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"To investigate the performance characteristics of a compression ignition engine using different types of fuel combination "

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ABSTRACT

Alternative automotive fuels are currently a significant problem worldwide due to efforts to reduce the global warming provided by the combustion of petroleum or petrol diesel. Biodiesel is non-toxic, biodegradable, produced from renewable sources and contributes to the minimal amount of net greenhouse gases such as CO2, SO2 and NO emissions to the atmosphere. Petroleum reserves are rapidly disappearing from the earth's surface. Biodiesel provides such an alternative. It has become interesting to know the CI engine performance dedicated to biodiesel fuel along with its compatibility as an alternative fuel to existing compression ignition engines. Chapter One introduced the concept with illustrations about biodiesel and its importance and its important properties.

Chapter Two provides a brief literature survey with the coconut biodiesel manufacturing process and shows the various reactions that occur during the production of this biodiesel. Chapter three talks about the whole process of the experimental and experimental setup and emphasizes the engine used for the experiments. Chapter four contains the results and discussions of the experiment with graphical plots. Finally, Chapter Five concludes with a future scope.

The growing concern over environmental pollution caused by conventional fossil fuels and the perception that they are renewable has led to the search for more environmentally friendly and renewable fuels. Among the various alternatives researched for diesel fuel, biodiesel derived from vegetable oils has been identified as one of the strongest competitors for reducing exhaust emissions worldwide..

Keywords:- *CI Engine, Biodiesel, gasoline, Brake Specific fuel Consumption, fossil fuel.*

INTRODUCTION

The use of fossil fuels in the automobile industry has increased the pollution and green house gases which has immensely affected the environment. The CO2emission has also increased, due to these reasons the need for alternative green fuels are required. The research is carried out all over the world to use biodiesel with petro-diesel.The research project is undertaken in order to investigate the performance of engine under the of diesel and biodiesel. This is done experimentaly.

Several countries including India have already begun substituting the conventional diesel by a certain quantity of biodiesel. The biodiesel production is mainly from edible oils such as soybean, sunflower and canola oils. Since, India is not self-sufficient in edible oil production, hence, some no edible oil seeds available in the country are required to be tapped for biodiesel production. The most common blend is mix of 20% bio-diesel with 80%biesel. Bio-diesel is the only alternative fuel that runs in any conventional, unmodified diesel engine. It can be stored anywhere that diesel fuel is stored. The life cycle production and use of bio-diesel produce approximately 80%less carbon dioxide emission, and almost 100% less Sulphur dioxide. Vegetable oil is a promising alternative to petro diesel fuel because it has several advantages. it is environmental friendly and can produce easily in rural areas, where there is an acute need for modern forms of energy.

- ***GENERAL REVIEW ON BLENDING APPLICATION:***

Thepurpose of this study is to investigate the effect of several oxygenated fuel additives, having a range of boiling points and other properties, on emission from diesel engines with alternative fuels and petro-diesel. As per Ullman T and Mason R(1990) the oxygenates were blended with no. 2 diesel fuel at I and 2 wt

% oxygen, and the effect on emissions was measures by the hot start portion of the heavy duty transient test 40 CFR, Part 86, Subpart N. Testing was performed in both 2 stroke and 4 stroke diesel engines. The hardware is typical of current on road engine technology and has been extensively used for fuel emission studies. According to EPA complex model.Fedregist.(1994) the oxygenated fuels have a history of reducing exhaust emissions from motor vehicles. Additions of methyl tertiary butyl ether (MTBE) and ethanol have been successful in reducing Co and non- evaporative hydrocarbon emissions from gasoline engines. The success of oxygenated gasoline has sparked interest in the use of oxygenated compound ad particulate matter (PM) emission reducing additives in diesel fuel. Bennethum and Winsor (1991) examined the oxygenated compound diglymediethylene glycol dimethyl ether in a 2 stroke engine. Heavy duty transient test result with the treated fuel showed a 6% CO and PM reduction at 0.5% vol % diglyme. At 5% diglyme, a 13 % Co reduction and a 20% PM

reduction were observed while HC and NOx remained unchanged. Winsor R.E. (1993) reported further work in which dimethyl carbonated added to diesel ar 3.5 et % oxygen. PM and Co reductions were approximately 15%.

