

# EFFECT OF USE OF PALM OIL AS A BIODIESEL IN FOUR-STROKE COMBUSTION ENGINE AT DIFFERENT LOADING CONDITION

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**Abstract:** Bio-fuels are the most promising area for finding the alternatives of conventional fuels. The researchers are also working toward the reduction of harmful gases that are produced during the combustion of pure diesel or petrol, which mainly causes pollution in the environment. In the same order for finding different alternatives of conventional fuels, Palm oil is used as a bio-fuel in this work. This work is mainly dedicated toward the use of Palm oil for making palm oil bio-diesel. At different percentage of addition of palm fuels in diesel performance of diesel engine was evaluated. For analyzing the percentage of addition of palm oil in diesel three different compositions was considered during the experiment that are 5, 10 and 15%. At each percentage of addition engine performance and emission smoke was analyzed at different loading conditions. This work also contains the analysis of the production of different harmful gases at the exit of combustion for that it measures the value of CO, CO<sub>2</sub> and NO<sub>x</sub>. Through analysis, it is found that with the use of palm oil as a biodiesel the performance of CI engine get increases and value of different harmful gases percentage get also decreases.

**Keywords:** Bio-diesel, Palm oil, blending, performance parameter, smoke percentage.

## 1. Introduction

Biodiesel is an unconventional fuel analogous to the original one or 'fossil' diesel. Biodiesel be able to form from traditional vegetable oil, animal oil/fats, tallow as well as waste cooking oil. The procedure utilized to alter these emollients to Biodiesel is stated as transesterification. This method has been defined in elaborated form below. The main conceivable basis of an appropriate oil originates from oil yields such as, soybean, palm, and rapeseed. In UK rapeseed signifies the extreme extent for biodiesel manufacturing. Furthermost biodiesel formed at existing time has been formed from leftover vegetable oil obtained from eateries, chip shops, industrialized manufacturers of food such as Birdseye and so on. However, oil right from the farmed factories denotes the ultimate possible origination. It has not been formed commercially solely as the underdone oil is very much costly. After the transfiguring rate, it's up to biodiesel that has been extra on it is solely very costly to contend with fossil fuel. Waste vegetable oil could frequently be obtained for free or obtained previously treated for lesser cost. The waste oil must be treated earlier alteration to biodiesel to eliminate contamination.

The experimental analysis of waste cooking oil addition of bio-diesel was performed at Apex innovations which are situated at MIDC area, Kupwad, Sangli Maharashtra-416436. Effect of addition of waste cooking oil in conventional diesel was carried out at three different percentages. First the blend of waste cooking oil and diesel was made through mechanical stirring and transesterification method and then it is used as a fuel in single cylinder four stroke diesel engine. Different equipment used during the experimental analysis is shown in the below section. For performing the experimental combustion of waste cooking biodiesel and diesel fuel CI engine was used. The specification of engine that is considered during the experimental was is mention here. IC engine set up under test is Research Diesel having power-3.50 kW @ 1500 rpm which is 1 Cylinder, four stroke, Constant Speed, Water Cooled, Diesel Engine, with Cylinder Bore-87.50 (mm), Stroke Length-110.00(mm), Connecting Rod length-234.00(mm), Compression Ratio-16.00, Swept volume-661.45 (cc).

Fig.1 shows the experimental setup used for performing experimental analysis



## 2. COMBUSTION PARAMETERS

During combustion following parameters was considered during the experimental work. Specific Gas Const (kJ/kgK): 1.00, Air Density (kg/m<sup>3</sup>): 1.17, Adiabatic Index: 1.41, Polytrophic Index: 0.98, Number of Cycles: 10, Cylinder Pressure Reference: 5, Smoothing-2, TDC Reference: 0

### 2.1 PERFORMANCE PARAMETERS

Different performance parameters that are considered during the experimental are mention here. Orifice Diameter (mm): 20.00, Orifice Coeff. Of Discharge: 0.60, Dynamometer Arm Length (mm): 185, Fuel Pipe dia (mm): 12.40, Ambient Temp. (Deg C): 27,

Pulses Per revolution: 360, Fuel Type: Diesel, Fuel Density (Kg/m<sup>3</sup>): 830, Calorific Value of Fuel (kJ/kg): 42000



Fig.2 shows the engine which is used during experimental analysis

For applying the different load condition on engine, dynamometer is coupled with the engine. The coupling of dynamometer with the engine is shown in the below fig.



