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Karanja Oil as an Alternative Fuel of Non-Edible Oil Blends with Diesel for Four Stroke Single Cylinder Diesel Engine

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Abstract: *On the face of the forthcoming energy crisis, vegetable oils have come back up as a promising supply of fuel. they're being studied wide due to their teeming availableness, renewable nature and higher performance once employed in engines. Several vegetable oils are investigated in compression ignition engine by fuel modification or engine modification. The vegetable oils have terribly high density and body, thus we've used the methyl radical organic compound of the oil to beat these issues. Their use in variety of karanja biodiesel in CI engines has given encouraging results. Karanja oil is non edible in nature and is out there copiously in Asian nation. associate degree experimental investigation was created to gauge the performance, emission and combustion characteristics of a diesel mistreatment completely different blends of methyl radical organic compound of karanja with mineral diesel. Karanja oil was emulsified with diesel in proportions of 10%,20%,30%,40% by mass and studied underneath numerous load conditions in an exceedingly compression ignition (diesel) engine. The performance parameters were found to be terribly on the point of that of mineral diesel. The brake thermal efficiency were higher than mineral diesel for a few specific mixing ratios underneath sure masses. The emission characteristics were additionally studied and levels of hydrocarbons (HC),carbon monoxide (CO), oxides of nitrogen (NO_x), were found to be above pure diesel.*

***Keywords**: Karanja oil, blending, biodiesel, engine performance*

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I. Introduction

Non-renewable energy sources are one of the real wellsprings of vitality on the planet today. Their ubiquity can be accounted to simple ease of use, accessibility and cost adequacy. Be that as it may, the constrained stores of non-renewable energy sources are an awesome concern attributable to quick consumption of the stores because of increment in around the world request. Petroleum products are the real wellspring of air contamination in this day and age. So endeavors are on to discover elective hotspots for this draining vitality source. Despite the fact that new innovations have come up which have made sun oriented, wind or tidal vitality sources effortlessly usable yet at the same time they are not all that prevalent because of issues in incorporation with existing innovation and procedures. Along these lines, endeavors are being coordinated towards discovering vitality sources which are like the present day fills with the goal that they can be utilized as immediate substitutes. Diesel fuel fills in as a noteworthy wellspring of vitality, mostly in the vehicle division. Amid the World Exhibition in Paris in 1900, Rudolf Diesel was running his motor on 100% shelled nut oil. In 1911 he expressed "the diesel motor can be encouraged with vegetable oils and would help extensively in the improvement of horticulture of the nations, which utilize it'' [1]. Studies have demonstrated that vegetable oils can be utilized in diesel engines as they are found to have properties near diesel fuel [2]. It is being viewed as a leap forward in light of accessibility of different kinds of oil seeds in tremendous amounts [3]. Vegetable oils are inexhaustible in nature and may create open doors for provincial work when utilized on huge scale [4]. Vegetable oils from products, for example, soya bean, nut, sunflower, assault, coconut, karanja, neem, cotton, mustard, jatropha, linseed and castor have been assessed in numerous parts of the world. Non eatable oils have been favored on the grounds that they don't rival sustenance saves. Karanja (pongamia) is an oil seed-bearing tree, which is non-eatable and does not locate some other reasonable application because of its dull shading and scent [5]. The oils have high thickness and different issues make their utilization troublesome, so it was utilized after change to its methyl ester which altered all the 3 qualities to suit our request. In this work, distinctive extents of karanja methyl ester, viz, 5%, 10%, 15%, 20%, 30%, 40% and half are blended with 95%, 90%, 85%, 80%, 70%, 60% and half separately with diesel fuel on mass premise. As it may, biodiesel likewise tends to build discharges of NOx. There are some specialized issues remaining concerning the utilization of higher premise. Biodiesel can be delivered from a wide assortment of plant oils, both palatable and non-consumable biodiesel in the vast majority of the created nations are being delivered from sunflower, shelled nut, palm and a few other feed stocks which are basically palatable in Indian setting. Subsequently, in the creating nations, for example, India, it is attractive to deliver biodiesel from the non-eatable oils which can be widely developed in the waste grounds of the nation. Rising fuel costs and looming emanation controls have honed the car business' attention on proficiency. In addition the fast consumption of non-renewable energy sources because of far reaching use has compelled to look for some low discharge and inexhaustible fuel. In the scan for elective fills, the great alternative was observed to be sustainable energizes like vegetable oils, liquor and so forth. In present examination, hemp oil, neem oil, hemp methyl ester and neem methyl ester have been taken for examine due to environ-accommodating nature. Moreover the utilization of non-eatable vegetable oils is of essentialness in light of the immense requirement for palatable oil as sustenance and they are too costly to ever be utilized as powers. Besides, the business utilization of biodiesel is unequivocally reliant on the cost of the feed stocks so lower cost feed stocks are required. The staggering expense of biodiesel, which is chiefly because of the surprising expense of oil feedstock, is the fundamental deterrent to its more extensive commercialization. Ecological concern and consumption in oil assets have constrained specialists to focus finding sustainable options in contrast to traditional diesel energizes. Because of the expansion in cost of oil and natural worry about contamination originating from vehicle emanation, biodiesel is rising as a creating region of high concern [6]. In the present examination, biodiesel is set up from HO and NO oil. Biodiesel properties were resolved and their motor execution and outflow qualities were examined on a four stroke single chamber coordinate infusion CI engine to check their achievability as CI engine fills alongside discovering financial matters of both biodiesel for advertise esteem.