- ***BIO DIESEL :***

Biodiesel is made of mono alkyl esters produced from vegetable oils, animal or old cooking fats. Waste vegetable oil biodiesel is fuel alternative produced from soybean oil. Biodiesel contains no petroleum diesel, but it can be blended with petroleum diesel.

Biodiesel is a clean, Eco-Friendly natural fuel obtained from tree born oils by a chemical transformation process called TRANSESTERIFICATION carried out in a Chemical Processing Plant. Transesterification is an age old chemical

- ***ENERGY REQUIREMENTFOR INDIA:***

India ranks sixth in the world in the term of energy demand accounting for 3.5% of world commercial energy demand. It is expected to grow at 4.8%. The growth in energy demand in all forms is expected to continue unabated owing to increasing urbanization ,standard of living and expanding population with stabilization not before mid of the current century. The demand of diesel (HSD) is projected to grow from 52.33 millions of tons in 2006-07 to 61.55 millions of tons in 2009-10. Our Crude oil production as per the tenth plan working group is estimated around 33-34 million metric tons per annum. The import bills are raising to $ 15.7 billion or so which is a huge amount for a country like ours. Consumption of diesel can be minimized by implementing biodiesel program expeditiously. More research work in this field will help the country in saving precious foreign currency, which otherwise is wasted in purchasing petroleum products instead of helping poor for their pure drinking water and meals [1].

Biodiesel is suitable for environmentally friendly fuels because of there are not any toxic compounds produced during the period of combustion. In this matter, Demirbas[1] reported that the advantages of biodiesel is better quality of exhaust gas emissions, its biodegradability and its contribution to the reduction in carbon dioxide (CO2)

emissions. The now days serious problem for biodiesel production is the high price of vegetable oil which leads to a highly expensive of biodiesel product price compared to that of petroleum based diesel product for anticipating such that situation, many researchers have started to utilize the waste resource based oils as reaction feedstock.

process and is a time tested method of Transforming Vegetable oils or fats into Biodiesel (Alkyl Esters of Fatty acids) and Glycerin plus some soaps etc. The chemistry lies in transforming the fatty acid chains into Alkyl Esters of respective fatty acids present in different feed oils used and isolation of glycerol present in the Triglyceride molecule in the oils and fats. Industrial production of Biodiesel consists of the following THREE distinct processing phases and three basic Equipment lineups.

Vegetable oil are more promising alternative fuels as they have several merits renewability, eco-friendly and easily cultivated in rural areas, where there is an acute need for modern forms of energy (1-3). Palm biodiesel blended with diesel fuel for certain percentage (up tp 30%) has significantly improved emission characteristics, as shown in the result of a 20,000 km road test carried out in Indonesia. Overall combustion phenomenon of an IDI engine running with soybean monthly ester are on per with diesel fuel except pollutions were reduced. Combustion pressure and combustion period was increased when the DI engine running with Palm biodiesel compared with diesel fuel.

2 LITERATURE REVIEW

Particulate matter (PM) and oxides of nitrogen (NOx emission) are the two important harmful emissions in diesel engine. Fuel companies and the researchers around the world are devoted to reduce such emission with different ways. Fuel modification, modification of combustion chamber design and exhaust after treatment are the important mean to alleviate such emission. In this context, engine researcher are hunting suitable alternative fuels for diesel engine. Among different alternative fuels, oxygenated fuel is kind of alternative fuel. Diethylene glycol dimethyl ether (DGM),

dimethoxy methane (DMM), dimethyl ether (DME), methyl tertiary butyl ether (MTBE), ibuty ether (DBE), dimethyl carbonate (DMC), methanol, ethanol and diethyl ether (DEE-a Cetane improver) have played theri role to reduce diesel emission. These fuels can either be used as a blend with conventional diesel fuel or as a neat fuel. The presence of oxygen in the fuel molecular structure plays an important role to reduce PM and other harmful emission form diesel engine. The present work report on the effect of oxygenated fuel on diesl combustion and exhaust emission. It has been found that the exhaust emission including PM. Total unburnt hydrocarbon (THC), carbon monoxide (Co), smoke cased and were entirely depended on the engine operating conditions. The reductions of the emission were entirely depends on the oxygen content of the fuel. It has been reported that the combustion with oxygenated fuels were much faster than that of conventional diesel fuel. This was mainly due to the oxygen content in the fuel molecular structure and the low volatility of the oxygenated fuels.

