage channels are to be constructed to prevent water stagnation in the upper layer of soil.

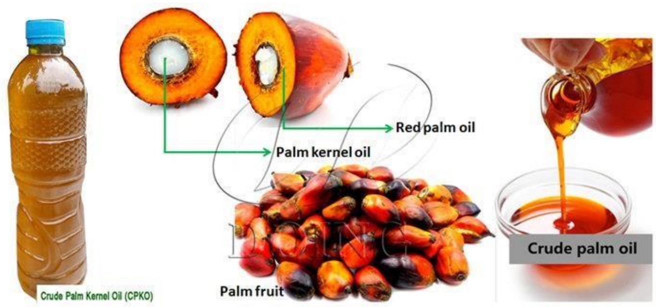

Fig -1: Palm oil production

Along with that, palm oil is also used as biodiesel, which significantly reduces carbon dioxide, carbon monoxide, toxic emissions, and other emissions when burned as a fuel. It is so far the biggest biofuel and represents 82% of the biofuel production. Biodiesel, being renewable, reduces the emissions of carbon dioxide by 80%.

Table-1: Fuel Properties

Parameters	ASTM D6751	Units	Value	Units
Flash point	130.0 min	˚C	162	˚C
Water and sediment	0.050 max	%vol	0.05	%
Kinematic viscosity 40 ˚C	1.9-6.0	mm^2 /sec	27	mm^2 /sec
Sulfer content	0.0015 max	ppm	0.0012	ppm
Copper strip corrosion	No 3max	-	1	-
Cetane	47 min	-	29	-
Carbon residue	0.050 max	% mass	0.24	%
Acid number	0.80 max	Mg KOH/g	1.4	Mg KOH/g
Free Glycerin	0.020 max	% mass	0.01	%
Total Glycerin	0.240 max	% mass	0.11	%
Phosphorous Contents	0.001 max	% mass	1.6	%
Distillation Temperature, Atmospheric Equivalent Temperature, 90% recoverred	360 max	˚C	284	˚C

Synthesis of Methyl Ester

The process of transesterification involves the reaction of a fat or oil with an alcohol to produce esters and glycerol. The reaction rate and efficiency increased with the application of a catalyst. Alcohol in excess is utilized to move the equilibrium to the product side because the reaction is reversible.

Ethyl esters of fatty acids (1) are reacted with an alcohol such as ethanol (2) to give ethyl esters of fatty acids (3) and glycerol (4):

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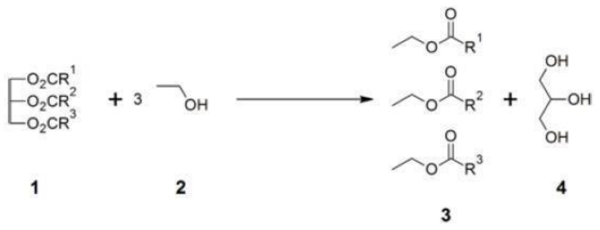

Fig -2: R1, R2, R3: Alkyl group

The alcohol reacts with the fatty acids to form the mono-alkyl ester (biodiesel) and crude glycerol as in fig.4.Alkyl reaction. The reaction between the bio lipid (fat or oil) and the alcohol is a reversible reaction so excess alcohol must be added to ensure complete conversion.

The production of biodiesel by trans-esterification of the oil generally occurs using the following steps:

1. Mixing of alcohol and catalyst. For this process, a specified amount of 450 mL methanol and 10gr Sodium Hydroxide (Noah) is mixed in a round bottom flask.

2. Reaction. The alcohol/catalyst mix is then charged into a closed reaction vessel and 1000 mL Palm oil is added. Excess alcohol is normally used to ensure total conversion of the fat or oil to its esters.

3. Separation of glycerin and biodiesel an in the fig.6. Once the reaction is complete, two major products exist: glycerin and biodiesel. The quantity of produced glycerin varies according to the oil used, the process used, the amount of excess alcohol used. Both the glycerin and biodiesel products have a substantial amount of the excess alcohol that was used in the reaction. The reacted mixture is sometimes neutralized at this step if needed.

4. Alcohol removal.

5. Glycerin Neutralization. The glycerin by-product contains unused catalyst and soaps that are neutralized with an acid and sent to storage as crude glycerin. In some cases, the salt formed during this phase is recovered for use as fertilizer. In most cases the salt is left in the glycerin.