II. Litereture Survey

Swarup Chandran[2018]et al. **-**Fuels derived from crops popularly known as 'BIODIESEL' are renewable and better alternative to petroleum fuels. They are mono alkyl esters of long chain fatty acids derived from vegetable oils and animals fats. They are produced by transesterification in which oil or fat is reacted with an alcohol in presence of catalyst. In this review paper, the performance and emission characteristics of Karanja oil has been discussed. Diesel and Karanja oil blends of different proportions were used to conduct short term engine performance and emission test. Specific fuel consumption, brake thermal efficiency and emissions were measured to evaluate and compute the behaviour of the engine running on Karanja oil. In this investigation, the viscosity of Karanja oil for the CI engine was decreased by blending with diesel. Significant improvement in the engine performance was observed compared to neat Karanja oil as a fuel [7].

Rubiat Mustak [2018]et al. **-**Due to limited resources and hazardous effects on environment people now a day tries to find out an alternative for fossil fuels. Fossil fuels when burnt produce a lot of carbon dioxide which is one of the primary reasons for global warming. Petroleum is a form of fossil fuel. With the help of distillation process petrol, paraffin, kerosene and diesel oil can obtain from natural petroleum. To protect the environment biodiesels can substitute these fossil fuels. Biodiesels can use as an alternative for diesel. Researchers from around the world tried for many years to find a suitable biodiesel which can substitute diesel. Many biodiesels have been produced from different sources and tested for their performances. Some researchers try to find out a good combination of biodiesel blends which can be used as an alternative of diesel. Some of them try to find out a suitable blend of diesel and biodiesel to reduce the environmental impact and for better emission characteristics. Effects of blending different types of biodiesels with diesel have been investigated by many researchers. In this present review article a summary is written on such attempts [8].

Sahil J. Parikh[2018]et al. **-**In present review work has been carries out to analyze the performance and emission characteristics of a single cylinder, CI engine fuelled with 100% diesel and Diesel-Biodiesel Blends at an various Load applied at an engine. Experiments will performed for five engine loads i.e. 1, 5 and 9 kg using baseline diesel and karanja biodiesel-diesel blends i.e. K30 and K40 with constant speed of diesel engine. The performance parameters evaluated were Break Power, Break thermal efficiency, break specific energy consumption (BSFC) and the emission parameters measured were Oxides of Nitrogen (NOX), Hydrocarbon(HC), Carbon dioxide(CO2), Carbon monoxide(CO)[9].

K. Sivaramakrishnan[2018]et al. **-**The performance and emission of a single cylinder four stroke variable compression multi fuel engines when fuelled with 20%, 25% and 30% of Karanja blended with diesel are investigated and compared with standard diesel. Experiment has been conducted at compression ratios of 15:1, 16:1, 17:1, and 18:1. The impact of compression ratio on fuel consumption, brake thermal efficiency and exhaust gas emissions has been investigated and presented. Experimental analysis on the performance of biodiesel over diesel was evaluated by response surface methodology to find out the optimized working condition. The overall optimum is found to be 25% biodiesel–diesel blended with a compression ratio of 18[10].