Fig.3 shows the couple of dynamometer with engine

For analyzing the effect of addition of different percentage of Palm oil blended bio-diesel in conventional diesel fuel, experimental analysis was carried out. With the change in percentage of Palm oil addition in diesel fuel effect of change in loading condition in each case was also analyzed. In order to use Palm oil as a bio-diesel, first blending process was done with the help of different instrument as mention in chapter 4. Here in this work blend of Palm oil bio-diesel is prepared according to B20 lower grade of blend. So to analyze the effect of different percentage of addition of Palm oil in diesel, three different percentages that is 5, 10 and 15 volume percentage of Palm oil variation was considered during the experimental analysis. With the variation of percentage of Palm oil effect of different loading conditions was also analyzed for that it considered five different loading conditions that is 0, 4, 8, 12 and 16 kg load. The load is applied with the help of dynamometer. It also measures the percentage of different exhaust gases in each case of analysis, it measures value of CO, CO<sub>2</sub> and NO<sub>x</sub> for each percentage of Palm oil addition at different loading conditions. During experimental work 16 compression ratio was considered for all the cases.

### 3. Comparison of different blending percentage

After analysing the effect of different percentage of addition of Palm oil in conventional diesel comparison was done at different performance parameters at different loading conditions. In order to compare the usefulness of use of Palm oil as bio-fuels, conventional diesel fuel performance at same loading conditions that are considered during Palm-biodiesel was also considered.

#### 3.1 For Indicated Power

In this case power generated inside the engine in the form of indicated power at different loading conditions was compared at different percentage of addition of Palm oil. The comparison graph of indicated power is shown in the below fig.

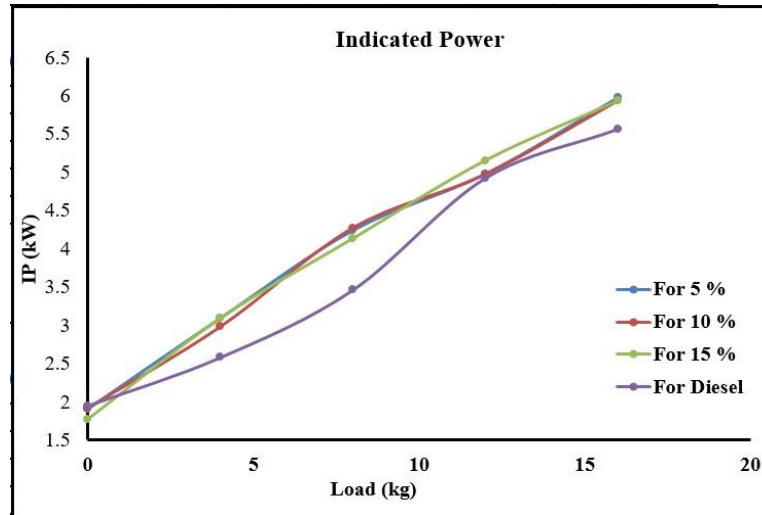


Fig.4 shows the comparison of indicated power at different conditions

From above graph it is found that value of indicated power for different percentage of addition of Palm oil blend is higher than the conventional diesel oil. Whereas with 15 % volume fraction of Palm oil, indicated power is more as compared to 5 and 10 % of Palm oil addition.

#### 3.2 Brake power

In this case power generated at the crank of the engine in the form of brake power at different loading conditions was compared at different percentage of addition of Palm oil. The comparison graph of indicated power is shown in the below fig. brake power shows the useable power output of the engine that can be used for further transformation of power. So it is very necessary to compare brake power at different condition with conventional diesel also so that usefulness or effectiveness of Palm bio-fuel can be analysed.

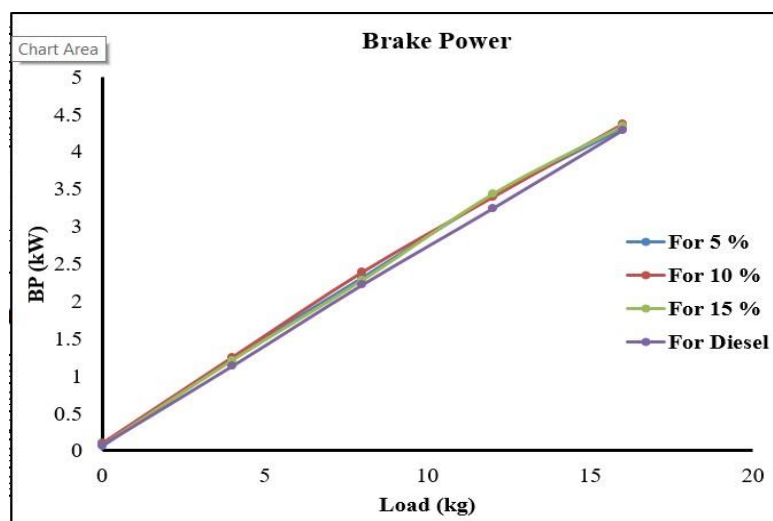


Fig.5 shows the comparison of brake power at different conditions

From above graph it is found that value of indicated power for different percentage of addition of Palm oil blend is higher than the conventional diesel oil. Whereas with 15 % volume fraction of Palm oil, indicated power is more as compared to 5 and 10 %

of Palm oil addition.