6. Methyl Ester wash fig.7. The most important aspects of biodiesel production to ensure trouble free operation in diesel engines are complete reaction, removal of glycerin, re-moval of catalyst, removal of alcohol and absence of free fatty acids.

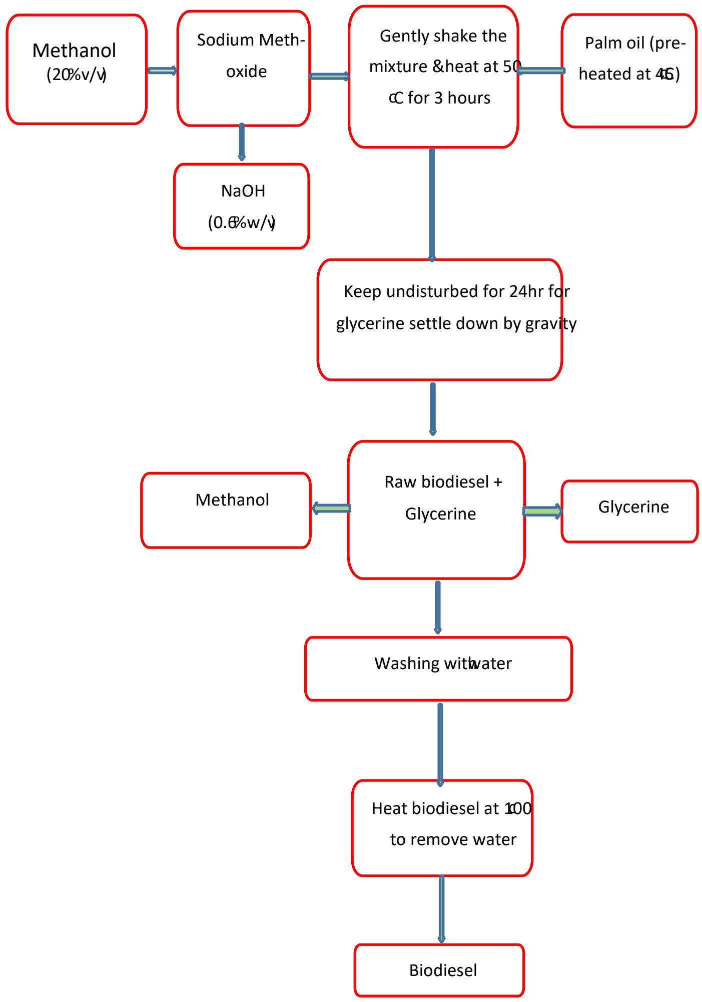

Fig-3: flow diagram of biodiesel preparation of palm oil

EXPERIMENTAL SETUP AND PROCEDURE

The setup consists of single cylinder, four-stroke Diesel engine as fig.11 connected to eddy current type dynamometer for loading. The compression ratio can be changed without stopping the engine and without altering the combustion chamber geometry by specially de-signed tilting cylinder block arrangement. The setup comes with the tools required to measure crank angle and combustion pressure.The engine indicator for PPV diagrams is the means by which these signals are connected to the computer.Additionally, there is room for the interface of load monitoring, temperature, fuel flow, and airflow.An air box, two fuel tanks for dual fuel tests, a manometer, a fuel measuring device, transmitters for measuring the flow of both air and fuel, a process indicator, and an engine indicator are all included in the setup. For measuring the water flow in calorimeters and cooling water, rotameters are available. A/F ratio, heat balance, braking power, indicated power, frictional power, BMEP, IMEP, brake thermal efficiency, indicated thermal efficiency, mechanical efficiency, volumetric efficiency, and specific fuel consumption may all be studied using this configuration.

Experiments are conducted on four stroke single cylinder water cooled diesel engine by varying loads from 0 to 30 Kg with different blends of palm oil biodiesel like B30 and B50 along with normal diesel.

The performance parameters such as Brake power, mechanical efficiency, indicated thermal efficiency, brake thermal efficiency, volumetric efficiency, air-fuel ratio which is connected to the engine as shown in graphs below. The variations in performance parameters and emissions are discussed with respect to load and compression ratio to identify the optimum blend which has similar characteristics as the diesel. The various results obtained are discussed below.