Dewi Harreh[2018]et al. **-**The application of nonedible feedstock for the production of biodiesel has become an area of research interest among clean energy experts in the past few years. This research is aimed at the utilization of (karanja), a nonedible feedstock from the state of Sarawak, Malaysia, to produce biodiesel to be known as crude karanja oil (CKO). A one-step transesterification process utilizing 7 : 1–10 : 1 wt% methanol (CH_3OH) and 0.5–1.2 wt% sodium hydroxide (NaOH) at 65∘C for 1.5hrs has been used for the biodiesel production yielding 84% conversion. The physiochemical properties of the CKO produced revealed that it conforms with EN14214 standards for brake power (BP), brake specific fuel consumption (BSFC), and brake thermal efficiency (BTE) as they are all noted be optimal at B40[11].

Dr. Narendiranath Babu T[2018]et al**. -**Increasing global concern because of air pollution produced by diesel engine has shown an immense interest in the ecofriendly fuels. In this context the non-edible vegetable oils and their methyl esters are considered as one of the alternate fuels. However, since their direct utilization leads to high viscosity poor atomization and incomplete combustion along with higher NOx. In order to lessen this effect investigations are carried out on the performance and emissions of diesel engine by adding cerium oxide (CeO2) Nano-particles to the karanja biodiesel blends. This has shown improvements in engine performance and its emissions [12].

D. Yoga raj[2018]et al. **-**The present research work is aimed to investigate the performance and emission characteristics of a Variable Compression Ratio (VCR) Diesel engine with karanja oil methyl ester (KOME) blend. An experimental work has been conducted on a four strokes, single cylinder water cooled diesel engine with a compression ratio of 17:1, 17.5:1 & 18:1 and 3.5 kW capacity. Blend (B) of KOME, B10 (10% KOME+ 90% Diesel), B20 (20% KOME+ 80% Diesel) and B30 (30% KOME+ 70% Diesel) biodiesel are used for conducting the test in diesel engine at different load conditions. Several parameters such as specific fuel consumption, thermal efficiency and emissions are recorded in a period of time. The noteworthy properties of KOME were related with the diesel to validate the experimental results. The experimental result shows that the fuel of B20 with the compression ratio of 18 can be used in diesel engines without any engine modifications [13].

III. Experimental Setup

3.1 Engine

The experiment is carried out at constant speed of 1500. The various blends are pre- heated before injected into the combustion chamber. At 70^{o}C and 80^{o}C the viscosity of the blends reduces drastically or adding methyl ester to reduce the viscosity of blend oil. After the required temperature is reached the diesel injection is cut off and the blended fuel is made to flow into the combustion chamber. Exhaust gas analyzers were used to analyze the emission levels with the help of probe in the exhaust air outlet to atmosphere. With the help of exhaust gas analyzer, the emission values were determined. Hydrocarbon, Carbon dioxide, Carbon monoxide and NOx values are determined.

Name of Manufacturer	Kirlosker
Rated Speed	1500 rpm
Brake Power	3.68KW
Efficiency Of Generator	82.3%
Fuel Used	Diesel
Stroke Length	110mm
Diameter Of Cylinder	87.5mm
Compression Ratio	17.5
Nozzle Opening Pressure	200-225 bar
No. Of Cylinder	One
No. Of Stroke	Four Stroke

