OPTIMIZATION OF WASTE COOKING OIL PERCENTAGE IN BIODIESEL USED IN FOUR STROKE DIESEL ENGINES

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***Abstract*: To reduce percentage of diesel, now a day bio-diesels are used. For reducing the percentage of use of diesel, bio-diesel are used now a day. In the same manner, this work carried out the analysis of use of waste cooking oil as a bio-fuel. Here in this work effect of use of waste-cooking oil as a bio-diesel fuel was done. Different percentage of waste cooking oil is used to make blend and analyzed the different performance parameters that is brake power, indicated power, brake thermal efficiency, indicated thermal efficiency and many others. It also analyzed the effect of addition of waste cooking oil on the percentage of different harmful gases that are produced during combustion of bio-diesel. Through experimental analysis it is found that waste cooking oil bio-diesel shows better and more efficient performance as compared to convention diesel, whereas the percentage of harmful gases is also low for waste cooking oil bio-diesel**

***Keywords:* Biodiesel, waste cooking oil, compression ratio, engine performance, exhaust gases, NOx**

1. Introduction

Biodiesel is classically finished by chemically countering oils examples are vegetable oil, soybean oil, and inborn fat that too with liquor as alcohol making esters fatty acid. A Biodiesel is a drop-in biofuel in addition therefore destined to be utilized in ordinary diesel locomotives which is consequently different from the root vegetation and waste oils used to fuel converted diesel locomotives. Biodiesel could be utilized in untainted form B100 or might be intermingled through gasoline diesel at slightly attentiveness in maximum instillation drive diesel machines. New exciting strenuous (29,000 psi) mutual bar locomotives devise severe workshop parameters of B5 or B20, dependent on creator.

2. Material properties

For performing the experimental analysis of addition of waste cooking oil in diesel, first the properties of conventional diesel and pure hydrogen gas are required. The properties of conventional diesel are mention in the below table.

Table 1: Properties of conventional diesel used for the experimental analysis

Properties	Value
Density (kg/m^3)	800-840
Vaporization heat (kJ/kg)	465
Self-ignition temperature (^{o}C)	355
In-flammability limits (%)	0.6-5.5
A/F ratio	15
Flame temperature (^{o}C)	2054
higher heating value (MJ/m^3)	36000
Cetane number (CC)	40-55

Table 2: Value of Different properties of WCO-biodiesel

S.No.	Properties	Standard	Values
1	Density at 15^{0}C	ASTM D287	0.881 g/cc
2	Specific Gravity	ASTM D287	0.881 g/cc
3	Gross Calorific Value	ASTM D4809	10800 calorie/gm^{0}C
4	Flash Point	ASTM D-9358T	152^{0}C
5	Fire Point	ASTM D93-58T	164^{0}C
6	Cloud point	ASTM D97	9^{0}C
7	Pour point	ASTM D97	6^{0}C
8	Kinematic Viscosity at 40^{0}C	ASTM D445	1.6 Cst

3. Experimental Work

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 transestrification method and then it is used as a fuel in single cylinder four stroke diesel engine.

3.1 Engine details and Performance Parameter condition

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

Fig 1: Shows the experimental setup of single cylinder four stroke diesel engine

Fig 2: Shows Number: Psp 18, For Emission Testing Equipment used for measuring the exhaust gases

4. Result and Discussion

For analyzing the effect of addition of different percentage of waste cooking oil blended bio-diesel in conventional diesel fuel, experimental analysis was carried out. With the change in percentage of waste cooking oil addition in diesel fuel effect of change in loading condition in each case was also analyzed. In order to use waste cooking 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 waste cooking oil bio-diesel is prepared according to B20 lower grade of blend. So, to analyze the effect of different percentage of addition of waste cooking oil in diesel, three different percentages that is 5, 10 and 15 volume percentage of waste cooking oil variation was considered during the experimental analysis. With the variation of percentage of waste cooking 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_2 and NOx for each percentage of waste cooking oil addition at different loading conditions.

4.1 For Indicated Power

The comparison graph of indicated power is shown in the below fig.