ENGINE SPECIFICATIONS

Product	4 stroke diesel engine PMV-TRB
Engine	Kirloskar make, single cylinder, 4 stroke, water cooled, 4.4/6 KW/bhp at 660 rpm, stroke 110 mm, bore 87.5mm, displacement 661cc, CR 17.5, modified to VCR engine CR range from 12 to 18
Dynamometer type	Eddy current, water cooled, with loading unit
Propeller shaft	With universal joints
Air box	MS fabricated with orifice meter and manometer
Fuel tank	Capacity 15 liters with glass fuel metering column
Calorimeter type	Pipe in pipe
Piezo sensor	Range 5000 PSI, with low noise cable
Crank angle sensor	Resolution 1 degree, speed 5500 rpm with TDC Pulse
Temperature sensor	Type RTD ,PT100 and Thermocouple type K
Temperature transmitter	Type 2 wire , input RTD PT100, range 0-100°C, output 4- 20 mA and Type 2 wire , input thermocouple, range 0- 200°C, output 4-20 mA
Load indicator	Digital, range 0-50 kg, supply 230 VAC
Load sensor	Load cell, type strain gauge, range 0-50 kg
Fuel flow transmitter	DP transmitter, range 0-500 mm WC
mili-voltmeter	Range 0-200 mV, panel mounted
Rotameter	Engine cooling 40-400 LPH; calorimeter 25-250 LPH

TERMINOLOGY

Engine Cylinder Diameter (Bore) (D): The operating cylinder's nominal inner diameter.

A = /4D2 for cylinder diameter (bore).

Piston area (A): The surface area of a circle with engine-sized circumference

Engine stroke length (L) is the theoretical separation between two consecutive reversals of a working piston's direction of motion.

When the direction of the piston motion is reversed (at either end point of the stroke), the working piston and any moving components that are mechanically attached to it are in the position known as dead center.

Bottom dead center (BDC) is the position of the piston when it is at its closest to the crankshaft. It is also referred to as the outer dead center (ODC) at times.

Top dead center (TDC) refers to the location that is dead center and is farthest from the crankshaft. It is also referred to as the inner dead center (IDC) at times.

The nominal volume produced by the working piston as it moves from one dead center to the next is known as the swept volume (Vs), and it is calculated as the sum of the piston's area and stroke. The swept volume of the engine is what the manufacturer refers to when describing its capacity in cc.

Vs = A L = 4 D 2 L

The nominal volume of the area on the combustion side of the piston at top dead center is known as the clearance volume (Vc).

The total of the swept volume and clearance volume is the cylinder volume. V=Vs+Vc

The numerical value of the cylinder volume divided by the numerical value of the clearance volume is the compression ratio (CR). CR=V/Vc

FOUR-STROKE ENGINE,

In a four-stroke engine, the cycle of operation is finished in either four piston strokes or two crankshaft revolutions. A cycle has 7200 crankshaft rotations since each stroke takes 1800 crankshaft turns. The following is the ideal four-stroke engine's sequence of operations:

A charge of air is drawn in during the suction or induction stroke while the inlet valve is open and the piston is moving down the cylinder. For a spark ignition engine, the gasoline and air are typically combined beforehand.

When the valves are both closed, the piston moves up the cylinder during the compression stroke. Ignition takes place as the piston approaches top dead center (TDC).ignition happens. Fuel is injected at the end of the compression stroke in engines with compression ignition.

Combustion spreads throughout the charge, increasing pressure and temperature while driving the piston downward during an expansion, power, or working stroke. The exhaust valve opens at the conclusion of the power stroke, causing the exhaust gases to expand irreversibly. This is known as "blow-down."

Exhaust stroke: The exhaust valve is still open, and the remaining gases are released as the piston moves up the cylinder. Some exhaust gas residuals will remain after the exhaust valve closes at the end of the exhaust stroke, diluting the following charge.

IC ENGINE PERFORMANCE

Volumetric efficiency (ηvol):

The maximum amount of air that can be sucked in during the suction stroke determines the engine's output since only a specific amount of fuel can be burned efficiently with a particular amount of air. Volumetric efficiency, which is the ratio of the air actually induced in ambient conditions to the engine's swept volume, is a measure of the engine's capacity to "breathe." Considering that the engine does not actually draw in a whole cylinder of air with each stroke, it is practical to define volumetric efficiency as follows:

volume of air ingested

ηvol (%) =

airflow mass to completely fill the swept volume under atmospheric conditions

Fuel consumption

Fuel consumption in an engine at a specific period and under specific test conditions can be calculated in terms of weight or volume. The abbreviations BSFC and ISFC stand for brake-specific fuel consumption and indicated-specific fuel consumption, which refer to fuel consumption based on brake power and indicated power, respectively.