Table 3.1:-Engine Specification

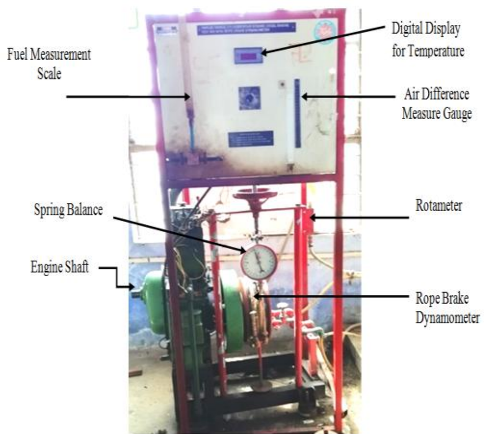

Fig.3.1 Actual view of experimental setup

IV. Result & Discussion

The results obtained by testing the diesel, BD00 and biodiesel BD10, BD20, BD30 and BD40 are discussed in this chapter. In the present investigation the viscosity of Karanja oil which has been considered as a potential alternative fuel for internal combustion engine. The blends of different proportion of Karanja oil diesel were prepared and tested on diesel engine. The kinematic viscosity of bio diesel decreases also with rise in temperature during combustion. The calorific value of Karanja oil is found 7% less than the diesel. The difference of calorific value of diesel and Karanja oil is due to the difference in their chemical composition which is due to difference in carbon and hydrogen content in molecular structure of diesel and bio diesel. Presence of oxygen molecule in molecular structure of non edible oil might be another reason accounting for this reason. The presence of oxygen molecule decreases the calorific value due to the fact that oxygen molecule reacts with hydrogen and form water vapor even before secondary air or oxygen supplied for combustion reaches the hydrogen. Specific gravity of bio diesel is found to be more than that of diesel due to its high molecular weight.

4.1 Influence of Blends On Brake Power Of Diesel Engine

The load is varied from 4kg to 12kg for each blend of karanja oil and diesel. The results have been carried out for pure diesel named as BD00 as a reference and then blends are tested one by one in order to find the effect of mixing karanja oil in diesel.

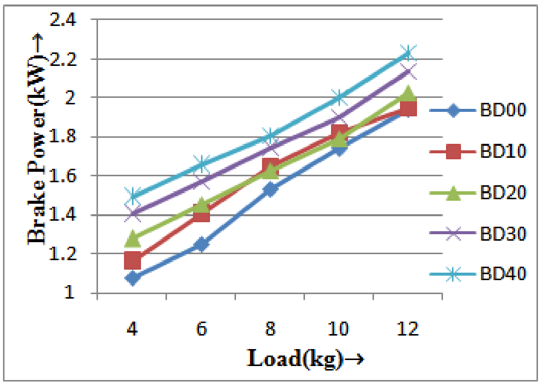

Fig 4.1:-Effect of load on break power for blending of Karanja oil with diesel

The above graph of Brake Power v/s load shows the variation of Brake Power with respect to load. As the load is increased, Brake Power is also increasing having no greater difference in performance on blending. The blend prepared are as follows: BD10 contains mixture of 10% Karanja oil and 90% Diesel, BD20 contains mixture of 20% Karanja oil and 80% Diesel, BD30 contains mixture of 30% Karanja oil and 70% diesel and BD40 contains mixture of 40% Karanja oil and 60% Diesel. Hence it is clear from the graph that mixing of karanja oil with diesel has no adverse effect on the Brake Power, Friction Power and Indicated Power of diesel or C.I Engine.

4.2 Influence Of Blends On Mass Fuel Consumption

The mass fuel consumption is calculated for the various blends prepared from karanja oil and diesel in which the loading varies from 4kg to 12kg with an interval of 2kg.

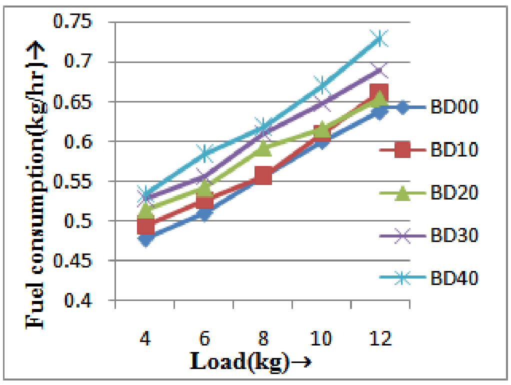

Fig 4.2:-Effect of load on mass of fuel consumed for various blends prepared with Karanja oil and Diesel

The graph above shows the comparison of mass of fuel consumed with respect to various load for pure diesel and blends of karanja oil with diesel for 10%, 20%, 30% and 40% of karanja oil with respect to diesel for loading of 4kg, 6kg, 8kg, 10kg and 12kg respectively. From the above graph it is clear that blending of karanja oil with gives good result. As the mass of fuel consumed increases when compared to pure diesel but the difference in the values can be considered for practical uses.

