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Role of 2 EHN fuel additive on reduction of NOx, UHC emissions from a diesel engine powered by Karanja biofuel.

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ABSTRACT:Social networking services are used for communication between people to share information through internet.Reaching hundreds millions of users, major social networks have become important target media for spammers. Social networks provide communication between people to share information through internet. The unbounded growth of content and users pushes the Internet technologies usage to certain limitations. The main objective of the proposed work is to find relationship between features and classifying patterns for detecting spam message from the unwanted sites. .In this paper we have reviewed the existing techniques for detecting spam users in social network. Features for the detection of spammers could be user based or content based or both and spam classifier methods.

KEY WORDS: Keywords: 2-EHN additive, NOx, UHC

I.INTRODUCTION

A. Alternative Fuel - A Substitute for Fossil Fuel

Fast depletion of fossil fuels is demanding an urgent need to carry out research work to find out the viable alternative fuels for meeting sustainable energy demand with minimum environmental impact. The major environmental concern, according to an IPCC report, is that “Most of the observed increase in globally averaged temperatures. Since the mid-20th century is due to the observed increase in anthropogenic greenhouse **“**Gas concentrations”. Since burning fossil fuels are known to increase greenhouse gas concentrations in the atmosphere, they are a likely contributor to global warming. Another concern is the peak oil theory, which predicts a rising cost of oil derived fuels caused by severe shortages of oil during an era of growing energy consumption. According to the 'peak oil' theory, the demand for oil will exceed supply and this gap will continue to grow, which could cause a growing energy crisis starting between 2010and2020. Lastly, the majority of the known petroleum reserves are located in the Middle East. There is general concern that worldwide fuel shortages could intensify the unrest that exists in the region, leading to further conflict and war. Alternative fuels, also known as non-conventional fuels, are any materials or substances that can be used as a fuel, other than conventional fuels.

Conventional fuels include: fossil fuels (petroleum (oil), Coal, propane, and natural gas), and also in some instances nuclear materials such as Uranium. Some well knew alternative fuels include Bio-diesel, Bioalcohol (Ethanol,Butane), chemically stored electricity (batteries and fuel cell), hydrogen, non-fossil Methane, non-fossil natural gas, vegetable oil and other biomass sources.Among all these alternative fuels bio-fuel is most popular.

B. OBJECTIVE OF THE PROJECT

The main intention of this study is

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- To search for an alternative fuel which ultimately improves the engine performance parameters as well as reduces the engine exhaust emission parameters by using Karanja oil methyl ester (KME).
- A single cylinder four stroke direct injection diesel engine with no engine modification is used to carry out the experiment with different blends of KME with fossil diesel.
- Proper blending with 2-EHN additive with the biodiesel-diesel fuel blends to enhance the performance of the biodiesel which in turn enhances the engine performance parameters and also reduces the engine exhaust emission parameters to make the fuel ideal.
- For optimization, Artificial Neutral Network approach is applied to predict the values of all required points within the ranges depending upon the values of input parameters coming out from experimental results.

At last, to establish the compatibility of Karanja oil biodiesel as a clean and environment friendly fuel for future use with distinguished effect in engine performance and exhaust emission

C. What is Biodiesel?

Biodiesel is clean burning alternative fuel that is made from 100% renewable resources. It is considered the fuel of the future. Sometimes it is also known as Bio-fuel. Biodiesel does not contain petroleum, but can be mixed with petroleum to produce a biodiesel blend that can be used in a number of vehicles. Pure biodiesel fuel, though, can only be used in diesel engines. Biodiesel is biodegradable and non-toxic, making it so safe that common table salt has been proven to be more toxic.

Biodiesel is made from vegetable oil through a process called Transesterfication. This process involves removing the glycerin from the vegetable oil or fat. During the process, by products are left behind, including methyl esters and glycerin.

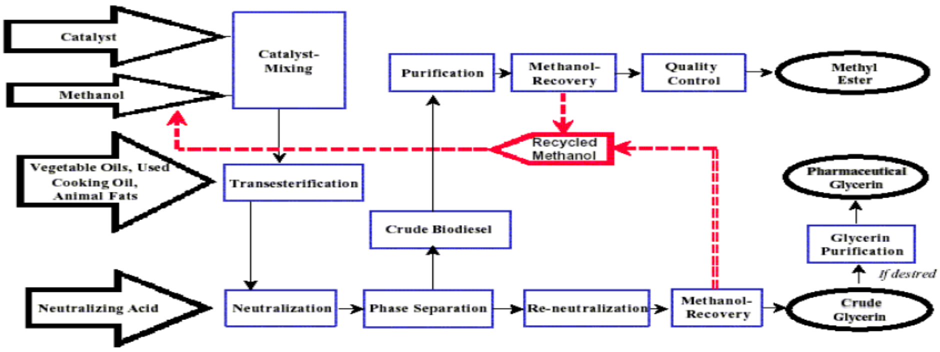

Fig 1 The Transesterfication process undergoes the following reaction.

The use of bio-diesel in conventional diesel engines results in substantial reduction of un burnt hydrocarbons, carbon monoxide and particulate matters. Bio-diesel is considered clean fuel, since; it has almost no sulphur, no aromatics and has about 10% built-in oxygen, which helps it to burn fully. Its higher cetane number improves the ignition quality even when blended with petroleum diesel.

