Preparation and Performance Analysis of CI Engine Run by Blends of Diesel and Biodiesel (Karanja Oil)

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Abstract--- *Biodiesel is an alternative fuel of diesel, is described as fatty acid methyl ester from vegetable oil or animal fats. The main objective of our project is to reduce higher viscosity of karanja oil by Transesterification and to increase the performance and emission characteristics of diesel engine. By using the biodiesel from pun gam oil, the performance test of biodiesel blend (B00, B10, B20,) in 1500 rpm and 5 bhp mechanical loaded CI engine is tested. By using different blends we have identified the engine parameters such as brake thermal efficiency, specific fuel consumption, and total fuel consumption, brake power. In this finally we have resulted which blend is better and which consumes less Fuel. Biodiesel have the distinct advantages of being renewable, biodegradable, & eco-friendly fuel. During the recent years, in the field of alternative fuels especially in the area of Biodiesel, research has been extensively carried out and different samples of Biodiesel have been prepared considering the scope, availability and economics of various edible and non-edible oils. Biodiesel from Mahua, Linseed, Rice Bran, waste cooking oil, Crude Palm, Castor, Jatropha & Karanja have already been prepared and successfully tested in diesel engines & vehicles. Small capacity of reactors of 5 & 10 liters biodiesel were designed and developed also for experimental purpose. As per Ministry of Rural Development, the National Mission on Bio-diesel is proposed to be implemented in two phases. The first phase will involve a demonstration stage for plantation of jatropha on four lakh hectares, and associated research activities for establishing the commercial viability of the fuel. Phase two will involve self-sustaining expansion of the bio-diesel programme. The overall objective of the national mission is to promote the creation of national infrastructure for production of bio-diesel through cultivation of jatropha plant and processing of its oil.*

Keywords--- *Diesel and Biodiesel, Performance Analysis, CI Engine.*

I. INTRODUCTION

Biodiesel is defined as a fuel comprised of mono- alkyl esters of long chain fatty acids derived from vegetable oils or animal fats. Biodiesel is typically created by reacting fatty acids with an alcohol in the presence of a catalyst to produce the desired mono-alkyl esters and glycerin.

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After reaction, the glycerin, catalyst, and any remaining alcohol or fatty acids are removed from the mixture. The alcohol used in the reaction is typically methanol, although ethanol and higher alcohols also have been used. The main advantage of using biodiesel is to reduce dependence on imported petroleum and to lower net greenhouse-gas emissions. Biodiesel typically has improved lubricity and ignition quality relative to diesel fuel. And also biodiesel is renewable; that it is not a fixed resource like fossil fuels that could be completely consumed. Biodiesel is simple to use, biodegradable, nontoxic, and essentially free of sulphur and aromatics. It is usually used as petroleum diesel additive to reduce levels of particulates, carbon monoxide, hydro carbons and toxics from diesel powered vehicles. When used as an additive, the resulting diesel fuel may be called B5, B10 or B20, representing the percentage of the biodiesel that is blended with petroleum diesel.

Biodiesel fuel has the following advantages.

- Is made from renewable energy source.
- Readily mixed with diesel.
- Friendly with our environment compare than diesel, petrol.

II. Literature Review

P. L. Naik and D.C.Katpatal (2013) was investigated the Performance Analysis of CI engine using pongamia pinnata (karanja) Biodiesel as an Alternative fuel. The main objectives of the work is reduce the higher viscosity of pungam oil using the esterification process followed by the transesterification process. The important property of fuel such as density, viscosity, flash point and calorific value of pungam biodiesel are compare to the diesel properties & find the performance and emission characteristics of diesel engine such as specific fuel consumption, mechanical efficiency, thermal efficiency for the different blends (B10, B20, B30) for the various loads and the result of this investigation the B20 biodiesel gives the better performance without any modification of diesel engine. A.Patel, R. Patel, M. Patel and P.Rathod (2016) was researched the Performance Analysis of Four Stroke Single Cylinder CI Engine Using Karanja Biodiesel-Diesel Blends.