### 3.3 Indicated thermal efficiency

Here in this indicated thermal efficiency is compared at different loading condition with different percentage of addition of Palm bio-fuels.

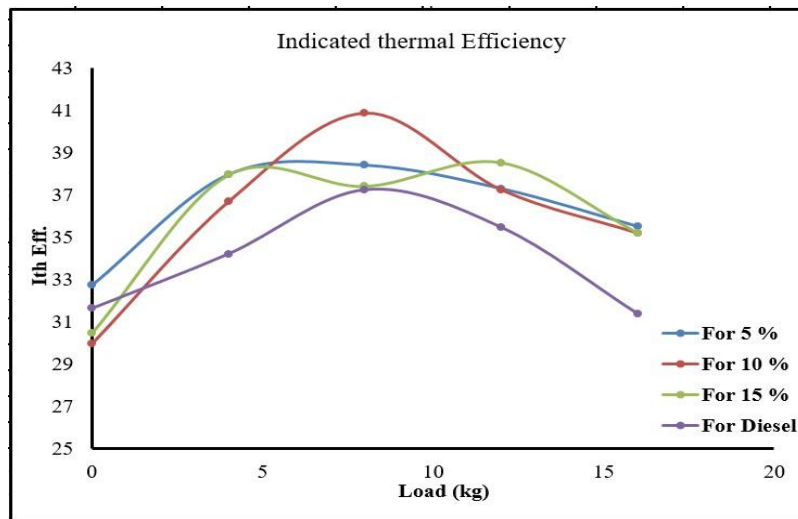


Fig.6 comparison of value of indicated thermal efficiency for different loading condition at different percentage of addition of bio- fuels

From above graph it is found that the value of indicated thermal efficiency is higher with addition of percentage of Palm oil in conventional diesel. Through graph it is found that with the increase in load from 0 to 8 kg the performance of engine increases whereas after 8 kg load it starts decreasing. As compared to pure diesel fuel value of indicated thermal efficiency for Palm oil blended bio-fuel is high at each loading condition.

### 3.4 Brake thermal efficiency

Here in this brake thermal efficiency is compared at different loading condition with different percentage of addition of Palm bio- fuels.

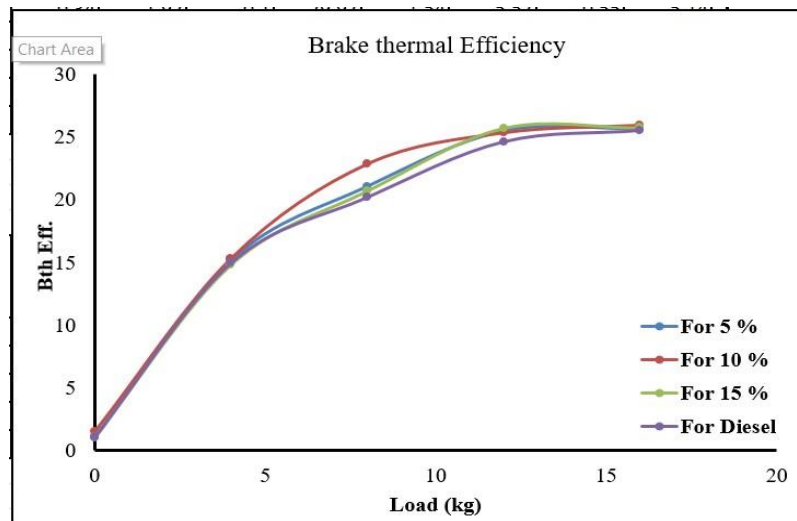


Fig.7 comparison of value of brake thermal efficiency for different loading condition at different percentage of addition of bio- fuels

From above graph it is found that the value of brake thermal efficiency is higher with addition of percentage of Palm oil in conventional diesel. Through graph it is found that with the increase in load the brake thermal efficiency of the system gets increases. As compared to pure diesel fuel value of indicated thermal efficiency for Palm oil blended bio-fuel is high at each loading condition.