2.1 REVIEW ON ADDITIVE APPLICATION IN GENERAL:

Experimental study of diethyl ether and Ethanol additives with Biodiesel blends fuel engine D.D. Nagdeotel, M.M. Deshmukh, M.Tech Student, Dept. Of Mech. Engg. Govt. College, Amaravati, Maharastra INDIA, 2016.

An experimental investigation is conducted to evaluate the effects of using diethyl ether and ethanol as additives to biodiesel blends on the performance and emission of a direct injection diesel engine. The test fuels are denotes as DI (100% diesel), BD (20% biodiesel and 80% diesel, 80% diesel and 5% ethanol in vol.) respectively. The results indicate theat, compared with BD there is slightly lower brake specific fuel consumption (BSFC) for BDET. Drastic reduction in smoke is observed with BDET and BDE at higher engine loads. BDET reflects engine performance and combustion characteristics than BDE and BD.

Simultaneous reduction of NOx and smoke from a direct injection diesel engine with exhaust gas recirculation and diethyl ether 2014.

An experimental investigation was carried out to analyse the simultaneous reduction of oxides of nitrogen (NOx) and smoke emission. The tests were performed on a signal cylinder direct injection diesel engine. The engine was

made to run on both pure diesel and diethyl ether (DEE) diesel blends. The DEE diesel blends were prepared by mixing certain proportions of DEE and diesel fuel. The amount of DEE in the diesel fuel blends was varied up to 30% vol % in steps of 10 Vol% by volume. The results obtained from DEE diesel blends were compared with those from pure diesel and it was found that the 20 vol% DEE diesel blends resulted in the optimum performance and emission characteristics. The study was further extended by using exhaust gas recirculation (EGR) with 20% DEE diesel blends and diesel. At 5 Vol% EGR operated with 20 Vol% DEE diesel blends, there is asimultaneous reduction of NOx and smoke emission by 54% and 20% respectively. In contrast, in the case of the pure diesel mode, when the EGR rate was fuel, namely the DEE diesel blend shows very promising results with respect to emissions, efficiency, and durability.

Application of Diethyl Ether ro Reduce Smoke and NOx Emissions Simultaneously with Diesel and Biodiesel Fueled Engines (MasoundIranmanesh, J.P. Subramanyam and M. K.G. Babu) 2011.

In this investigations tests were conducted on a single cylinder DI diesel engine fuelled with neat diesel and biodiesel as baseline fuel with addition of 5 to 20% DEE on a volume basis in steps of 5 % as supplementary oxygenated fuel to analyse the simultaneous reduction of smoke and oxides of nitrogen. Some physicochemical properties of test fuels such as heating value. Viscosity, specific gravity and distillation profile were also determines in accordance to the ASTM standards. The results obtained form the engine tests have shown a significant reduction in NOx emission especially for bio diesel and a little decrease in smoke of DEE blends compared with baseline fuels. A global overview of the results has shown that the 5% DEE- diesel fuel and 15% DEE biodiesel are the optimal blend based on performance and emission characteristics.

Pugazhvadiual et al. 2009, investigate the effect od adding DEE to biodiesel blends (B25, B50 and B75) and biodiesel (B100). DEE was added in 10% , 15% and 20% (v/v) to the biodiesel fuels.

All the biodiesel blends produced a higher NOx emission compared to diesel. With B25 blends, the NOx emission was reduce by the addition of DEE at all load conditions. With B75 and B100 blends, the NOx emission was lowered by the addition of DEE at low and medium loads. However, at high loads the NOx emission was higher relative to diesel; but lower compared to the corresponding fuel blens. The addition of 15% to 20% DEE was more beneficial in reading NOx compared to 105 DEE.

