

Experimental Investigation on Performance and Emission Characteristics of Diesel Engine Using Coconut Blends With Acetone as Additive

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ABSTRACT: The modern world needs are increasing as the days are going so as to overcome the needs of the human beings science is improving day to day. The requirement of the fossil fuels are growing day by day & hence due to utility gets increasing supply gets decreasing. So the scarcity of the day fossil fuels is gradually increasing so to overcome this the modern world is searching alternatives like different oils like Edible oils like Coconut Oil, Cooking Oils etc and Inedible oils like Mahua oil, Jamun seed oil & many others oils etc. This work considers the Transesterification of coconut oil and to measure the properties like viscosity, flash point, fire point, density and calorific value of the pure coconut oil after transesterification. Then mixing of blends with diesel taking two samples CB30 (30% Coconut oil + 70% diesel) & CB50 (50% Coconut oil + 50% diesel). Choosing CB50 as best by results obtained by performing emissions & performance test on biodiesel blends. Acetone as additive blended with Coconut Biodiesel gives better results and comparing the experimental values of bio-diesel blends CB50+5% Acetone with diesel.

KEYWORDS: Bio-diesel, Coconut oil, Transesterification, Acetone.

I. INTRODUCTION

Fuel and energy crisis and the concern of the society for deplete the world's non-renewable energy source led to a renewed attention in the seek for alternative fuels. With the expansion of modern civilization and industrialization in the world wide, the demand of the energy is rising day by day. Majority of the world's energy needs are met through fossil fuels & natural gas. To overcome this one of the most capable alternatives fuel is the vegetable oils and their derivative.

The first utilize of vegetable oil in a compression ignition engine was first established through "Rudolph Diesel" who use peanut oil in his diesel engine. There are many oils existing like soybean, sunflower, safflower, coconut, linseed, rapeseed and palm oil etc...

In view of the current unsteadiness in oil prices, biodiesel stand as an attractive source of alternative energy. By adopt and increasing the use of biodiesel, Nigeria will also be free from her over-dependence on crude oil reserves. Besides, conservative fossil fuel has been reported as being finite. While it is praiseworthy to note that biodiesel will not completely displace petroleum diesel, biodiesel has its place as an alternative fuel and can be a cause of lubricate as an additive to diesel fuel. The emissions produced from biodiesel are cleaner compare to petroleum-based diesel fuel. Particulate emissions, dirt and carbon monoxide are lower while biodiesel is an oxygenated fuel.

The authors Oguntola J Alamu et al.,¹ after conducting the study, they concluded that the potential for use of coconut oil for the production of alternative renewable and environmental friendly diesel fuel (biodiesel) was investigated. Test quantities of coconut oil biodiesel were produced through transesterification reaction using 100g coconut oil, 20.0%

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ethanol (wt% coconut oil), 0.8% potassium hydroxide (KOH) catalyst at 65°C reaction temperature and 120 min. reaction time. The process yielded 10.4% biodiesel. The coconut oil biodiesel produced was subsequently blended with petroleum diesel and characterized alternative diesel fuel through some ASTM standard fuel tests. VV Rakesh et al.,² From their comparative study conducted it is seen that diesel is having higher calorific value and flash and fire points compared to any other blends. Biodiesels with molar ratio 8:1 has higher viscosity than diesel and biodiesel with molar ratio 7:1. It is also seen that diesel is superior in density than any other blends. The properties of biodiesel are almost similar range with compared the ordinary diesel. A.Suryanto et al.,³ concludes from their work is the quality of obtained biodiesel in this study meets the standards and regulations established biodiesel (SNI-2012). Nicholas A. Musa et al.,⁴ reviewed that Coconut oil was characterized and biodiesel was produced from it and also characterized in this study. From the results obtained and discussed, it is very evident that coconut oil is a good feedstock for biodiesel production and the biodiesel can be used in convectional diesel engine without modification because of close fuel properties.