In this project work the opportunities of utilizing 100% pure karanja biodiesel and increasing the chance of using the Karanja Biodiesel-Diesel in the diesel engines. In this research the blends of Karanja Biodiesel-Diesel is K10, K20, K40, K60 ,K80 and pure Karanja Biodiesel are taken and the load varies 1,3,5,7 and 9kg & the results are compared to the performance of the diesel fuel from the research the K20 Biodiesel blend gives the more performance with lesser fuel consumption. N.Stalin and H .J. Prabhu (2007) was studied the Performance Test of IC Engine Using Karanja Biodiesel Blending with Diesel. The constant increase of the cost of the diesel and consider the environmental advantages the biodiesel are used as an alternate fuel. The Biodiesel from the karanja oil was produced by the alkali catalyzed transesterification process and the experiment done on the prony brake-diesel engine setup, using the duel fuel the specific fuel consumption, mechanical efficiency, thermal efficiency are calculated.

The result indicates B40 was used as the alternate fuel in diesel engine without any modification. The cost of the B40 duel fuel is lesser than the pure diesel.

III. HISTORICAL BACKGROUND OF BIO DIESEL

Dr. Rudolf Diesel, who invented the first Diesel Engine in 1895, used only biofuel in his engine. His visionary statement was "The use of vegetable oils for engine fuel may seem insignificant today, but such oils may become in course of time, as important as petroleum and coal tar products of the present time". The above prediction is becoming true today as more and more biodiesel is being used all over the world. In 1900 at the world fair in Paris, a small version of a diesel engine ran on plant oil. This was organized by the French society for the support of the Otto engine. At that time, crude oil was available in abundance; hence, vegetable oils could not attract as a source of fuel much. Despite the widespread use of fossil petroleum-derived diesel fuels, interest in vegetable oils as fuel for internal combustion engines was reported in several countries during the 1920s and 1930s. While engineers and scientists have been experimenting with vegetable oils as fuel for a diesel engine since 1900, it is only recently that the necessary fuel properties and engine parameters for reliable operation have become apparent. In recent times, due to realization that crude oil is limited and poses a threat to well being of mankind from emissions of exhaust gases, vegetable oil has been revisited for its scope as a fuel in compression ignition engines. Some operational problems were reported due to the high viscosity of vegetable oils compared to petroleum.

Diesel fuel, which results in poor atomization of the fuel in the fuel spray and often leads to deposits and coking of the injectors and valves. To lower the viscosity of vegetable oil, chemical and thermal processes were tried to make vegetable oil compatible to compression ignition engines. Attempts to overcome these problems included heating of the vegetable oil, blending it with petroleum-derived diesel fuel or ethanol, pyrolysis, cracking of the oils, micro-emulsification and transesterification, where triglycerides from vegetable oils react with a lower alcohol to produce fatty acid alkyl esters possessing properties similar to mineral diesel. Transesterification of a vegetable oil was conducted as early as 1853 by scientists E. Duffy and J. Patrick, many years before the first diesel engine became functional. On August 31, 1937, G. Chavanne of the University of Brussels (Belgium) was granted a patent for a procedure for the transformation of vegetable oils for their uses as fuels. The use of biodiesel was recognized much later and became technically relevant only after the energy crisis in the year 1973 and afterwards. More recently, in 1977, Brazilian scientist Expedito Parente invented and submitted first industrial process for the production of biodiesel for patent.

IV. PROPERTIES OF VEGETABLE OILS AND BIODIESEL

Ideal diesel molecules are saturated non-branched hydrocarbon molecules with carbon chain length ranging from 12 to 18 whereas vegetable oil molecules are triglycerides generally with un-branched chains of different lengths and different degrees of saturation. Vegetable oils mainly contain triglycerides (90 to 98%) and small amounts of mono and diglycerides.