4.3 Influence Of Blend On Specific Fuel Consumption

Specific fuel consumption may be defined as the ratio of mass of fuel consumed to the Brake Power. The experimental values were calculated in the previous chapter.

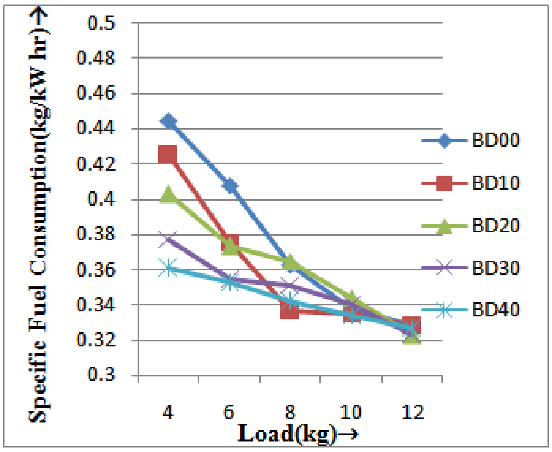

Fig 4.3:-Effect of load on Specific fuel consumption for various blends of Karanja oil and Diesel

The graph above shows the behavior of Diesel Engine or C.I Engine of specific fuel consumption with respect to various loading and using fuel with blending firstly it is carried out on pure diesel then in second phase with blending of 10% karanja oil and 90% diesel, in third phase with 20% karanja oil and 80% diesel, in fourth phase with 30% karanja oil and 70% diesel and lastly in fifth stage with 40% karanja oil and 60% diesel. On reading the above graph it is found that specific fuel consumption decreases with increase in load. The slope of the curve moves downward from 4kg to 12kg.

4.4 Influence of Blend on Heat Supplied

Heat supplied for Diesel Engine is calculated by the product of mass of fuel consumed and calorific value of fuel.

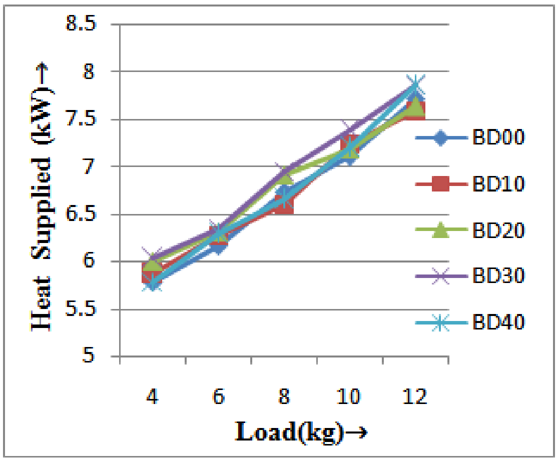

Fig 4.4:- Effect of load on heat supplied for various blends of Karanja oil with Diesel

The above graph shows the variation of heat supplied with respect to load. The load applied is from 4kg which increases with an interval of 2kg i.e. next loading will be 6kg, 8kg, 10kg and 12kg respectively. The fuel is varied by blending diesel with karanja oil from 10% to 40% karanja oil having interval between the values of 10%. From the above graph it is found that heat supplied is increased with the increase in load.

4.5 Influence of Blend on Brake Thermal Efficiency

Brake efficiency is about power output that you measured by using dynamo-meter with respect to calorific value and indicated efficiency is the one you found from indicator diagram(the one where indicated mean effective pressure is measured)..

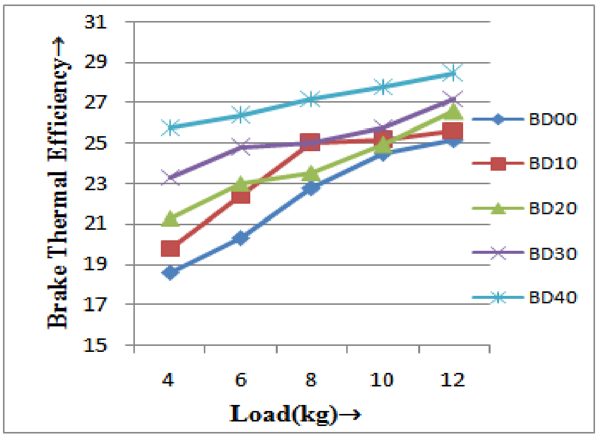

Fig 4.5:- Effect of load on brake thermal Efficiency for various blends of Karanja oil with Diesel

The graph shown above shows the behavior of various blends of karanja oil with diesel in brake thermal efficiency with respect to loading. For investigating the performance of blends initially the test is carried out in pure diesel and later on karanja oil is blended in percentage from 10% to 40%. From the above graph it is found that the brake thermal efficiency increases with the increase in loading.