Air-fuel (A/F) or fuel-to-air (F/A) ratio:

From the perspective of combustion and engine efficiency, the relative proportions of fuel and air in the engine are crucial. This is stated as either the proportion of the fuel mass to the air mass or the other way around.

Mechanical effectiveness and power:

Power, often known as the rate at which work is completed, is calculated as the product of force and linear velocity or torque and angular velocity. As a result, in addition to speed, power is also measured in terms of force (or torque).

Brake power

Brake power is the force an engine produces at its output shaft and is expressed as

BP = NT x 2 x 60,000 in kW

where Nm = WR and T = torque

W is equal to 9.81 * Net mass applied in kg, R is radius in mN, and speed is expressed in RPM.

Specified power

It is the power generated by combustion inside the engine cylinder.

and petrol.

(BP + FP) = IP KW

Machine Effectiveness

It is the ratio of the supplied power (brake horsepower) to the stated power (piston power).

MECHANISM = BP/IP

Mean effective torque and pressure:

A pressure that is assumed to be exerting itself on the piston throughout the power stroke is known as the mean effective pressure.

Power in kW = (Pm LAN/n 100)/60 in bar

Where Pm = mean effective pressure

L = length of the stroke in m

Piston area in m2 is equal to A. N reflects the engine's rotative speed. RPM For a two-stroke engine, n is the quantity of revolutions needed to complete one engine cycle; n n=1. (For a four-stroke engine) n = 2

As a result, it is clear that the power output of a particular engine can be expressed in terms of mean effective pressure. Mean effective pressure is referred to as brake mean effective pressure (BMEP) if it is based on brake power and indicated mean effective pressure (IMEP) if it is based on indicated power.

FUEL PROPERTY ANALYSIS OF PURE DIESEL AND ITS BLEND OF PALM AND DUEL BIODIESEL

In this stage various properties and characteristics are discussed in below for diesel, Palm-diesel blends of PB10, PB30, PB50, and PB70 & PB100 along with D100.

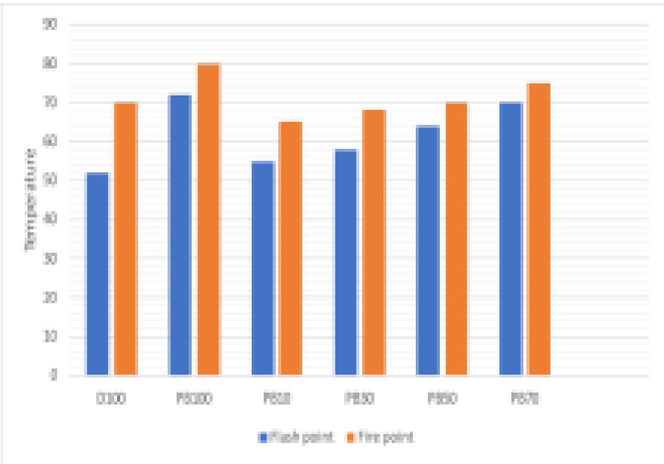

Fig -3: Temperature Vs Flash & Fire Point D100 of palm oil at B10, B30, B50, B70 and B100

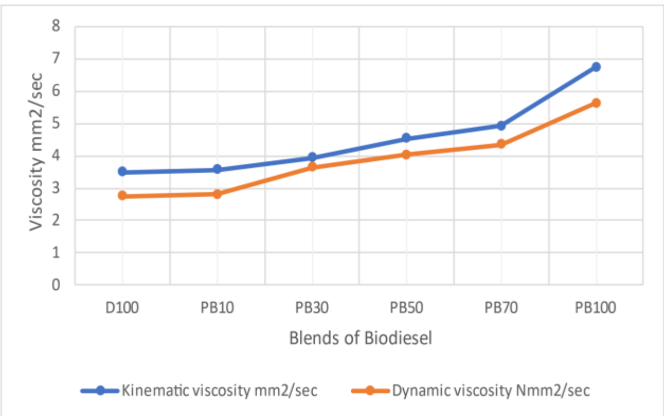

Fig -4: Kinematic and Dynamic viscosity of D100 of palm oil at B10, B30, B50, B70 and B100

As shown in Fig. 3, the comparison between the temperature, flash, and fire point of diesel and palm oil blends is 10, 30, 50, 70, and 100. D100 (pure diesel) has a low flash point. The PB30 blend has a low flash and fire point. The palm-diesel blends of PB10, PB30, PB50, PB70, and PB100, along with D100 of kinetic and dynamic viscosity, are shown in Fig. 4. There is no difference between D100 and PB10, but it continually increases in rim blends. By comparing the blend, we can see that as the blend ratio increases, the velocity of the blend increases.