The Vehicular Norms

The Bharat Stage II emission norms are enforced in the entire country from1.4.2005 and Euro III equivalent norms are to be enforced in 2010. In addition to 4 metros, where Bharat Stage II norms are already in place, Bangalore, Hyderabad,Ahmedabad, Pune, Surratt, Kanpur and Agra have also met this norm from 1.4.2003. The four metros and the other seven cities have already complied with Euro III since 2005 and Euro IV equivalent emission norms are due in 2010. The 2 and 3 wheelers are conforming to Bharat Stage II norms from 1.4.2005 all over the country and Bharat Stage III norms from 1.4.2008. For new vehicles, a drastic reduction in sulphur content (< 350 ppm) and higher cetane number (>51) will be required in the petroleum diesel produced by Indian Refineries. Bio-diesel meets these two important specifications and would help in improving the lubricity of low sulphur diesel.

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D. Significance of Biodiesel

The diesel engines dominate the field of commercial transportation and agricultural machinery due to its ease of operation and higher fuel efficiency. The consumption of diesel oil is several times higher than that of petrol. Due to the shortage of petroleum products and its increasing cost, efforts are on to develop alternative fuels especially, to the diesel oil for full or partial replacement. It has been found that the biodiesels are promising fuels because their properties are similar to those of diesel and are produced easily and renewably from the crops.

Biodiesel have comparable energy density, cetane number, heat of vaporization and stoichiometric air-fuel ratio with that of the diesel fuel. None other than Rudolph Diesel, the father of diesel engine, demonstrated the first use of vegetable oil in compression ignition engine. He used peanut oil as fuel for his experimental engine. During World War II, attempts were made to use vegetable oils as fuel in diesel engines. In recent years, biodiesel has received significant attention both as a possible renewable alternative fuel and as an additive to the existing petroleum-based fuels. Biodiesel exhibits several merits when compared to that of the existing petroleum fuels. Many researchers have shown that particulate matter, un burnt hydrocarbons, carbon monoxide, and sulphur levels are significantly less in the exhaust gas while using biodiesel as fuel. However, an increase in the levels of oxides of nitrogen is reported with biodiesel.

E. Global Warming and Economical Issues

The carbon cycle of biodiesel consists of release and absorption of carbon dioxide. Combustion and respiration processes release carbon dioxide and crops for their photosynthesis process absorbs the carbon dioxide. Thus, the accumulation of carbon dioxide in atmosphere reduces. The carbon cycle time for fixation of CO_2 and its release after combustion of biodiesel is quite small (few years) as compared to the carbon cycle time of petroleum oils (few million years). Transport sector contributes a significant amount of carbon dioxide, one of the principal greenhouse gasses. CO_2 from combustion of fossil fuels is the predominant GHG produced by transport, accounting for over 95% of the annual global warming potential produced by the sector. Nitrous oxide produced by vehicles equipped with catalytic converters, and methane emitted by internal Combustion engines account for nearly all the remainder the total share of CO_2emission by transport sector alone is about 21% globally and with the rising number of vehicles everyday this share is expected to rise up to 23% by the year 2030. Transport sectors also a key factor in world overall increase in oil demand. Almost 2/3 of the worldwide Increase in oil demand between the years 2004 to 2030 comes from transport sector.

F. Application of biodiesel

World scenario

British Train Operating Company, Virgin Trains claimed tohaverun the world's first "biodiesel train", which was converted to run on 80% petro-diesel and only 20% biodiesel and it is claimed it had saved 14% on direct emissions. In 2005, Chrysler(then part of DaimlerChrysler) released the Jeep Liberty CRD diesels from the factory into the American market with 5% biodiesel blends. The Royal Train on 15th September 2007 completed its first ever journey run on 100%biodiesel fuel supplied by Green Fuels Ltd. Since 2007 the Royal Train has operated successfully on B100 (100% biodiesel). A state-owned short-line railroad in Eastern Washington ran a test of a 25% biodiesel 75% petro-diesel blends during the summer of 2008. Also in 2007 Disneyland began running the park trains on B98 biodiesel blends (98% biodiesel). The program was discontinued in 2008 due to storage issues, but in January 2009 it was started.

Indian scenario

Government of India started Bio Fuel mission in 2003, but it announced Bio Fuel policy on 11th September 2008. IOCL has announced their project on behalf of it. Indian Railways already started the use of biodiesel made from non edible oils such as Jatropha and Karanja in short term usage. In Kolkata, the Calcutta Tramways Company and

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Calcutta State Transport Corporation use the blend of biodiesel with diesel at their buses on regular basis. The major Automobile giants like, Tata, Daimler-Chrysler India use biodiesel from non edible oils. The Council for Scientific and Industrial Research encouraged Tata Motors and Indian Oil Corporation Limited to bring this Biodiesel as a way-out to the world's fuel crisis.

G.Present Study:-

In the present study, biodiesel is produced from non edible oil Karanja. The biodiesel is the methyl ester of Karanja Oil. Its properties are similar to that of high speed diesel. Before conducting the performance test of biodiesel in the Kirloskar made single cylinder variable compression ratio engine, we need to design the experiment. In the present study, there are three input variables: load, compression ratio and blend of fuel. And the compression ratio can be varied from 18:1 to 11:1 as per requirement. The blends can also be varied from 0-100% by any sort of variation as shown in the literature. As per the literature the load also can vary from no load to full load in any sort of variation. Moreover we choose the levels of these three input parameters or design factors as five as per the literature suggested. The load is varied from 20% to100% with increment of 20%. The compression ratio varies from 18:1 to 14:1. The blends of fuels vary from 0-100 by a variation of 20%.