4.6 Exhaust Emission of Diesel Engine

Undesirable emissions in internal combustion engines are of major concern because of their negative impact on air quality, human health, and global warming. Therefore, there is a concerted effort by most governments to control them. Undesirable emissions include unburned hydrocarbons (HC), carbon monoxide (CO), nitrogen oxides (NO_x), and particulate matter (PM)

4.7 Emission of NOx

Under the high pressure and temperature conditions in an engine, nitrogen and oxygen atoms in the air react to form various nitrogen oxides, collectively known as NOx. Nitrogen oxides, like hydrocarbons, are precursors to the formation of ozone.

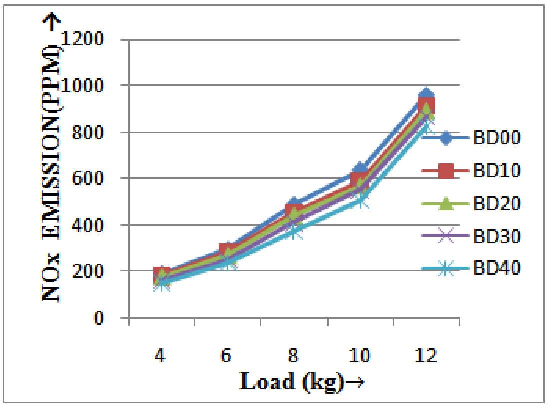

Fig 4.7:-Effect of load on nitric oxide for different blends of diesel with varying percentage of karanja oil

The slower burning character of the fuel causes a slight delay in the energy release, which results in higher temperature in the later part of power stroke and exhaust stroke. This high temperature favors the formation of nitric oxide. The higher release of nitric oxide can also be attributed to presence of nitrogenous compounds in the fuels of plant origin. At higher loads, more fuel is burnt and higher temperature of the exhaust gases results in higher production of nitric oxide.

The graph above shows the behavior of Diesel Engine against the NO_x emission with respect to different loading condition from 4kg to 12kg for various blends prepared from karanja oil and diesel. The blends prepared are BD10, BD20, BD30 and BD40 described above for the percentage of karanja oil in the mixture of diesel and karanja oil. From the graph it is found that emission of NO_x decreases with the increase in percentage of karanja oil in the mixture.

4.8 Emission of CO

The emission of carbon monoxide for various blends at different loads can be seen in table and graph. The emissions are slightly higher for almost all blends. This can be attributed to higher viscosity of the fuel which results in poor atomization & incomplete combustion of the fuel.

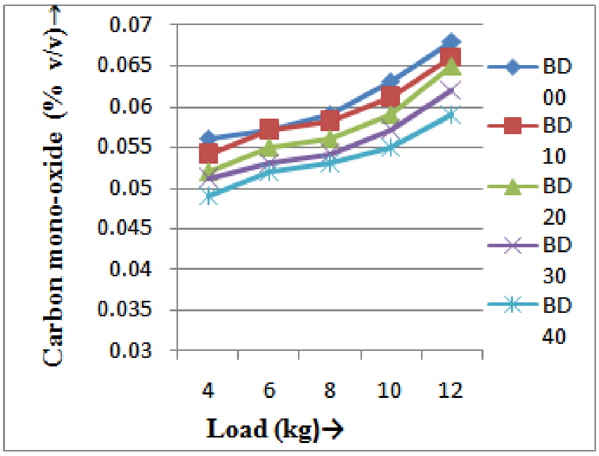

Fig 4.8:- Effect of load on carbon mono oxide for various blends of diesel and karanja oil.