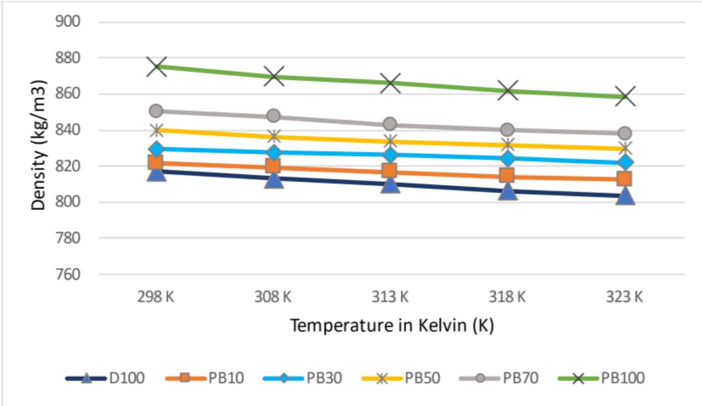

Fig -5: Density Vs Temperature for D100 of palm oil at B10, B30, B50, B70 and B100

In the present study, density is examined at various temperatures (298 K, 308 K, 313 K, 318 K, and 323 K), as shown in Fig. 14, density on the vertical axis and temperatures on the horizontal axis, and the different blends of palm-based biodiesel and petro-diesel using a specific gravity bottle. In the current experimental study, we have developed a correlation between the temperature and volume fraction of biodiesel and density. The correlation can be utilized to determine the density of biodiesel at any temperature and any volume fraction of the biodiesel mixture at any degree of blending.

By comparing the studies, it was found that with an increase in the volume fractions of biodiesel in the blends, the density of the blends increases, and with an increase in the temperature, the density of the blends decreases. With an increase in the volume fractions of biodiesel in the blends, the calorific value decreases. Also, from the experimental data, we developed correlations for the prediction of the density of different blends at different temperatures, and we also developed correlations for the prediction of calorific value at different volume fractions. These properties are used to determine the optimum blend ratio for palm-based biodiesel and petro-diesel blends.

PERFORMANCE ANALYSIS USING PURE DIESEL AND ITS BLEND OF PALM AND DUEL BIODIESEL

In this stage various performance parameter characteristics are discussed in below for diesel, Palm-diesel blends and Duel biodiesel.

BRAKE POWER

Comparison of Brake Power for various blends with respect to load was made for duel biodiesel blends of B10, B30, and B50. Now all these blends were compared with pure diesel as shown in figure below (fig.5). It is observed from the graph that duel biodiesel blend are most similar results as by comparing table from appendix the D100 and PB50 mostly the same value and PB 30 has deflection at Load 25 to 30 the brake power is constant.

BRAKE THERMAL EFFICIENCY

Here the plot shows in the fig.10 the variation of brake thermal efficiency for different blends at their optimal ratio. It is observed that blend PB100 has high brake thermal efficiency at Load15 and constantly decreases by increases the Load.as per the PB50it is high at point of Load 15 and same as D100. As for PB30 by increases the Load the brake thermal efficiency is also increases.

VOLUMETRIC EFFICIENCY

Comparison of volumetric efficiency for diesel and various blends with respect to load and various compression ratios were made and plotted as shown in fig 9 below. The observation of the graphs shows that duel biodiesel blend B30 has high volumetric efficiency than the other blends PB50 and D100 of it all the blends of duel biodiesel has poor ratio of volumetric efficiency.

SPECIFIC FUEL CONSUMPTION

As per the graphs shows in fig.7 by comparison of specific fuel consumption for diesel and various blends with respect to load and various compression ratios were made and ploted as showed in fig below. the comparison from the graphs shows that the duel biodiesel blend B10 given good results than D100 palm oil biodiesel blends. Blend B320 was similar to diesel duel biodiesel B50 given good results than D100 and palm biodiesel blends.