Vegetable oils can be used as alternative fuels because they are biodegradable, nontoxic, and clean fuels. Vegetable oils and their derivatives as diesel engine fuels lead to substantial reductions in sulfur, carbon monoxide, polycyclic aromatic hydrocarbons, smoke and particulate emissions. Number of vegetable 43oils like karanja oil, rapeseed oil, rice bran oil, cottonseed oil, sunflower oil and jatropha oil has been tested as fuels in diesel engines. Studies indicate that, over short periods of time, neat vegetable oil perform satisfactorily in unmodified diesel engines. Vegetable oils have high viscosity due to large molecular weight and bulky molecular structure. The viscosity of liquid fuels affects the flow properties as well as spray atomization, vaporization, and air/fuel mixture formation. Higher viscosity also has an adverse effect on the combustion of vegetable oils in existing diesel engines, fuel pumps and injectors. Temperature greatly affects the viscosity of vegetable oils. It has been reported that the viscosity of oils and fats decreases almost linearly with temperature. The significant fuel properties of vegetable oils as listed indicates that the kinematic viscosity of vegetable oils varies in the range from 27–67 CSt at 40^0 C. The high viscosity of these oils is due to their large molecular mass in the range of 600–900, 180^0 C).

Material. Karanja (Pongamia pinnata) seeds have been collected from karanja tree.

V. BIODIESEL PRODUCTION BY TRANSESTERIFICATION PROCESS

Biodiesel fuels are produced by a process called trans-esterification, in which various oils (triglycerides) are converted into methyl esters through a chemical reaction with methanol in the presence of a catalyst, such as sodium or potassium hydroxide. The bi products of this chemical reaction are glycerol and water, both of which are undesirable and needed to be removed from the fuel along with traces of the methanol, un-reacted triglycerides and catalyst. Biodiesel fuels naturally contain oxygen, which must be stabilized to avoid storage problems.

Meher et al. studied the effects of catalyst concentration (KOH), alcohol /oil molar ratio, temperature and rate of mixing on the transesterification of karanja oil with methanol. They found that the optimum reaction conditions for methanolysis of karanja oil was 1% KOH as a catalyst, molar ratio 6:1, reaction temperature 65^0 C and rate of mixing was 360 rev/min for a period of 3 hours. The yield of methyl esters was found to be higher by 85% in 15 minutes and reaction was almost complete in two hours with a yield of 97%. With 12:1 molar ratio or higher, the reaction was completed within an hour. The reaction was incomplete with a low rate of stirring (180 rev/min). Further in the optimization study, Meher et al. found that the yield of methyl ester from karanja oil under the optimal condition was 97 to 98%.

Rathore and Madran studied the kinetics of transesterification of karanja oil into its alkyl esters in supercritical methanol and ethanol without using any catalyst. The effect of molar ratio and reaction temperature on alkyl ester formation was studied.

The free fatty acid and moisture content in the material are the key parameters for determining the viability of the vegetable oil transesterification process. According to Freedman et al. the free fatty acid content should be lower than 1% to carry out the alkali catalyzed reaction. In their study they observed that if the acid value was greater than 1, more NaOH was required to neutralize the free fatty acids. Water also caused soap formation, which consumed the catalyst and reduced catalyst efficiency. The resulting soaps caused an increase in viscosity, formation of gels and made the separation of glycerol difficult.

Ma et al. studied the effect of free fatty acids and water content in the transesterification of beef tallow. The presence of water had more negative effects on the transesterification than free fatty acids. They concluded that for best results, the water content and the free fatty acid content in beef tallow should be kept below 0.06 % w/w and 0.5 % w/w respectively.

Zullaikah et al. had successfully obtained biodiesel from rice bran oil with high free fatty acids content. A two-step acid-catalyzed methanolysis process was employed for the efficient conversion of rice bran oil into fatty acid methyl esters.

Hawash et al. studied the transesterification of jatropha oil using supercritical methanol in the absence of catalyst under different temperature conditions.

Ramadhas et al. reported the use of acid catalyst followed by alkali catalyst in a single process using rubber seed oil with high free fatty acid content. The objective of this study was to develop a process for producing biodiesel from a low-cost feedstock like crude rubber seed oil.