II. Review of Literature

Rudolf Diesel, the father of Diesel engine, demonstrated the first use of vegetable oil in compression ignition engine. He used peanut oil as fuel for his experimental engine as fuel for his engine. With the initiation of cheap petroleum, appropriate crude oil Factories were refined to serve as fuel and diesel engine started evolving together. Later in the year 1940 vegetable oil were used again as fuel in emerging situations, during the period of World War 2. Because of the increase in the crude prices, limited reserve of fossils fuels and also for the environmental concern there has renewed focus on vegetable oils for producing the most suitable alternate to the diesel fuel, called biodiesel, the esters of Vegetable oil. Researchers are making a sincere attempt to find out the suitable alternative to diesel fuel which does not require major engine modifications. The review of literature is carried out on that basis. A brief discussion of some important research findings is presented below.

Carraretto et al. [1] experimented with a C.I. engine which was firstly tested on test bench and later on fitted on an urban bus. During the operation they measured distance travelled, fuel consumption and exhausts emissions. They found that with biodiesel, the specific fuel consumption and NO_X increases and CO, CO_2 emissions are reduced. Moreover the global emission of CO_2 can be reduced by using biodiesel.

Raheman and Phadatare [2] observed that Karanja oil methyl ester and by volume blends with diesel (20-80%) can be a suitable alternative fuel for replacing diesel. At exhaust emission study indicated that CO, smoke density and NO_X are reduced by a good percentage compared to diesel. The exhaust temperature is not varying much from diesel in case of B20. The fuel consumption is also nearly the same as that of diesel. For all fuels they observed increase in BTE (Brake Thermal Efficiency) with increasing Biodiesel percentage.

In a study made by **Puhan et al.[3]** it is indicated that biodiesel grows it's a acceptability as an alternative fuel because of its chemical properties. It is non toxic, renewable and biodegradable. The researchers produced biodiesel from Mahua seed oil. Using methyl alcohol for transesterification reaction and NaOH as catalyst of their action. After transesterification they got Mahua oil methyl ester which is called Mahua biodiesel. Like other biodiesel it has higher cetane number and specific gravity compared to diesel. But the heating value or calorific value is less than that of diesel. Engine performance of manual oil methyl esters shows a very similar performance of diesel. But the BSFC is high in case of MOME (Mahua oil methyl ester) as the calorific value is low. The Brake Thermal Efficiency is a little bit lower compared to that of diesel; it is a little bit lower, because of lower calorific value and specific gravity. However the BSEC is higher in case of biodiesel. At emission study the Mahua oil methyl ester shows a very good performance. It reduces CO and HC heavily and reduces NO_X by a small fraction.

Aziz et al. [4] studied the performance and emission with palm oil methyl esters& its blends with diesel. The biodiesel provide similar brake thermal efficiency to diesel in part load. BSFC is higher and brake power is lower than diesel because of low calorific value of biodiesel. Due to high oxygen content, biodiesel produce lesser smoke than diesel because of better combustion and the NO_Xemission of biodiesel is higher than diesel, especially at full load.

Avinash Kumar Agarwal [5] produced biodiesel from Ratanjyot (Jatropha), Karanja, Nagchampa and Rubber which is non edible oil by using both methyl and ethyl alcohol and get esters of its. The study found that the behavior of 20% blend of biodiesel is similar to that of petroleum diesel. It improves both efficiency and BSFC. In addition it reduces the exhaust emission and hence it is eco friendly. They claimed that in long run it is proved that biodiesel can be a better alternative to petroleum diesel, because it does not need any engine modifications.

Raheman and Ghadge [6, 7] carried out experiment by using Mahua biodiesel and its blends (by volume mixture with diesel) in a Ricardo E6 engine. The test conducted by varying compression ratio in a range of 18-20 and ignition timing (injection timing) 35°- 40° BTDC. It is observed that Brake Specific Fuel Consumption and Exhaust Gas temperature increase with the increase in compression ratio, load and advancement of ignition timing. Moreover the Brake thermal efficiency is decreased at the same time. The B20 Blend exhibits similar results as that of crude petroleum diesel. It can substitute the diesel easily without any engine modification at the Compression ratio 20 and ignition timing 40° Before TDC. They observed that with an increase in percentage of biodiesel the Brake specific fuel consumption increases and Brake thermal efficiency decreases. But the reverse was observed with an increase in engine load. The exhaust emission reduces, but NO_X increases with the increasing percentage of MOME in blends and the emission also increases with the increase in engine load.

Ghosal et al. [8] illustrated a short term engine performance test with Mahua oil methyl ester, diesel and their blends from 20-100%, by varying temperatures and injection pressures. The engine performance parameters (BSFC, BTE, and EGT) and emission parameters are studied. BSFC & EGT increases with percentage of biodiesel increases and decreases with fuel temperatures and operating pressures. The B20 blend found to be best for substitute diesel. The brake power, BSFC and BTE increases & EGT decreases with compare to diesel at higher temperature & pressure.

Rao et al. [9] concluded that the vegetable oils are promising alternative fuels for agricultural diesel engines, but it has slightly inferior performance and emits higher smoke emission due to higher viscosity. The exhaust temperature, CO and CO_2also increases with the power and amount of biodiesel mix. They observed that the B25 blend of methyl ester of Jatropha oil and diesel could be the better substitute to replacing the diesel.

Kalbande and Vikhe [10] studied the performance of Jatropha and Karanja Biodiesel and their blends with diesel. The fuel properties are found to be similar to biodiesel. The efficiency of Karanja biodiesel is higher for B20 and B40 blend. It indicates that the fuel consumption of these blends is lower than others. In case of Jatropha, the B60 and B80 deliver the maximum efficiency.