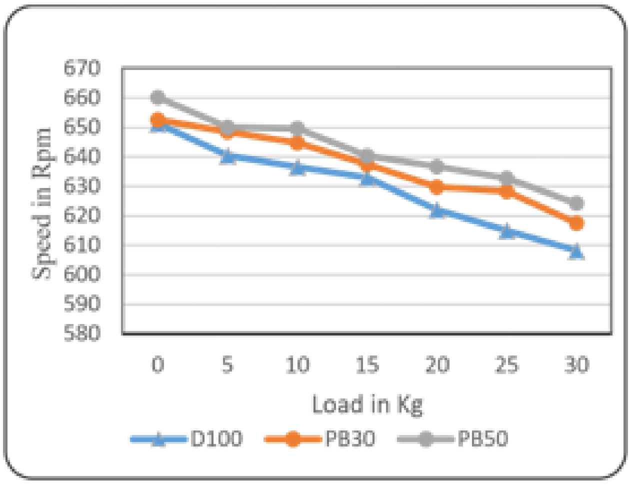

Fig -7: Load Vs Speed in Rpm for D100 and Plam oil blend at B30 and B50

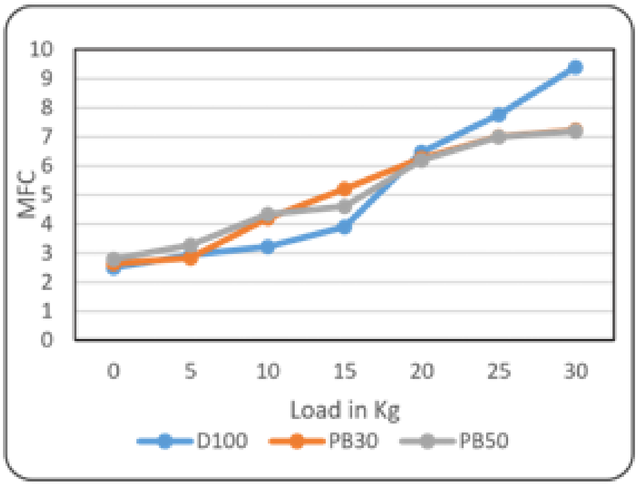

Fig -8: Load Vs MFC for D100 and Plam oil blend at B30 and B50

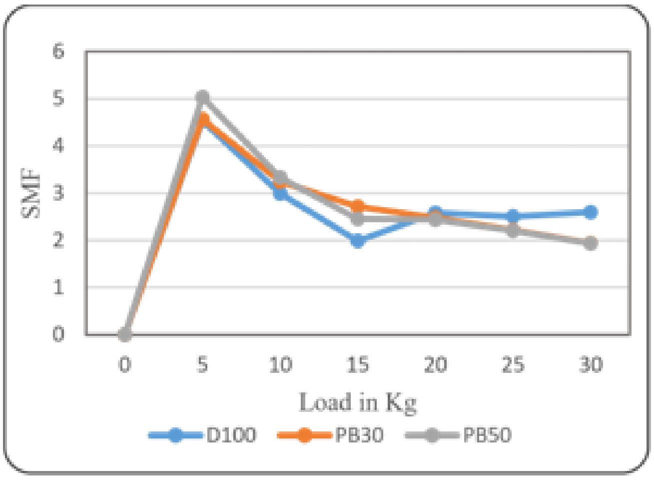

Fig -9: Load Vs SMF for D100 and Plam oil blend at B30 and B50

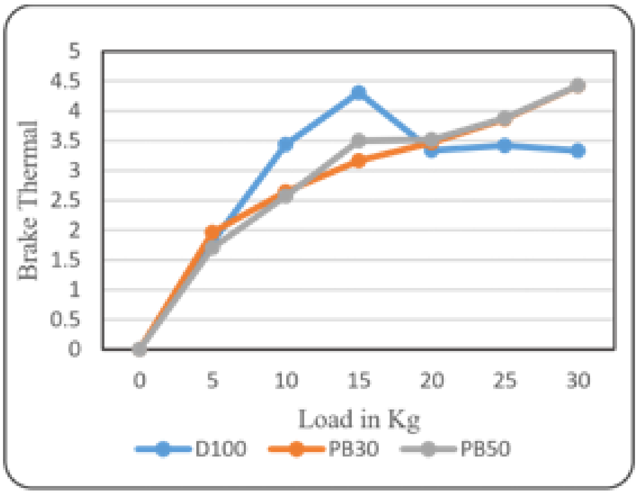

Fig -10: Load Vs $\eta_{B\ Them}$ for D100 and Plam oil blend at B30 and B50

COMPARISON OF PERFORMANCE ANALYSIS OF D100, PB30 & PB50.