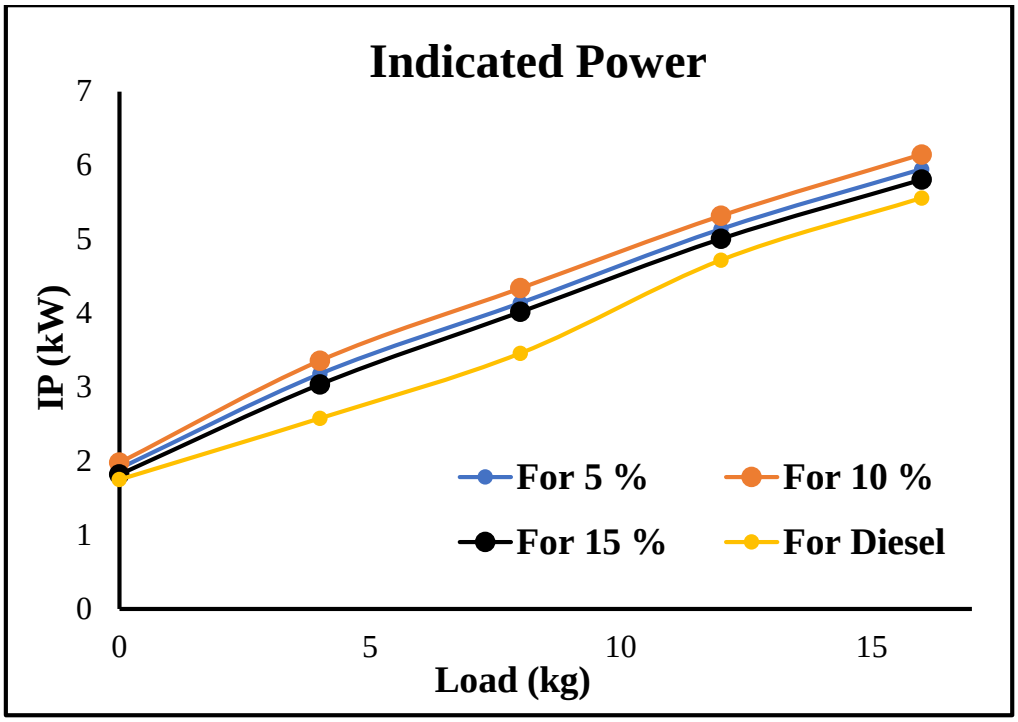

Fig 3: Shows the comparison of indicated power

From above graph it is found that value of indicated power for different percentage of addition of waste cooking oil blend is higher than the conventional diesel oil. Whereas with 10 % volume fraction addition of Waste cooking oil, indicated power is more as compared to 5 and 15 % of waste cooking oil addition. Through graph it is clearly indicated that there is a marginal increment in terms of power for 15, 5 and 10 % addition.

4.2 Brake power

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 waste cooking bio-fuel can be analyzed.

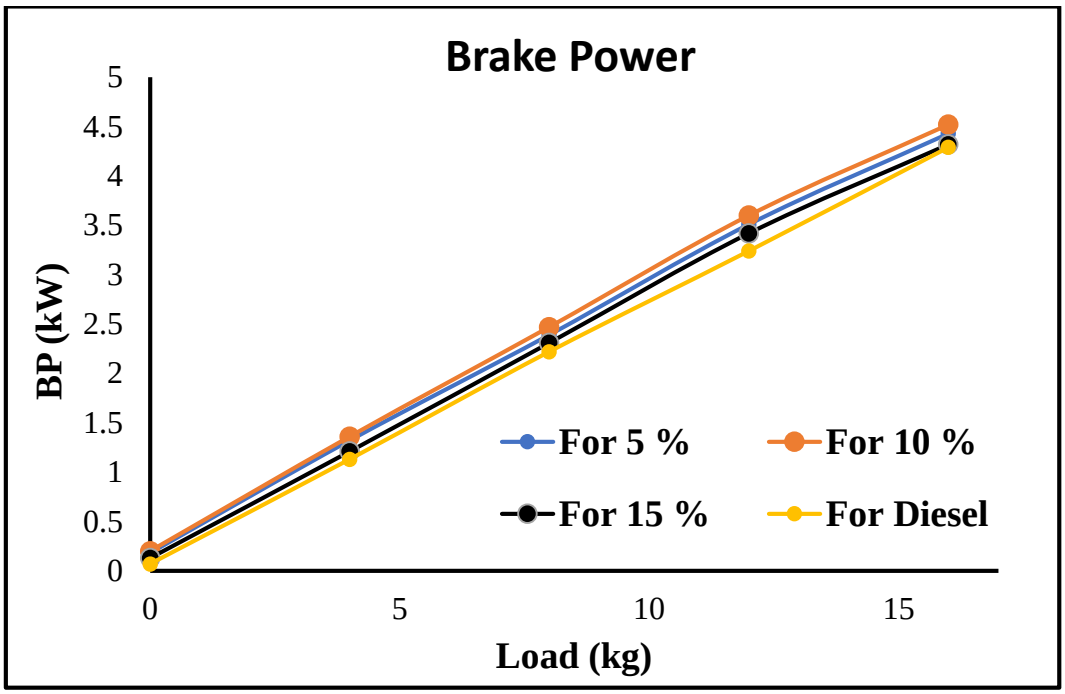

Fig 4: Shows the comparison of brake power

From above graph it is found that value of indicated power for different percentage of addition of waste cooking oil blend is higher than the conventional diesel oil. Whereas with 10 % volume fraction addition of Waste cooking oil, brake power is more as compared to 5 and 15 % of waste cooking oil addition. It is observed that bake power follows the same nature as indicated power.