Fontaras et al. [11] investigated the combustion and emission characteristics of Biodiesel. Using neat soybean Biodiesel (B100) and 50% by volume blend with Petro-diesel (B 50) in a EURO 2 diesel passenger car, which does not need any engine modification of existing C.I. engine. With a help of chassis dynamometer they also investigated the real world cycle measurement. They observed that not only there is a cold starting problem with Biodiesel; it decreases the engine efficiency as well. Although biodiesel emits less particulate matter compared to that of diesel, the specific fuel consumption is higher in case of biodiesel.

Qietal. [12] first produced biodiesel from soybean crude oil using alkaline catalyzed transesterification process. The produced biodiesel shows higher values of specific gravity, viscosity, flash point compared to diesel, but the calorific value is lower than diesel. Their analysis shows at part load the peak pressure rise is higher in case of biodiesel but at full load it is same as diesel. At full load the power output and Brake Specific Energy Consumption of Biodiesel is similar to diesel.But Brake specific fuel consumption increases in case of Biodiesel. Biodiesel provides a significant reduction in CO, HC and NOX compared to diesel.

It has been observed by **Godiganur et al. [13]** that in long run the raw Mahua oil is not suitable for diesel engine since the problems such as injector choking, engine deposits filter gumming, piston ring sticking and thickening of lubricating oil occur. After transesterification the Mahua oil methyl ester gains similar properties of diesel and it can be a substitute of diesel. It is well acceptable as it is biodegradable, non toxic, and renewable. It can be mixed with any proportion and can be used in C.I. engine. Among the different blending, the 20% blend is found to be the most suitable to substitute the diesel. As it increases Brake Thermal Efficiency from engine point of view and on other hand emission point of view the CO and HC are reduced and NO_X increases slightly.

Lin et al. [14] showed that the biodiesel, methyl ester which we can get after transesterification of raw vegetable oil, is a well known substitute of diesel fuel, as it is non-toxic, biodegradable, environ-friendly and it also checks global warming. At this study, soybean, peanut, corn, sunflower, rapeseed, palm, palm kernel and waste fried oil methyl esters are being studied. All the methyl esters show that they could be a better option for C.I. engine without any engine modifications. The low calorific value causes the high BSFC for methyl esters, i.e. Biodiesel and high cetane number causes better ignition. From emission point the methyl esters reduced the Exhaust Gas Temperature, HO, CO emission. But on the other hand it increases NO_X also.

Since raw Karanja oil cannot be used in diesel engine owing to its high viscosity, **Baiju et al. [15]** first Transesterified it using both ethyl and methyl alcohol to produce Karanja oil ethyl ester and Karanja oil methyl ester. After transesterification both have the similar properties comparable to diesel. In C.I. engine ethyl ester is having the cold flow problem. But both of them can be a good substitute of diesel oil in C.I. engine without any modification. Due to lower calorific value biodiesel have a little power loss, on other hand it shows a good emission characteristic at full load though emission of NO_X is bit higher than diesel. The other response like CO, HC and smoke are reduced in both cases. They also observed that the methyl ester shows a better performance than ethyl ester.

Sahoo et al. [16] found that use of raw non edible feed stocks like Jatropha, Karanja, Polanga have sudden difficulties, but after transesterification the properties of esters are similar to diesel and can be used without going through any hardware modification. Jatropha, Karanja and Polanga methyl esters are blended with diesel at 20% and 50% by volume mixture. The maximum power output is obtained from J50blend. The smoke is reduced in case of Biodiesel at full throttle. Use of biodiesel at full and part throttle condition results in reduction of the PM, HC and smoke. On other side the CO and NO_X increases a bit compared to diesel.

Murugesan et al. [17] observed that methyl ester of Karanja oil (B100) can be directly used in C.I. engines without any modification for short term usage. In the case of Biodiesel the BSFC is found to be higher than that of diesel and the emissions characteristics are reduced. They noted that the B20 blend (by volume percentage of biodiesel 20%+80% crude diesel) is most suitable alternative for diesel.

Venkanna et al. [18] studied the effect of engine performance, emission and combustion characteristics using methyl ester of Pongamia Pinnata Linn Oil (Honge Oil) and diesel. Engine performance, emission and combustion parameters are very similar to that of diesel at HB 20 blends (20% Honge oil + 80% diesel). BSFC and BSEC are similar to diesel at HB 20. The emissions such as smoke density, CO, HC, NO_X emission are found to be similar to diesel.

Kandasamy and Thangavelu [19] studied the operational characteristics of diesel and ester of sunflower oil in diesel engine. Due to lower calorific value of sunflower oil the thermal efficiency is slightly less while specific fuel consumption is slightly higher compared to diesel. The above result shows that the attempt to run with esters of sunflower oil is effective and can be used as an alternative fuel without having modification of engine.

III.Karanja Oil

A. WHAT IS KARANJA?

Karanja is a medium sized tree that generally attains a height of about 8 meters and a trunk diameter of more than 50 cm. The trunk is generally short with thick branches spreading into a dense hemispherical crown of dark green leaves. The bark is thin gray to grayish-brown and yellow on the inside. The tap root is thick and long, lateral roots are numerous and well developed.