The performance parameters such as brake power, mechanical efficiency, indicated thermal efficiency, brake thermal efficiency, volumetric efficiency, and air-fuel ratio are connected to the engine as shown in graphs. The variations in performance parameters and emissions are discussed by comparing the results with respect to each blend (D100, PB30, and PB50) to identify the optimum blend that has similar characteristics as the diesel. The following discussion covers the various results found. The comparison showed the brake power, mechanical efficiency, volumetric efficiency, SFC, and brake thermal efficiency for loads 0, 5, 10, 15, 20, 25, and 30. By comparing at load 0 kg as shown in the above fig. 11 The volumetric efficiency is high for palm oil biodiesel PB50 and for swept volume PB30, and the actual volume PB30 has a high volume. At 0kg load, the torque, brake power, and brake thermal efficiency are zeros. According to Fig. 12 The brake power of the D100, PB 30, and PB50 is very similar, with a point difference in their values. For the indicated power, they are also very similar, with point differences in their values. For volumetric efficiency, as can be observed, the PB30 has a high volumetric efficiency compared with other loans.

At a load of 10 kg, the comparison of performance parameters is shown in Fig. 13. The volumetric efficiency is higher for palm oil biodiesel PB50, and for swept volume and mechanical efficiency, PB30 and PB50 have similar results. As we see in Fig. 14 at load 15 kg, with the comparison for specific fuel compression, we can observe the difference between D100, PB30, and PB50. In this case, the brake power is PB50, a little higher than both PB30 and D100. In actual volume, both blends have similar results. At the same time, the sept volume is also quite different in three volumes; here, the D100 has less than PB 30 and PB 50. We can clearly observe in Fig. 15 Mechanical efficiency: here we can observe the percentage as the hand is smaller and PB 50 is somewhat higher than D 100, PB30, and PB50. As for Fig. 16, at Load 25 kg, the brake thermal efficiency and mechanical efficiency are the same for both B30 and B50, and at the same time, the swept volume is high in PB50. PB30 has high brake power, indicated power and fuel consumption compare with other blends.at the Load 30kg fig.17 by comparing the all performance result PB30 has given best results at both volumetric efficiency and mechanical efficiency and as for brake power and indicated power PB50 has high values.