João Felipe G.Oliveira et al.,⁵ according their study, an alcohol excess of 200% using adsorption in zeolite yielded higher conversion values than when using 800% of alcohol excess in a system without water adsorption. This can be very interesting for possible commercial usage of esterification of highly acidic waste oils in the biodiesel industry. E.I.Bello et al.,⁶ Coconut oil biodiesel has properties that are close to those of diesel fuel and mostly within the ASTM and EN limits of biodiesel. The biodiesel yield is 95% and the oil is 94.2% saturated with lauric acid constituting 54.7%. Dr.K.Ramesh et al.,⁷ their investigation has been done on diesel blends B0 (pure Diesel), B10 (10% Biodiesel &90% Diesel) and B20 (20% Biodiesel&80% Diesel) and the following observations have been done. The brake specific fuel consumption (BSFC) is decreasing with increasing in load. The brake specific fuel consumption of all the blends are in almost equal range. The brake thermal efficiency increases with increase in load. Mechanical efficiency is increases with increase in load. Carbon monoxide content is decrease with increase in load. Carbon monoxide emission decreased as compared to that of biodiesel. Md A. Hossain et al.,⁸ detailed studies need to be done about the prospect of biodiesel in Bangladesh. Biodiesel production from coconut oil is comparatively higher than soybean and rapeseed. But energy output and fuel consumption rate is better than the following two. Beside this coconut oil has a much better lubrication property than other bio-fuels. Pouya Mohammadi et al.,⁹ in this study some co-solvents were utilized as fuel stabilizer to achieve energy recovery from EPS wastes through dissolution in biodiesel and to simultaneously improve biodiesel-EPS cold flow properties. Among all the solvents tested in the present study, acetone was found to have possessed the best stabilization effect when recycling EPS waste by dissolution in biodiesel. Moreover, acetone addition largely compensated for the deteriorating impact of polymer dissolution on cloud point value of the fuel. It also improved the flash point criterion and consequently fuel safety.

II. EXPERIMENTAL SETUP AND METHODOLOGY

1. Experimental Setup

The experimental set up consists of a single-cylinder , four stroke, vertical water cooled, DI, natural aspirated, diesel engine connected to water brake dynamometer for loading of the engine. The engine operated at speed 1500 rpm with compression ratio 17.5:1. Fuel consumption of time was measured with the help of burette and stop watch. Thermocouple is used to measure the exhaust gas temperature. Exhaust gas analyser is used to measure exhaust gases like CO, HC, and NO_x. This experiment conducted with pure diesel, diesel blend of Coconut oil for CB30, CB50 and CB50 by using 5% of acetone as additive. The effects are plotted against load (%). The experimental set up as shown in fig.

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(a)

2. Experimental Methodology and Properties

The process of converting oils into biodiesel is called Transesterification. In this process, we take fresh coconut oil to make it as useful biodiesel. The components used in this process are:

a) Coconut oil – 500 ml b) Methanol – 100 ml c) KOH – 2.5 gm. First 500 ml of coconut oil is taken into a glass beaker and it is placed on a heater. Then by using heater coconut oil is heated up to 100⁰ C to remove the impurities present in the coconut oil and after heating we have to cool the oil for getting up to 65⁰ C which is standard temperature for the process. Then in another beaker 100ml of methanol is taken and 2.5 gm of KOH is taken. Now we have to mix well till KOH dissolve in the methanol. Then a lid is placed on this mixture if not methanol gets evaporated. Afterwards coconut oil gets to 65⁰ C then the mixture of methoxide is poured in to coconut oil. Then a magnetic stirrer is placed in beaker on heater. Now we stir the mixture with 600 rpm by maintaining at 60⁰C-65⁰ C till 120 minutes (2 hrs). Then we switch off the heater and we pour the mixture after cooling into a funnel and leave the mixture in a stable position for 24 hrs for settling. After 24 hrs we get two layers in the funnel upper layer is oil and lower layer is crude in the oil. Then for more refinement in the oil we go for water wash, we pour more than half of water in a bottle and mixture is poured in the bottle. Then we shake the bottle well and this mixture is poured in to funnel again. We leave the mixture in funnel for 18-20 hrs to settle. Again, two layers are formed in the funnel upper layer is oil and crude in lower layer. We collect the oil and heat the oil up to 40⁰ C – 45⁰ C and hence we get final required biodiesel.