Karanja tree grows mainly in Western India and near Mumbai. The tree is occasionally seen on roadsides in Peninsular India. It is indigenous species and available throughout India from the foothills of the Himalayas down to the south of the Peninsula, especially not far from the seacoasts. Native to the Asian subcontinent, this specieshas been introduced to humid tropical lowlands in Malaysia, Australia, the Seychelles, the United States and Indonesia. Karanja trees are green during summer and they add to natural beauty. They also provide shelter and cool air. Karanja trees are normally planted along the highways, roads and canals to stop soil erosion. If the seeds fallen along road side are collected, and oil is extracted at village level expellers, tons of oil will be available for lighting the lamps in rural area. It is the best oil for lighting.

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Fig 3.1 Seeds of Karanja Tree

Karanja is one of the few nitrogen fixing trees to produce seeds containing 30- 32% oil. Native to humid and subtropical environments, Karanja grows in areas having an annual rainfall ranging from 500 to 2500 mm. In its natural habitat, the maximum temperature ranges from 27C to 38C and the minimum 1C to16C. Mature trees can withstand water logging and slight frost.

Karanja trees can grow on most of the soil types ranging from stony to sandy to clay. It does not grow well on dry sands. It is highly tolerant of salinity and drought. Hence, it is commonly grown along waterways or seashores, with its roots in fresh or salt water. The growth rates are found to be fastest on well drained soils with assured moisture

B. TRANSESTERIFICATION PROCESS

Transesterification or alcoholysis is the displacement of alcohol from an ester by another in a process similar to hydrolysis, except then alcohol is used instead of water. This process has been widely used to reduce the high viscosity of triglycerides.

The transesterification reaction is represented by the general equation as:

RCOOR' + R"OH↔RCOOR" + R'OH

If methane is used in this process it is called methanolysis. Methanolysis of glyceride is represented:

Fig.3.2Base catalysed Transesterification

Transesterification is one of the reversible reactions. However, the presence of a catalyst (a strong acid or base) accelerates the conversion.

The mechanism of alkali-catalysed transesterification is described below. The first step involves the attack of the alkoxide ion to the carbonyl carbon of the triglyceride molecule,

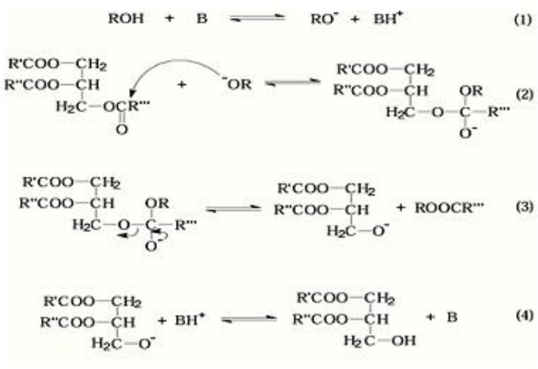

Fig.2.1Mechanism of base catalysed Transesterification

D. Physico-chemical properties of oil:

The physicochemical properties of karanja oil are shown in the table-3 given below. :-

TABLE 1 Physico-chemical Properties of Karanja oil

Properties	Value
Water Content	0.05%
Specific Gravity	0.9366
Density	0.9358 gm/cc
Carbon Residue	0.80%
Ash Content	0.05%
Flash Point	212 C
Fire Point	224 C
Copper Strip Corrosion	No corrosion was observed
Acid Value	16.8
Iodine Value	86.5
Boiling Point	330 C
Sediments (insoluble in hexane)	0.006%
Cloud Point	2 C
Pour Point	-4 C
Calorific Value(Kcal/kg)	8742
Cetane Number	38
Saponification Value	85.7
Unsaponifiable matter	0.90%

IV.Experimental Setup and Procedure.

A. Details of Testing Equipment

The performance test is carried out on a single cylinder variable compression ratio DI diesel engine using high speed diesel, methyl ester of karanja oil and their blends with diesel. The engine is assembled and coupled with an eddy current dynamometer. The arrangement of experimental setup used for carrying out the present study is shown in Tables 4.1, 4.2 and 4.3 given below. The different compression ratio taken varies from 14:1 to 18:1. The load range taken is from 3kg to12 kg.

During experiment, fuel consumption is measured by a burette and a stop watch, the engine exhaust (CO, HC, CO_2, O_2 and NO_X) is analyzed and calculated by AVL DIGAS 444 gas analyzer fitted with DIGAS SAMPLER at the exhaust.

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Manufacturer	Kirloskar Oil Engines Ltd.
Model	TV 1
Type	Four stroke, Water Cooled
No. of cylinder	One
Rated Power	3.5 kW @ 1500 RPM
Compression Ratio	12:1 to 18:1
Bore	87.5 mm
Stroke	110 mm
Injection Timing	23° before TDC
Method of Loading	Eddy Current Dynamometer