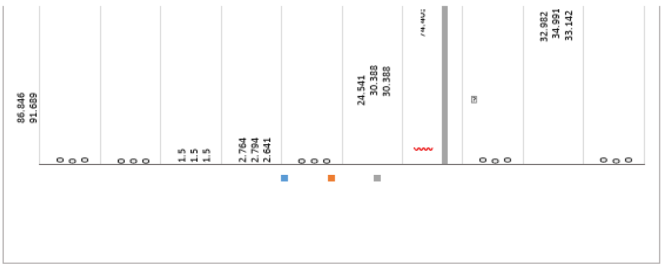

Fig – 11: Comparison of Performance Analysis Of D100, PB30 & PB50 at Load 0 Kg

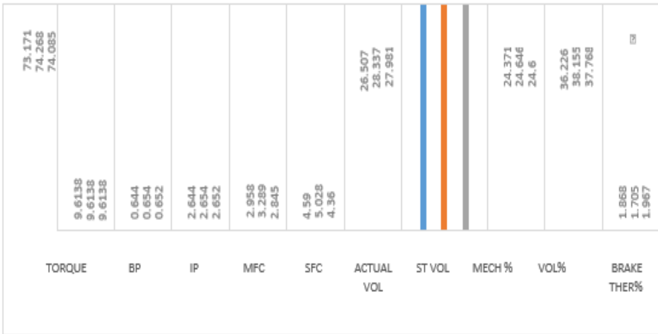

Fig – 12: Comparison of Performance Analysis Of D100, PB30 & PB50 at Load 5 Kg

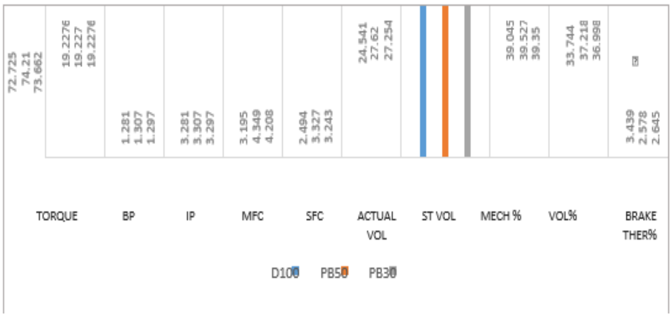

Fig – 13: Comparison of Performance Analysis Of D100, PB30 & PB50 at Load 10 Kg

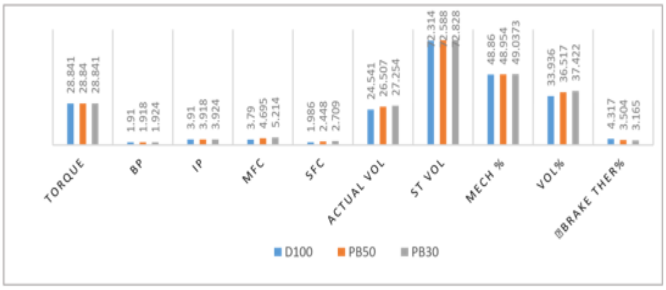

Fig – 14: Comparison of Performance Analysis Of D100, PB30 & PB50 at Load 15 Kg

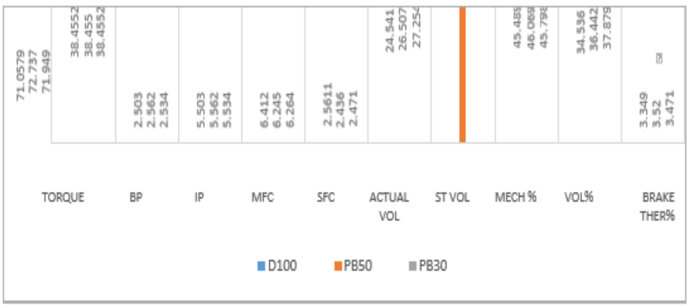

Fig.-15: Comparison of Performance Analysis of D100, PB30 & PB50 at Load 20 Kg

Fig.-16: Comparison of Performance Analysis of D100, PB30 & PB50 at Load 25 Kg

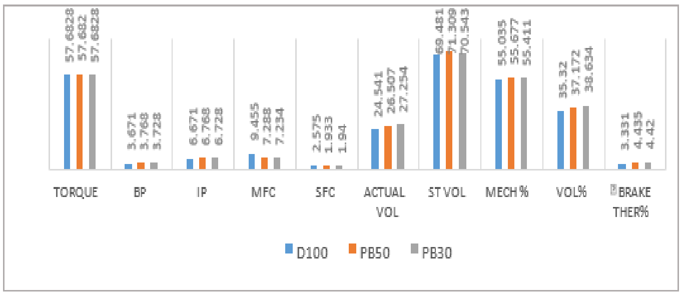

Fig -.17: Comparison of Performance Analysis of D100, PB30 & PB50 at Load 30 Kg

CONCLUSION

The experiment are conducted on diesel, Palm-diesel blends of PB10, PB30, PB50, and PB70 & PB100 along with D100 to find various properties and characteristics like flash point, fire point, viscosity and density. By comparing the various properties and characteristics are discussed in above for diesel, Palm-diesel blends. The comparison showed that PB10 and PB30 has low fire and flash point. As for calorific value PB30 has high value than other blends.

The performance tests were conducted on Ignition engine at different loads by varying speed in rpm with two different duel biodiesel blends as B30 and B50 along with pure diesel D100. The results of Brake power, Mechanical efficiency, Brake thermal efficiency, volumetric efficiency, Specific fuel consumption, exhaust gas temperature and the emissions of the engine vise duel biodiesel were compared with pure diesel and Palm biodiesel blends.

The comparison showed that the Brake power, Mechanical efficiency, volumetric efficiency, SFC, Exhaust gas temperature were higher with B30 than pure diesel and palm blends. Brake thermal efficiency is higher with B50 than diesel and Palm biodiesel blends.

So, the duel biodiesel of Palm oil at the blends PB30 and PB50 can used as alternative fuel on the IC engines without any engine modifications.

FUTURE SCOPE

In order to increase the heat transfer rate and to reduce the heat loss and emissions, various coating techniques will be employed to coat the piston and cylinder components with ceramic materials. Moreover, in addition to the dual blends, various oxygenated and Nano additives are existed and the investigations are going on to increase the performance parameters like brake thermal efficiency, mechanical efficiency etc. and also to reduce the brake specific fuel consumption.

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