DEE as a fuel additive has shown to offer beneficial effects in terms of both performance and emissions. Anandet. Al. 2007, have showed that a 20% DEE in diesel along with 5% EGR result in the simulations simultaneous reduction of smoke and NOx emission. *Recently, Ramadhaset.al 2008.,studied the was of DEE as a fuel additive for reducing the cols starting problem and to improve the performance and emission characteristics of a diesel engine fuelled with biodiesel. In the work, pongamia oil derived from the seed of PongamiaPinnata is used to produce biodiesel. P. Pinnata has been recognized as one of the most suitable among other plant species such as Jatrophacurcus and Madhucaindica for producing biodiesel.*

<u>TRANSESTERIOFICATION OF NON-EDIBLE</u>

The use of Vegetable oils in lieu of biodiesel fuel in convention diesel engines required certain modification of their properties. The Problem of substituting diesel fuels with pure vegetable oil are mostly associated with their high viscosities Tat and Van Gerpan

(2007). Is have been put to develop vegetable oil derivatives that would approximately the properties and performance of the hydrocarbon based fuels. Reduction of viscosity can be induced by any of the process like transesteriofication , mineralization, preheating and pyrolysis. Mineralization consumes more time and pyrolysis brings about irregular molecular break down. Hencetransesterification of some of the non- edible oil is taken up in the present work to experiment on a laboratory based DI diesel engine. The experimentation was performed with the esterified version of non-edible vegetable oil. Waste frying oil methyl Ester (MME) and additive Diethyl ether (DEE) at various percentages.

3 TRANS ESTERIFICATION OF VEGETABLE OILS:

Transesterification is the general term used to describe the important class of organic reactions, where an ester is transformed into another ester through interchange of alkyl groups and is also called as alcoholises. Transesterification is an equilibrium reaction and the transformation occurs by mixing the

reactants. However, the presence of a catalyst accelerates considerable the adjustment of the equilibrium. The general equation for transesterification reaction is given below.

RCOOR + R" OH RCOOR " + R' Oh ***Eq. 2.1***

The basic constituent of vegetable oils is triglyceride. Vegetable oil comprise of 90-98 percent triglycerides and small amounts of mono glyceride, diglycerif and free fatty acids, In the transesterification of vegetable oil, a triglyceride reacts with an alcohol in the presence of a strong acid or base, producing a mixture of fatty acid acid alkyl ester and glycerol. The overall process is a sequence of three consecutive and reversible reactions in which diglyceride and mono glyceride are formed as intermediates. The stoichiometric reaction required one mole of triglyceride and three moles of alcohol. However, an excess the alcohol is used to increase the yield of alkyl esters and to allow phase separation from the glycerol forms. Several aspects including the type of catalyst (base or acid), alcohols/vegetable oil molar ratio, temperature, purity of the reactants mainly water content in alcohols and free fatty acid content have influence on the course of transesterification. So in this work, the reactions of high purity have been

used methyl alcohols with 99.95% purity. In the case catalyzed process. The transesterification of vegetable oils proceeds faster than the acid catalyzed reaction. Also the alkaline catalysts are less corrosive than acidic compounds.

The mechanism of the base catalysed transesterification reaction of vegetable oil is shown in the figure 2.1. the first step Eq.-1 is the reaction of the base with the alcohols, producing an alkoxide and the protonated catalysed. The nucleophilic attack of the alkoxide at the carbonyl group of the triglyride generates a tetrahedral intermediate, from which an alkyl ester and the diglycricgenerates a tetrahedral intermediate, from which an alkyl easter and the diglyceride are formed. The latter deprotonates the catalyst, regenerates the acti9ve species and enable it to react with a second molecular of the alcohol thus starting another catalytic cycle. Diglycerides and monoglycerides are converted by the same mechanism to a mixture of alkyl ester and glycerol.

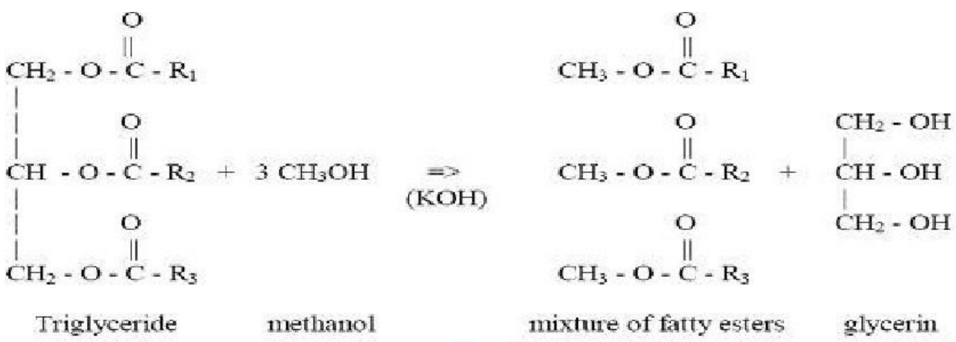


Figure 2.1 Mechanism of the base catalysed Transesterification Process.