Table.1 Properties of Coconut Oil and its Blends

	Coconut oil	Diesel	CB30	CB50	CB50+5% ACE
Kinematic viscosity @40°C in CSt	5.40 cst	2-6 cst	3.38 cst	5.01 cst	2.97 cst
Flash point	103°C	82 ⁰ C-96 ⁰ C	47 ⁰ C	57 ⁰ C	66 ⁰ C
Fire point	114°C	82 ⁰ C-96 ⁰ C	59 ⁰ C	68 ⁰ C	77 ⁰ C
Gross calorific value kj/kg	37,029 kj/kg	44,800 kj/kg	43,438.1 kj/kg	42,351.6 kj/kg	45,445.5 kj/kg
Density @15°C in kg/m ³	905 kg/m ³	820 ⁰ C-950 ⁰ C	870 ⁰ C	880 ⁰ C	880 ⁰ C

III. EXPERIMENTAL RESULTS AND DISCUSSIONS

In this discussion we discuss the results of performance characteristics and emission characteristics obtained for Coconut blends like CB30, CB50&CB50+5%ACE and compare with diesel.

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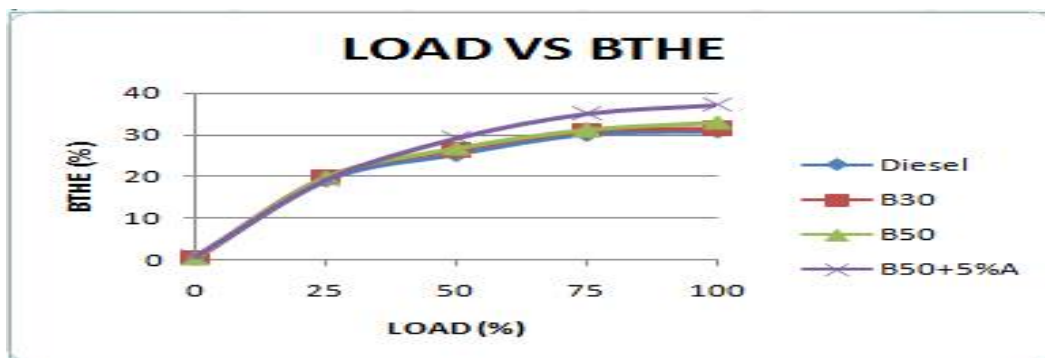
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Performance Characteristics

1. Brake Thermal Efficiency

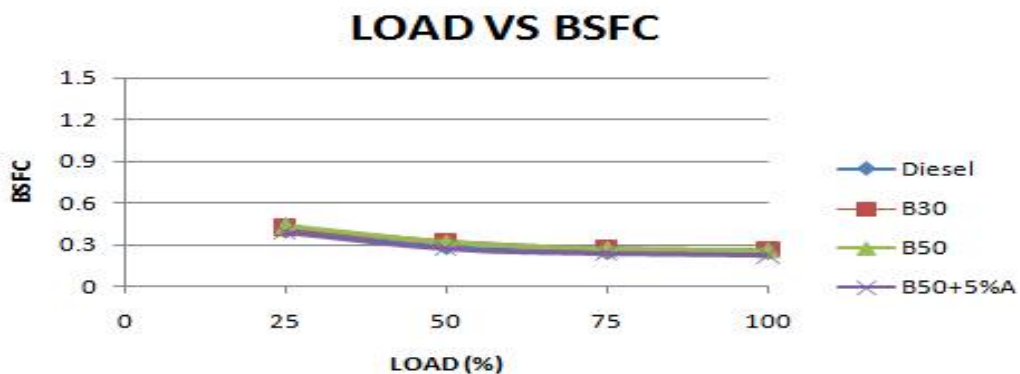
From the present test results observed from graph of load vs Bte that CB50+5%ACE has shown highest brake thermal efficiency than that of other test fuels because of its lower heat content, higher viscosity, higher density and lower volatility in comparison to diesel.