### 3.5 Specific fuel consumption (SFC)

After measuring the different power outcome of the engine specific fuel consumption of fuel at different percentage of addition

of Palm oil at different loading conditions was also measured to compare the requirement of fuel. Value of pure diesel at different conditions was also considered during the experiment. The comparison of different cases specific fuel consumption is shown in the below fig.

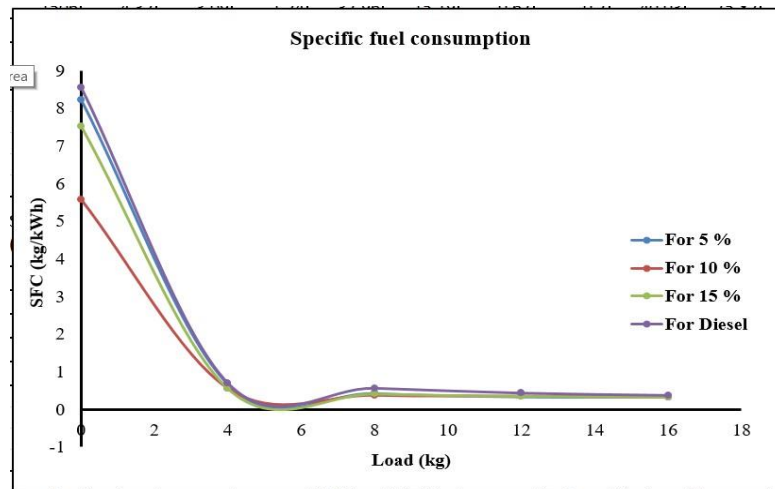


Fig.8 Comparison of value of specific fuel consumption at different conditions

From above graph it is found that the value of specific fuel consumption is less for Palm oil added bio-fuels as compared to conventional diesel fuel. As the load increases the specific fuel consumption rate decreases and after certain load it becomes almost same. Through graph it is also seen that with 10 % addition of Palm oil, specific fuel consumption of fuel is less as compared to other percentage of blend and pure diesel.

### 3.6 Fuel consumption

It is also necessary to measure the value of fuel consumption of blending fuel during different loading condition of engine and at different percentage of addition of Palm oil. The comparison graph of different conditions fuel consumption is shown in the below fig.

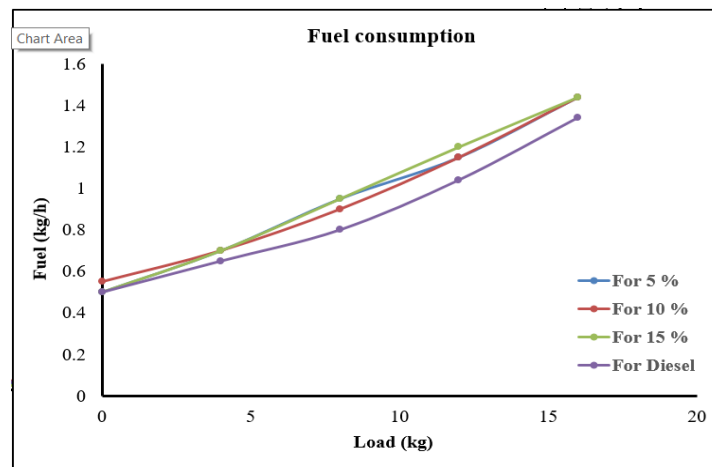


Fig.9 Shows the comparison of fuel consumption at different conditions

From above graph it is found that overall fuel consumption for diesel is less as compared to bio-fuel blend. Through graph it is analyzed that with the increase in percentage of Palm oil the fuel consumption get increased.

## 4. Conclusion

From above analysis it is found that with Palm oil blended bio-diesel performance of CI engine is more as compared to convention diesel fuel. For Palm oil bio-diesel value of indicated power is high as compared to pure diesel fuel in each case of loading condition. Use of Palm oil also increases the brake power of the system. Through experiment it is found that at the percentage of Palm oil increases from 5 to 10 % value of brake power get increases, whereas after 10 % that is for 15 % is get decreases. In case of indicated thermal efficiency the value of Ith Eff. For Palm oil blended fuel is higher as compared to convention diesel fuel. Brake thermal efficiency get also increased with Palm oil blended fuel. Value of specific fuel consumption is less in case of Palm oil blended fuel at each load condition which means that the specific fuel requirement is less for blended fuel. In case of different smoke gases production in the exhaust gases, it is found that with Palm oil blended fuel value of harmful gases percentage is less as compared to pure diesel.

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