Alkaline metal alkoxides (Such as CH3ONa) for the methanolysis) are the most active catalyzed since they give high yield in short reaction times given if they applied at lower molar concentrations. However, they require the absence of water which makes them inappropriate for typical industrial process. Alkali metal hydroxide (KOH and NaOH) are cheaper than metal alkoxide, but less active. Nevertheless, they are good alternatives since they can gives the same high conversations of vegetable oil just by increasing the catalyst concentration by 1 or 2 folds.

EXPERIMENTAL SET UP

A hundred Litters per Day capacity Bio-Diesel generating setup was installed in RGTU Energy Park to produce Bio-Diesel from JetropaCurcos and waste frying oil. A single cylinder 4-stroke diesel Engine was purchased & Installed in Thermal Engg. Lab of Mechanical Engg. Deptt ,to conduct experimental work for testing Bio-Diesel.

Service details of the 100 Four blends of diethyl ether in waste frying oil Methyl Ester (CME) were tested, namely, 3%,5%, 10%, and 15% by volume additive Diethyl ether (DEE is added to bi-diesel (CEM). The crank case oil dilution is regularly tested to verify the extent of contamination. Experimental is carried out at various engine loads.

In this chapter a detail description of procedure of making biodiesel in energy park of RGTU is mentioned, along with the complete technical specifications and of CI enginetest kit used for performance testing is also written here. Procedure followed for conducting experimentations is also recorded in this chapter. Experimental tests have been carried out to evaluate the performance, emission and combustion characteristics of a diesel engine when fuelled

coconut oil and its blends of 20%, 40%, 60%, 80% and 100% of biodiesel with ordinary diesel fuel separately at different load. The emission like HC, CO, and NOx, were measured in the exhaust gas analyzer and smoke density was measured in the smoke meter. AVL 444Di-gas analyzer was used to measure the oxides of nitrogen. AVL 437 smoke meter was used to measure the density of exhaust gases. AVL combustion analyzer was used to analyse the combustion characteristics.

EXPERIMENAL SETUP

The following equipment are consists for experimental setup :

- ✓ *DI diesel engine with rope dynamometer Single Cylinder*
- ✓ *Engine Date Logger*
- ✓ *Smoke Analyser*
- ✓ *Exhaust Gas Analyser*

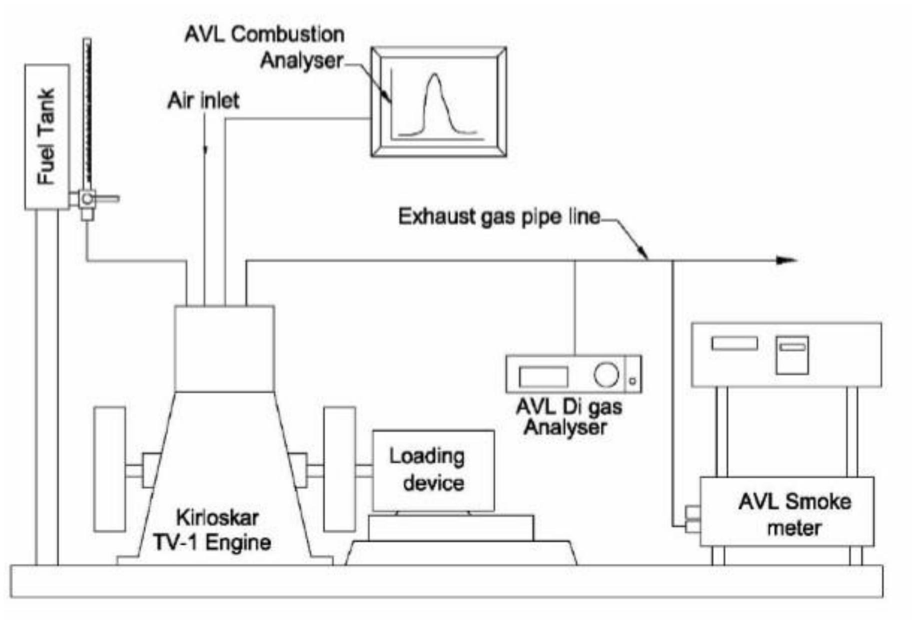


FIG.