(b)

2. Brake Specific Fuel Consumption (BSFC)

From the graph of load vs bsfc below observed that CB50+5%ACE show that lower BSFC other than tested fuels. This is mainly due to the higher viscosity, density, low volatility compared with base fuel. Thus for the same energy output from the engine, it only requires smaller mass fuel flow, which decreases bsfc to compensate the reduced chemical energy in the fuel.



(c)

Emission Characteristics

1. Load vs CO emissions

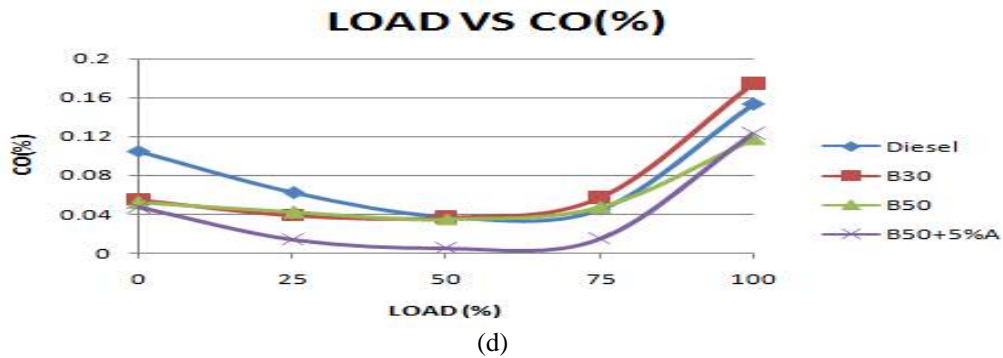
From the graph of load vs CO(%) observed that CB50+5%ACE show that lower CO emissions due to it has been reported that higher cetane number of biodiesel blends; results in the lower possibility of formation of rich fuel zone and thus reduces CO emissions

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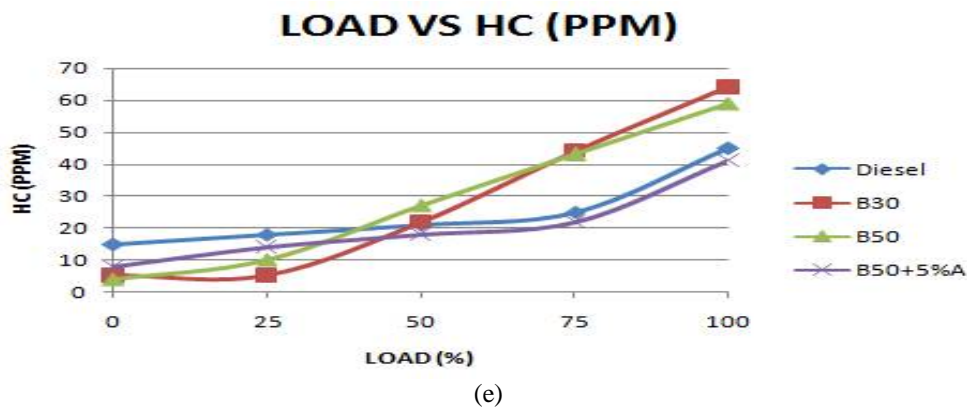
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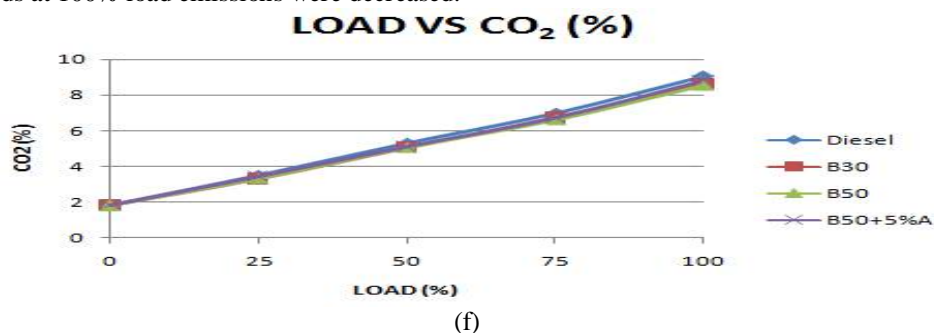
2. Load vs HC emissions