The engine is directly coupled to an eddy current dynamometer using flexible Coupling and a stub shaft assembly; the output of the engine Current dynamometer is fixed to a strain gauge load cell of electronic data acquisition system for measuring load applied to the engine. Provisions are available to provide different load (3 kg, 6kg, 9Kg and 12kg) on the engine, leading to load ranging from 20% and ending up at 100%. By knowing the dynamometer shaft length 0.185m, the applied torque on the engine can be calculated. A gas analyzer is used for the measurement of carbon monoxide (CO), nitric oxide (NO_X), unburnt hydrocarbon (HC), oxygen (O_2), particulate matter (PM). CO was measured as percentage volume and NO, HC was measured as n- hexane equivalent, ppm, which is fitted at the exhaust, by this arrangement we can get the emission characteristics. A glass burette is provided at the fuel tank assembly for diesel and bio-diesel fuel measurement separately. The fuel consumption is measured from the glass burette; by this we can measure the fuel consumption by volume per minute, for this purpose a stop watch is also used and then we can calculate the BSFC and BTE. The experiments are started at a rated speed of 1500 rpm but as the load increases the rpm decreases. No adjustment is made at the fuel injection timing; 23°c BTDC is used for diesel and Karanja Oil Methyl Ester (KOME), respectively. The experiments are conducted by using diesel (D100), B20 (20% KOME+80% diesel), B40 (40% KOME+60% diesel), B60 (60% KOME+40% diesel), and B100 (100% KOME), at different load conditions on the engine from 0 to 100% in appropriate steps at different compression ratios (CR) of 14:1, 15:1, 16:1, 17:1 and 18:1. The compression ratio can be changed by the arrangement provided to the cylinder head by decreasing or increasing the clearance volume. When the clearance volume is increased the compression ratio decreases and vice versa. For every fuel change, the fuel line is cleaned and the engine is left to operate for 30 min to stabilize at its new condition. In each experiment, engine parameters related to the thermal performance of the engine such as fuel consumption and applied load are measured.

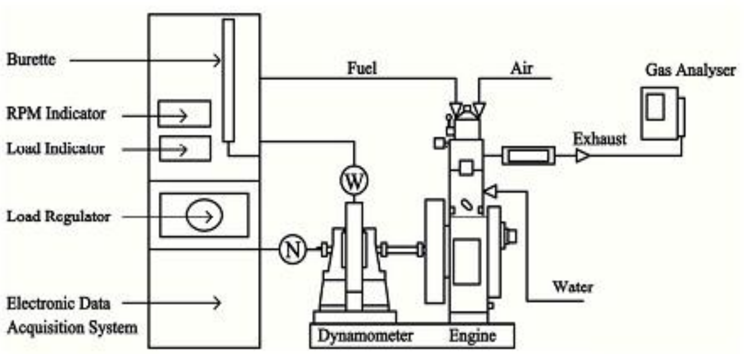

Fig 4.1: The Schematic Diagram of Experimental Setup

B. METHODOLOGY

The fuels used in this study are standard diesel and KME (99.9% purity, Laboratory used).The blending was done on volume basis as we know that biodiesel is miscible diesel in all proportions. Hence there is no problem of miscibility of

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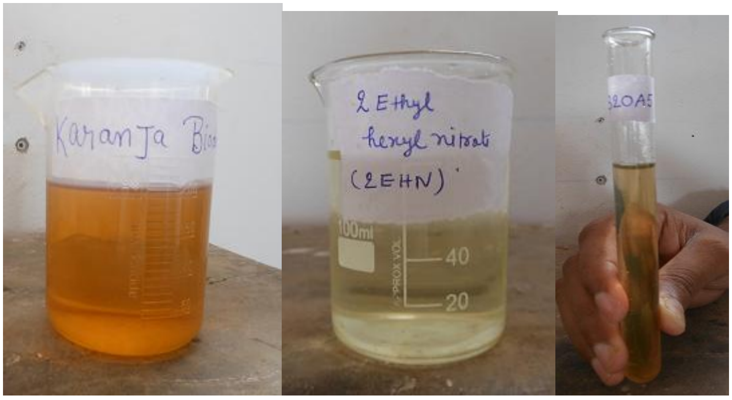
karanja biodiesel with diesel. For this experiment we have used blends of diesel and biodiesel in following proportion. They are mentioned below:-

1. D100- sample containing 100% diesel fuel.
2. B10- Sample containing 10%biodiesel 0.,5 % EHN, 89.5 %diesel.
3. B20- Sample containing 20% biodiesel ,0.5 %EHN 79.5 %diesel.
4. B30- Sample containing 30% biodiesel ,0.5% EHN ,69.5 % diesel.



KARANJA BIO-DIESEL 2-ETHYLHEXYL NITRATE B20

S.NO	Property	Karanja	B100	B10	B20	B30	Diesel	specification	Test methods
1	Density (kg/m3)	912	898	856	862	868	850	860–890	P16
2	Kinematic viscosity (cSt)	27.84	5.46	3.23	3.49	3.77	4.842	2.5–6.0	P 25/D 445
3	Calorific value (MJ/kg)	34	39.15	43.32	42.23	41.34	44.82		D5865
4	Flash Pt C	242	196	89	91	95	76	120	P 21/D93
5	Cloud Pt	14.6	10.2	7	7.1	8.2	6.5	–	D2500
6	Pour Pt C		4.2	3.5	3.6	3.7	3.1	–	D2500
7	Cetane no	46	57.9	48.2	47.9	47.6	49	51	P9/D613
8	Sulphur (mg/kg)	0.007	0.005	23	21	16	29	<50	P 83/D 5453
9	Carbon residue (% mass)	1.2	0.0035	0.0861	0.015	0.0083	0.1	<0.05	ASTM 4530
10	Sulphated ash (% mass)	0.014	0.002	0.001	0.001	0.001	0.001	<0.02	P 4/D874
11	Water content (mg/kg)	–	340	71	118		52	<500	P 40/D2709
12	Acid value (mg KOH/g)	5.06	0.42	0.15	0.15	0.2	0.1	<0.5	P 1/D 664
13	Methanol (% mass)	–	0.09	0.02	0.02	0.03	–	<0.20	EN 14110
14	Ester content (% mass)	–	98		–	–	–	>96.5	EN 14103
15	Free glycerol (% mass)	–	0.01	–	–	–	–	<0.02	ASTM D6584
16	Total glycerol (% mass)	–	0.19	–	–	–	–	<0.25	ASTM D6584
17	Phosphorous (mg/kg)	–	3.2	–	–	–	–	<10	ASTM D4951
18	Iodine value (g I_2/100 gm)	96	86.5	–	–	–	38.3	<120	EN 14104
19	Oxidation 110^{0}C (h)	–	11.6	–	–	–	–	>6	EN 14112

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V. Results and discussion.