4.3 Specific fuel consumption (SFC)

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

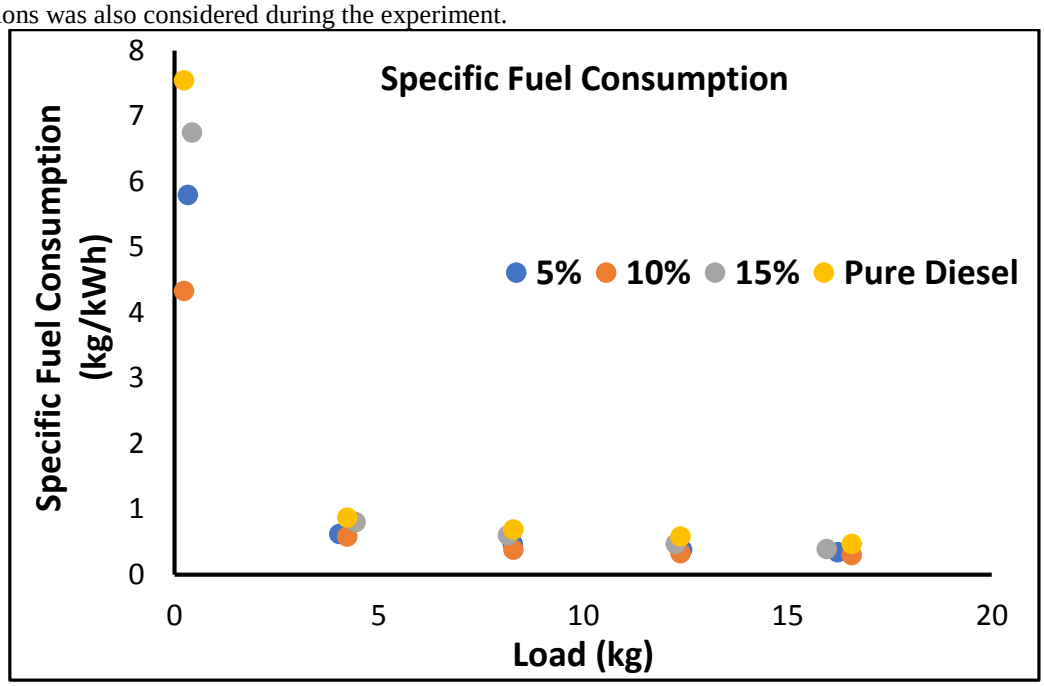

Fig 5: comparison of value of specific fuel consumption

From above graph it is found that the value of specific fuel consumption is less for waste cooking 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.

4.4 Carbon-mono-oxide

After comparing the value of carbon-di-oxide, carbon mono oxide was also compared for different percentage of addition of waste cooking bio-fuel at different loading conditions. During experimental analysis value of percentage of CO is measure with the help of smoke gas analyzer. For comparison graph it is found that the value of CO percentage for different percentage of addition of waste cooking oil is less as compared to conventional diesel fuel. At the initial loading stage value of CO percentage for different waste cooking oil addition case is low but as the load on the engine start increases the value of CO percentage start increasing in each case of analysis.