PROCEDURE PREPARATION OF BIODIESEL FROMCOCONUT OIL:

BIODIESEL PREPARATION:

The filtered oil was heated up to a temperature of 50°C in water bath to melt coagulated oil. It is important not to overheat the oil above 65°C, because at that temperature alcohol would boil away easily. The heated oil of 100 ml was measured and transferred into a conical flask containing catalyst-alcohol *solution. The reaction was considered to start at this moment, since heated oil assisted the reaction to occur. The reaction mixture was then shaken by using shaker at a fixed speed for 2 h.*

SEPARATION OF BIODIESEL FROM BY-PRODUCTS:

The product of the reaction was exposed to open air to evaporate excess methanol for 30 min. The product was then allowed to settle down overnight. Two distinct liquid phases: crude ester phase atthe top andglycerol phase at the bottom were produced in a successful trans esterification reaction.

RESULTS & DISCUSSION

Experimentation Diethyl Ether DEE contains Oxygen by 21% gravimetrically, highly as an additive alongwith the main fuel, waste frying oil Methyl ester (CME) Replacing total petroleum diesel in a direct injection diesel engine is conducted. Some important properties to elicit benefits of CME and DEE combination have been enlisted below:

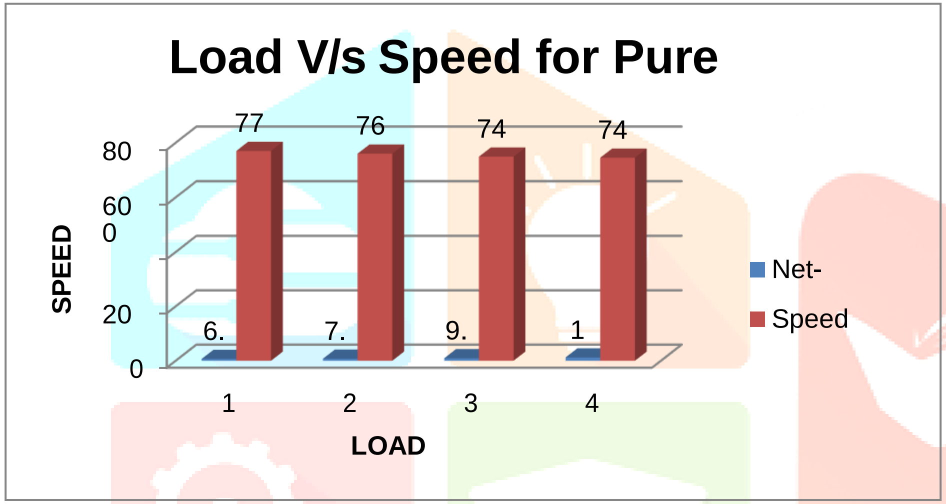
Repeated experimental work was done by using this single cylinder 4-stroke diesel engine and datawere recorded at different loads for neat diesel, neat biodiesel and by mixing different ratio of diesel and biodiesel, using different blends all data was collected and represent in the graph which is shown below.

DIESEL WITHOUT BIO DIESEL (PURE DIESEL)

Net-Load(Kg)	*Speed (RPM)*	*Fc(Kg / hour)*	*BSFC (kg.Kwhr.)*	*B.P. (W)*	*BME P Bar*	*µbth(%)*	*µvol(%)*	*A/F*
6.7	*770*	*0.415*	*0.460*	*1019*	*2.45*	*20.1*	*89*	*37.4*
7.3	*760*	*0.561*	*0.476*	*1160*	*2.78*	*19.0*	*91*	*33.7*
9.3	*749*	*0.695*	*0.511*	*1375*	*3.36*	*17.8*	*92*	*22.8*
12	*745*	*0.890*	*0.494*	*1745*	*4.30*	*17.8*	*93*	*18.9*