A. LOAD vs BP graph:

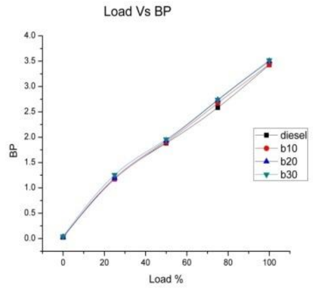

Figure 5.1 shows the variation of brake power with respect to load for diesel fuel and Karanja biodiesel and additives .it can be observed from the figure that shows that there is no significant change in brake power .All blends i.e B10,B20, B30 including diesel gave more or less same readings. In specific 6% loss in Brake power is observed, this is because of low energy content of karanja blends.

B. LOAD vs BSFC graph:

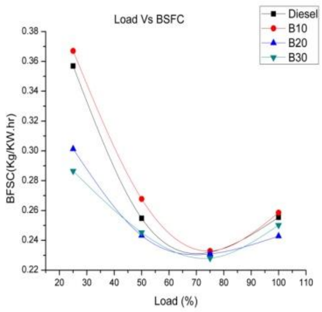

Figure 5.2 shows the variation of brake specific fuel consumption with respect to load for diesel fuel and Karanja biodiesel and additives.It can be observed from the figure that shows b20 and b30 blends shows lower specific fuel consumption when compared to the conventional diesel But b10 biodiesel blend shows higher specific fuel consumption at any load. so should prefer b10 when for lower fuel consumption

C. LOAD vs BSEC graph:

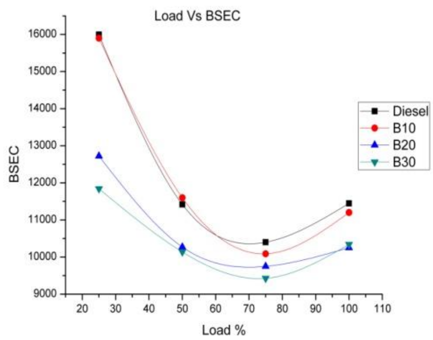

Figure 5.3 shows the variation of brake specific energy consumption with respect to load for diesel fuel and Karanja biodiesel and additives.It can be observed from the figure that shows B20 and B30 blends shows lower specific energy consumption when compared to the conventional diesel but B10 biodiesel blend shows higher specific energy consumption at low load. But after half load energy consumption decreases.

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D. LOAD vs BTE graph :

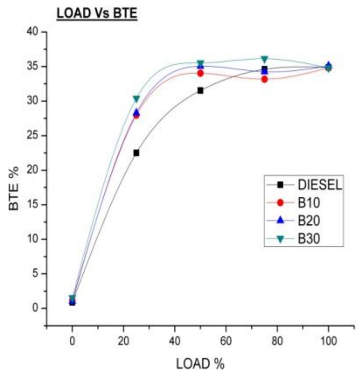
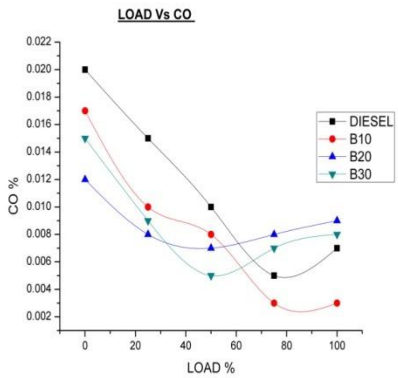


Figure 5.4 shows the variation of brake thermal efficiency with respect to load for diesel fuel and Karanja biodiesel and additives. It can be observed from the figure that all samples gave good performance than diesel around 12% average increase in BTE occurred in all samples when compared to diesel. This is because of excess oxygen content in the Karanja oil and because of combustion enhancer additive(EHN). B30 gave reasonable performance among all the



Karanja blends. **E. LOAD vs CO graph:**

Figure 5.5 shows the variation of co with respect to load for diesel fuel and Karanja biodiesel and additives. It is one of the prime objectives of the project. CO emissions are very less up to half load for any Karanja blend but after half load the CO emissions of B20 and B30 slowly creeped up. This is because of excess oxygen content in the Karanja blends which resulted in complete combustion and formed carbon-dioxide instead of carbon-monoxide.

F. LOAD vs CARBONDIOXIDE graph:

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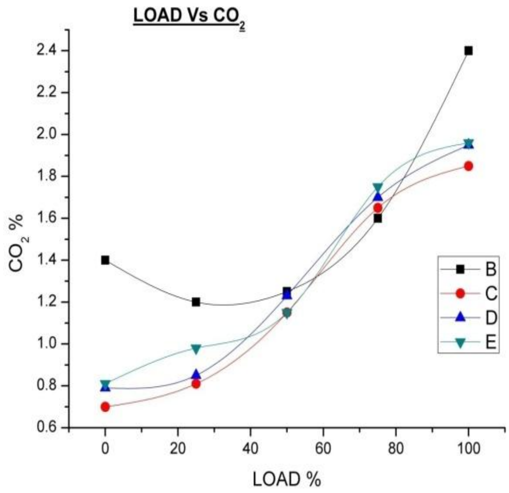