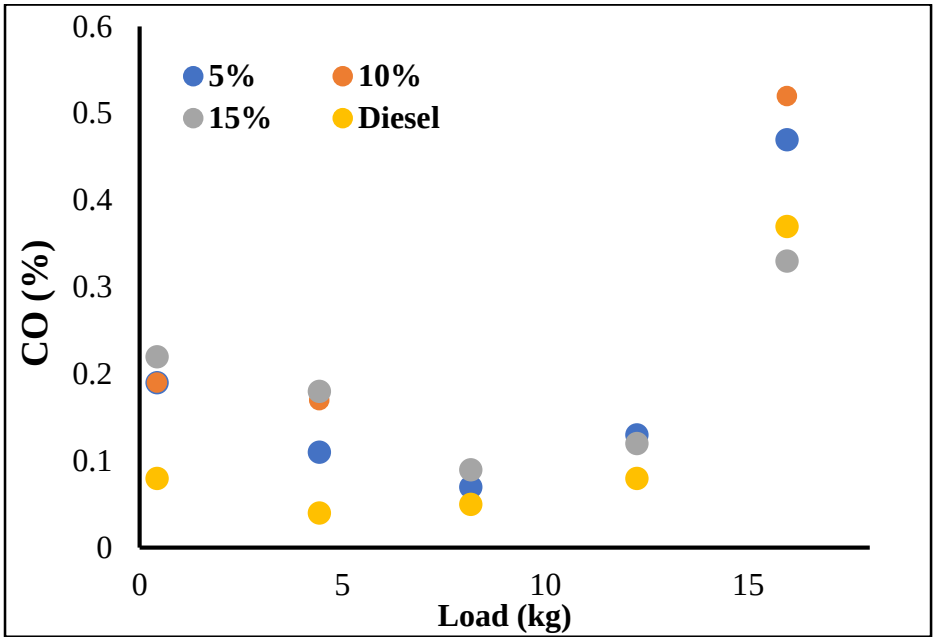

Fig 6: shows the comparison of value of CO percentage

4.5 Nitric oxide

The most harmful heavy gas during the combustion of diesel is NOx. It creates so many problems for human being. Government making different norms to cut down the percentage of generation of these heavy gases. So, in the same manner to reduce the percentage of NOx in exhaust gases waste cooking oil is used as a bio-fuel.

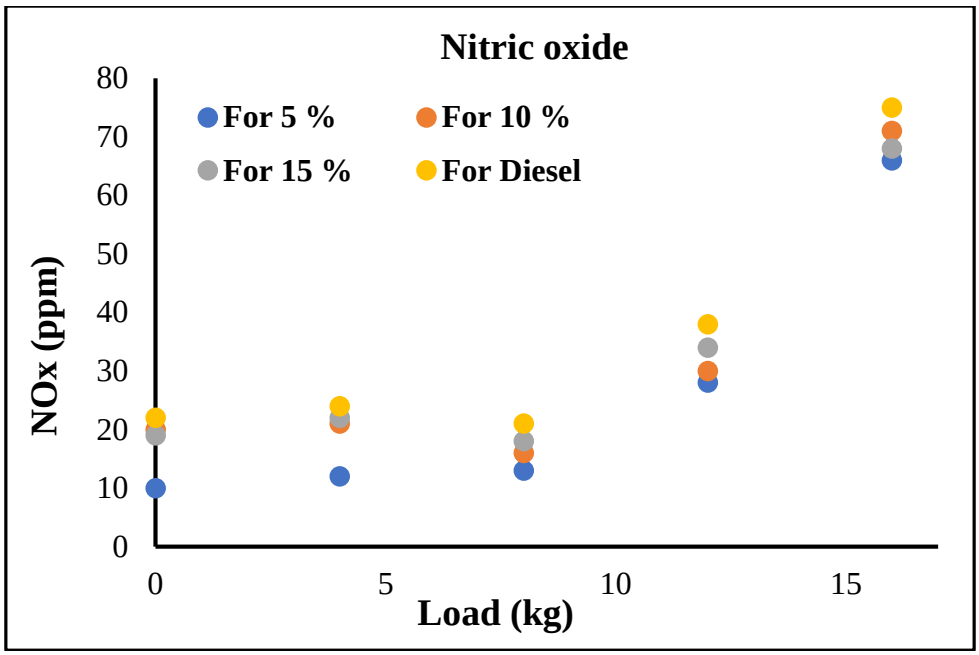

Fig 7: Shows the comparison of NOx

Through analysis and graph it is found that the value of NOx is higher for pure diesel fuel as compared to waste cooking oil blended fuel at each load condition. Through graph it can say that with increase in percentage of waste cooking oil value of NOx is increasing, but with respect of conventional diesel fuel it is less.

5. Conclusion

Through experiment, it is found that waste cooking oil blended bio-diesel performance is more as compared to convention diesel fuel. With the addition of waste cooking oil, the indicated and brake power of the system increases from 5 to 10 % addition, whereas after 10 % that is for 15% is get decreases. It follows same trend for indicated and brake thermal efficiency, the value of I_{th} and B_{th} Eff. for waste cooking oil blended fuel is significantly higher as compared to convention diesel fuel. Value of specific fuel consumption is less in ease case of waste cooking oil blending percentage at each load condition, which means the specific fuel requirement is less for WCO biodiesel. It is also found that, with waste cooking oil biodiesel fuel value the harmful gases percentage in exhaust is less as compared to pure conventional diesel. For waste cooking oil bio-diesel value of indicated power is high as compared to pure diesel fuel in each case of loading condition. In case of different smoke gases production in the exhaust gases, it is found that with waste cooking oil blended fuel value of harmful gases percentage is less as compared to pure diesel.

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