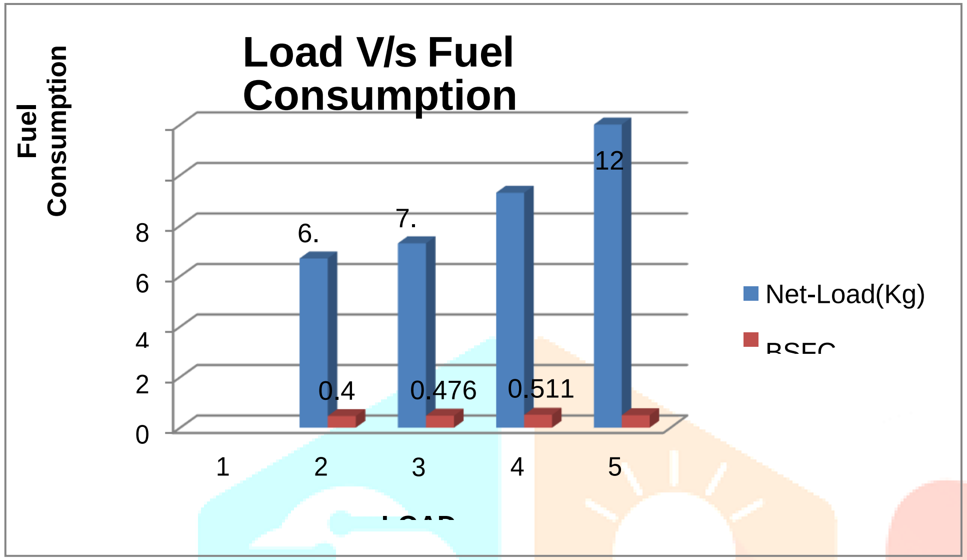
.1 Figure : 5.1

Figure No. 5.1 speed is plotted against the load for neat diesel and blend of bio- diesel and speed decrease as load increase. In the beginning speed is nearly same for neat diesel and blend at all load and have lower value at 20% blend of bio diesel.



Variation of speed with load for pure dieselFigure 5.2Speed is plotted against the load for pure diesel and speed decrease as load increased.

Fuel Consumption



Variation of fuel consumption with load for pure diesel

Fuel consumption V/s load is plotted for Purediesel and fuel consumption increase as load increases. In the figure fuel consumption is nearly same for neat diesel.

10% BLEND OF BIO DIESEL

Net-Load(Kg)	Speed (RPM)	Fc(Kg/	BSFC (kg.Kwhr.)	B.P.	BMEP	µbth(%)	µvol(%)	A/F
		hour)		(W)	Bar			
6.7	763	0.504	0.55	1011	2.4	16.9	90.5	28.7
7.9	756	0.56	0.467	1155	2.8	18.1	91.1	27.5
10	754	0.687	0.495	1357	3.36	16.9	92.7	23

Figure : 5.1

Speed is plotted against the load for 10% blend diesel and speed decrease as load increased.

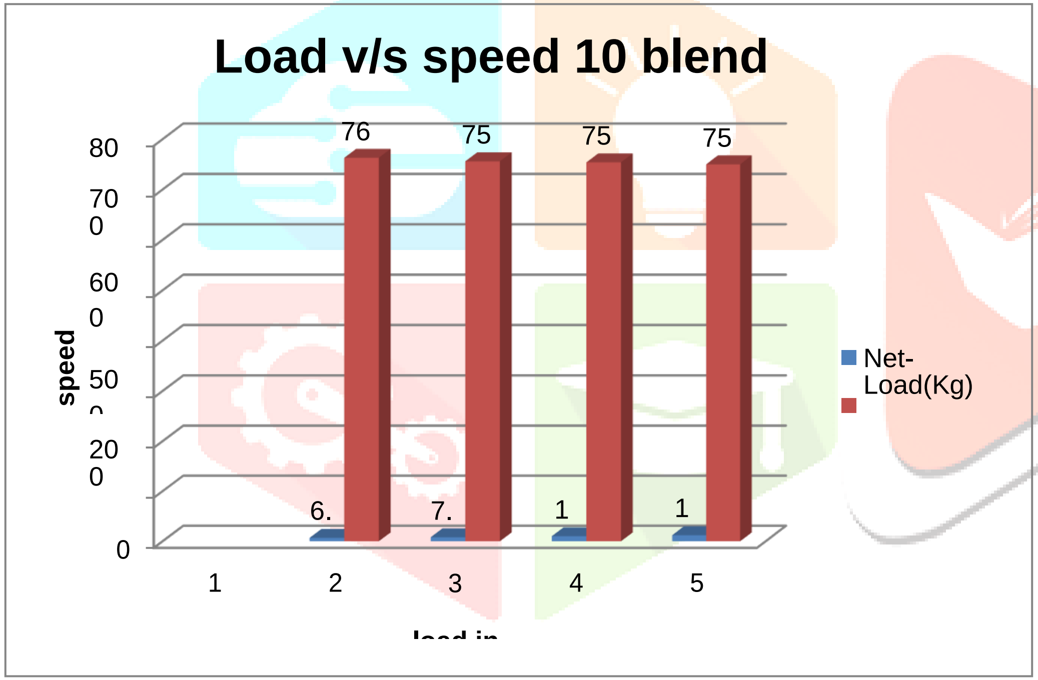


Figure : 5.2

BSFC is plotted against the load with 10% blend of bio-diesel. BSFC increase as load increase