The above graph shows the variation of emission of carbon mono-oxide with respect to load from 4kg to 12kg with an interval of 2kg for various fuel in first step pure diesel (BD00) is taken for reference standard, in the second stage blend is prepared by taking 10% of karanja oil and 90% diesel in a mixture named BD10, in third stage blend of 20% karanja oil and 80% diesel is taken in mixture, in the fourth stage blend of 30% karanja oil and 70% diesel is taken and in the last stage 40% karanja oil and 60% diesel is taken in a mixture. The graph shows that the emission of carbon mono-oxide is reduced a little bit on comparing with diesel. Although emission of carbon mono-oxide increase with the increase in load but it is reduced little bit as compare to pure diesel and reduced with further addition of karanja oil in the mixture.

4.9 Emission of HC

The raw unburned fuel is generally known as Hydrocarbon. Whenever there is an incomplete combustion or combustion does not take place at all, as with misfire, combustion chamber emits a large amount of hydrocarbon.

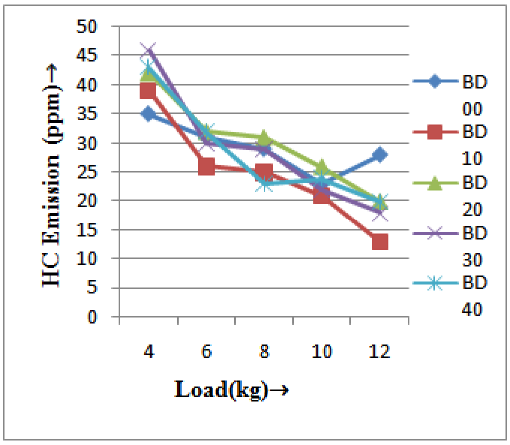

Fig 4.9:- Effect of load on hydrocarbon for various blends of diesel and karanja oil.

The graph above shows the behavior of diesel engine on the fuel used diesel and blends prepared from diesel and karanja oil and hydrocarbon emission with respect to various loading condition ranging from 4kg to

12kg. From graph it is found that the emission of hydrocarbon decreases with loading but it is clear from the graph by adding the percentage of karanj oil in the mixture of diesel and karanja oil the value of hydrocarbon emission is decreased. When we are looking for the particular fuel only the hydrocarbon emission graph goes upward. Hence it is clear that hydrocarbon emission is reduced by blending the diesel with karanja oil as compare to pure diesel.

V. Conclusion

In light of the Experimental outcomes following end can be drawn:

1) Karanja oil can be one of interchange fuel for diesel engine. This has qualities near diesel. It is miscible with diesel fuel in any extent and can be utilized as diesel fuel extender.
2) India is Agriculture based nation; extensive segment of our waste and unfertile land can be utilized for Karanja ranch with the goal that vast generation of Karanja oil can be utilized for bio diesel creation, will go about as a future fuel.
3) On contrasting the physical and concoction properties of Karanja oil are very like diesel. Anyway its consistency is higher by multiple times when contrasted with diesel.
4) Transesterfication procedure can lessen the thickness of karanja oil to a significant dimension and enable it to be utilized in diesel motor.
5) Calorific estimation of karanja oil is observed to be low by 8% because of distinction in substance piece and contrast of carbon-hydrogen substance.

It is found that blends prepared by karanja oil and diesel shows good result as compare to pure diesel. The brake power is increases with the increase in loading and with the increase in blend percentage. The mass of fuel consumed also increase with the increase in loading as well as blending percentage. The specific fuel consumption is reduced with increase in loading and with the increase in blend percentage. Although the main parameter for combustion of fuel is heat supplied it is found that heat supplies decrease with the increase in loading as well as increasing the blend percentage. The brake thermal efficiency also improves with increasing the blend percentage and with loading condition increment. The results for the mechanical efficiency are like no change for any loading condition and any blend i.e. remain constant for all values.

When we are talking about the emission of diesel engine, the main pollutants obtained from the combustion of fuel are Nitrous Oxide (NO_x), Carbon mono-oxide (CO) and Hydrocarbon (HC) shows that there is a reduction in these emissions with the increase in blend percentage. However the values of emission of these pollutant increases with the increase in loading condition but when it is compared to diesel we found there is a improvement in emission of these pollutant.

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