From the graph of load vs HC (PPM) observed that CB50+5%ACE show that lower HC emissions mainly because of oxygen content of fuel is the main reason for more complete combustion and HC emission reduction. . Furthermore, higher cetane number of biodiesel blends reduces the combustion delay, and such a reduction has also been related to decreases in HC emissions



3. Load vs CO₂ emissions

From the graph of load vs CO₂(%) observed that CB50+5%ACE show that lower CO₂ emissions because of more amount of CO₂ in exhaust emission indicates the complete combustion of fuel. Compared to diesel fuel, CO₂ for biodiesel blends at 100% load emissions were decreased.



4. Load vs NO_x emissions

From the graph of load vs NO_x (PPM) observed that CB50+5%ACE show that lower NO_x emissions due According to increased oxygen levels increase the maximum temperature during the combustion, and thus decrease

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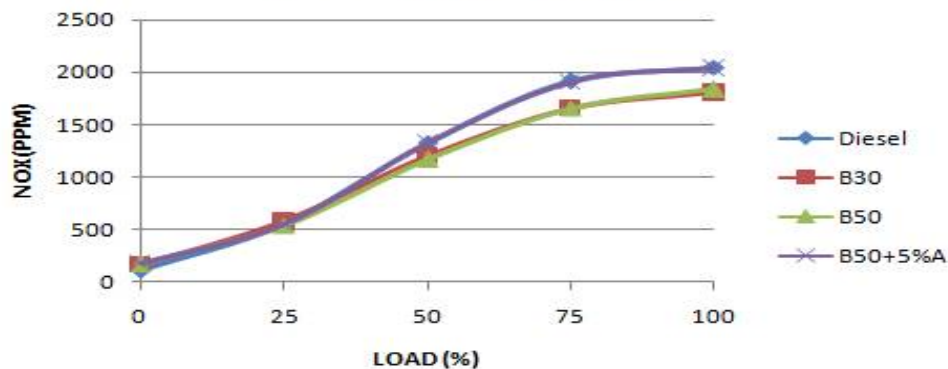
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NO_x formation. The fuel borne oxygen is more effective than the external oxygen supplied with the air. The decrease in NO_x compared to diesel fuel is shown.

LOAD VS NO_x(PPM)

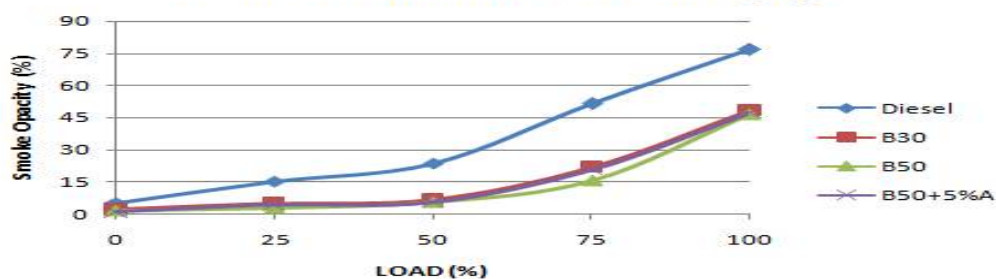


(g)

5. Load vs Smoke Opacity

From the graph of load vs Smoke Opacity (%) observed that CB50+5%ACE shows that lower Smoke Opacity due to the smoke emission is mainly affected by the heterogeneous of diesel combustion and air-fuel ratios. Smoke formation primarily occurs in at higher temperatures if the fuel is partially oxygenated, locally over rich ranges can be reduced which in turn reduces the smoke formation.

LOAD VS SMOKE OPACITY (%)



(h)

IV. CONCLUSION

From the results and discussion we conclude that Coconut Oil is one of the alternate fuels in Diesel Engine. Now it can be used in Diesel engine as alternate fuel by blending with diesel. It is observed that it has better efficiency almost 7% than and reduces the emissions like CO, HC, CO₂, NO_x and Smoke Opacity than diesel.

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