Figure 5.6 shows the variation carbondioxide with respect to load for diesel fuel and Karanja biodiesel and additives.it is clearly seen that from graph all the blend shows low emissions of carbondioxide at low loads and slightly increases at half loads which is negligible and again decreases at full loads when compared with conventional diesel

G. LOAD vs HYDRO CARBONS graph:

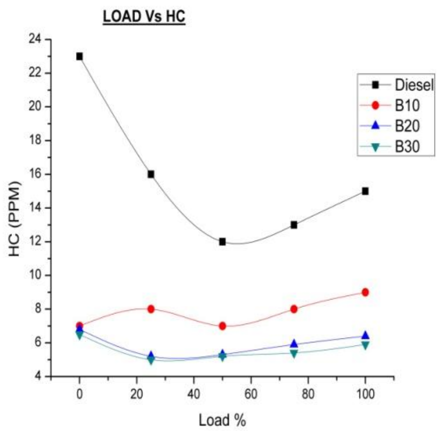

Figure 5.7 shows the variation hydrocarbons with respect to load for diesel fuel and Karanja biodiesel and additives .Due to the excess oxygen present in the biodiesel complete combustion took place and formation of HC gone down .from the graph it is clear that B30 showed least HC production.

H. LOAD vs EXHAUST GAS TEMPERATURE graph:

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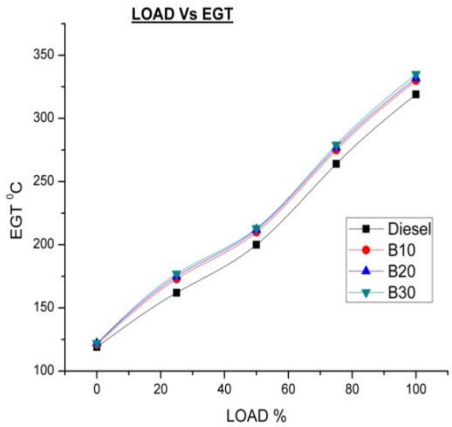

Figure 5.8 shows the variation exhaust gas temperature with respect to load for diesel fuel and Karanja biodiesel and additives. It is a measure of performance as higher exhaust gas temperatures results in higher heat release in combustion chamber there by giving probability to increase brake thermal efficiency. From the graph it is clearly seen that that EGT is high in all the blends when compared to conventional diesel**.**

I. LOAD vs NOX graph :

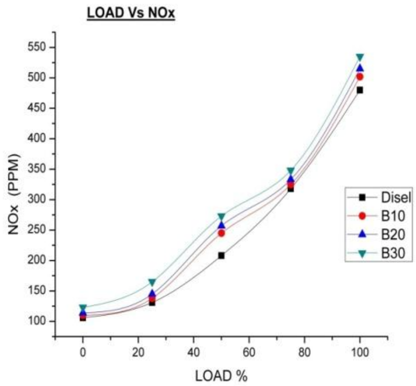

Figure 5.9 shows the variation of NOx with respect to load for diesel fuel and Karanja biodiesel and additives.Due to the excess oxygen present in the biodiesel complete combustion took place and temperature inside the combustion chamber increased thereby increasing the NOx emission. From the graph it is clear that B30 showed maximum NOx emissions. It cannot be completely stopped but it can be minimized like EGR techniques.

J. LOAD vs MECHANICAL EFFICIENCY graph:

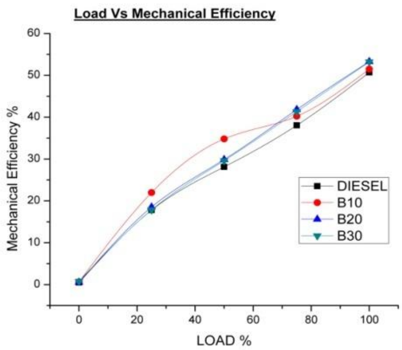

Figure 5.10 shows the variation in mechanical efficiency with respect to load for diesel fuel and Karanja biodiesel and additives. From the above graph it is clearly seen that Mechanical Efficiency is high in all the biodiesel blends when compared to conventional diesel.

VI. CONCLUSIONS

Karanja methyl ester seems to have a potential to use as alternative fuel in diesel engines without any modification in CI engine. Blending diesel decreases the viscosity considerably. The following results are made. From the experimental study-

1. It was founded that blends of KME and diesel could be successfully used with acceptable performance than pure diesel up to a certain limit.
2. From experiment it is concluded that B20 could replace the diesel for diesel engine for getting better performance.
3. The brake thermal efficiency was marginally better than pure diesel fuel.
4. Brake specific fuel consumption is lower for KME blends than diesel at all the load condition.
5. The exhaust gas temperature is found to increase with concentration of KME in fuel blends due to coarse spray formation and delayed combustion.
6. Volumetric efficiency is found to be better for KME blends than pure diesel fuel for all the load conditions.
7. It is also concluded from the experiment that use of additives with diesel and biodiesel blends has increased the cetane number, lubricity, and stability of the testing fuel which resulted into improved performance with the KME blends.

Future scope of The Work

The present study opens many avenues for future works. This may include the following

1. The number of blend of Biodiesel and Diesel can be increased.
2. Two new factors may be introduced they are the injection timing and injection pressure.
3. The exhaust gas temperature and smoke opacity can be measured by using smoke meter.
4. The experiment can be performed in turbocharged or supercharged engine with addition of exhaust gas recirculation.
5. In emission study the particulate matter emission and SO_2 emission can be measured.

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