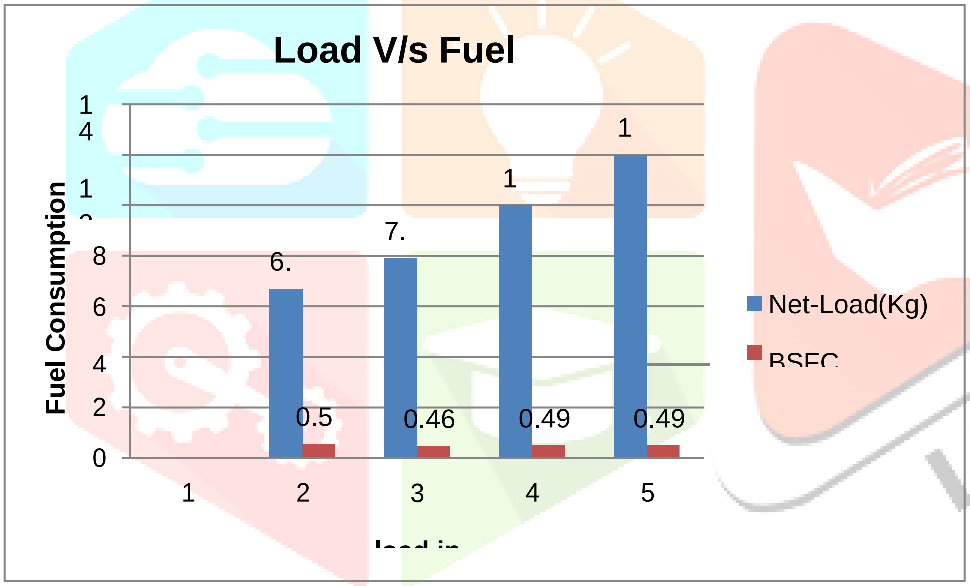


Figure : 5.3

Volumetric efficiency is plotted against the load for blend of of bio diesel and volumetric efficiency as load increases.

20% BLEND OF BIO DIESEL

Variation of volumetric efficiency with load for 5% blend diesel

Net-Load(Kg)	Speed (RPM)	Fc(Kg/ hour)	BSFC (kg.Kwhr.)	B.P. (W)	BMEP Bar	µbth(%)	µvol(%)	A/F
6.5	768	0.47	0.48	1003	2.41	17.9	93	32
7.5	756	0.54	0.478	1134	2.89	17.7	94	30
9	749	0.68	0.54	1352	3.37	16.5	95	25

<u>CONCLUSITION ANF FUTURE SCOPE</u>

The objective of this study was to characterize the effect of biodiesel produced from coconut oil on the combustion Characteristics, performance and exhaust emissions of a diesel engine. The properties, performance, emissions and combustion characteristics of the engine fuelled with biodiesel and diesel were compared. Based on the experimental results, the following.

- Conclusions can be drawn: In the beginning for smaller values of Brake Power and Load blend biodiesel consumption is higher than the neat diesel consumption which narrows down with higher values of brake power and load.
- BSFC values for smaller load is higher for blend bio-diesel and this gap reduces later for higher value of load.
- Brake power for neat diesel have higher values than blend bio-diesel at all load and difference decreases

as load increases andbrake power is minimum for 20% blend.

- Brake thermal efficiency is higher for neat diesel at all load and lower for 20% blend and difference decreases as load increases.

- Volumetric Efficiency Variation with load is nearly same for these fuels Volumetric Efficiency values are found always higher with blend Biodiesel fuel for all the loads.

Future Scope of Work:

- Analysis of composition of exhaust emission can be done with prolonged service with neat bio-diesel.
- Performance of engine can be compared for various blends of biodiesel with neat diesel; present study is focused only to blend biodiesel fuels.

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