ISO et al. have studied the transesterification by immobilized lipase in non- aqueous conditions. Noureddini et al. have investigated the biodiesel production by lipase catalyst. The time taken to get the 67% yield of biodiesel was 72 hours at room temperature. However, the energy input was zero. The reaction time and the cost of lipase were hurdles to commercialize lipase processes.

Components of Bio-Diesel Plant

1. Three Neck Round Bottom Flask
2. Burette Stand
3. Heater mantles
4. Condenser
5. Motor With Stirrer Arrangement
6. Thermo-meter
7. Thermo-meter pocket
8. Separator
9. Reduction adaptor

VI. DESCRIPTION OF BIO-DIESEL COMPONENTS

1. Three Neck Round Bottom Flask

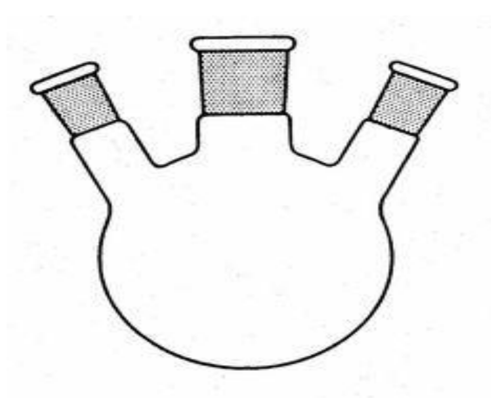

Figure-1

Specifications

Brand Name	LABOY
Capacity	1000ML
Color	No Color
Item Weight	1.0 grams
Model Number	HMF011435
Number OF Items	1
Part Number	HMF011434

2. Burette Stand

Specifications

Brand Name	**Jlab**
Model Number	**1382**
Number of Items	**1**
Part Number	**1382**

Figure 2

3. Heater Mantle

Figure 3

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Specification

Brand Name	SSU
Item Weight	400.0 grams
Number of Items	1

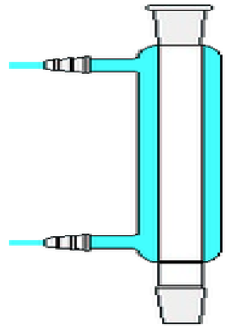

Figure 4

Figure 5: Kirloskar engine

Figure 6: Prepared biodiesel

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Figure 7: Experimental set up

Figure 8: Tachometer

4. Motor with Stirrer Arrangements

Specification

Brand Name	REMI
EAN	7108324490668
Item Weight	5.0 kilograms
Model Number	RMS1184
Number of Items	1
Part Number	RMS1184

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VII. Characteristics Of Oil Which Is Used For Biodiesel Production

The feasibility of the raw materials described in the following paragraphs to produce biodiesel has been studied. They have been selected according to the partners' expertise and to bibliography studies. Each one of the oils selected has some specific features which has provoked its inclusion in the study. In general, it has been tried to select those with higher world-wide production and attractive price, although some others have been included due to there are some interesting reasons to be taken into account:

1. The rapeseed was selected since it was the most widely used raw material across Europe and the raw material used as oil of first use, in addition to this it has a relatively high world-wide production.
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4. Palm oil production is much lower than that of palm kernel and its prices is much higher, but given the fact that they proceed from the same fruit but they show really different features it is interesting its study. Besides, studying the prices history it has shown interesting minimum prices for biodiesel production.

The oil used is an unavoidable raw material in any study of this type. Its low prices apart from solving an ecological problem make them very interesting.

VIII. Performance Analysis Of CI Engin Run By Diesel (B00)

The engine performance tests were conducted with a single cylinder four stroke diesel engine. The test rig arrangement mainly consists of loading arrangement, a fuel input measuring arrangement, air intake measuring arrangement, an arrangement for measuring the heat carried away by cooling water from engine jacket, an arrangement for measuring the heat carried away by cooling water from exhaust gases, a control panel. The specification of the test engine is as given below Table 1, Table 2 and 3

Engine type : Kirloskar Engine

Dia of Engine : .96m

No. of cylinder : 1

No of stroke : Four

Type of cooling : Water

Fuel used : Diesel, Biodiesel

The parameters like fuel consumption, speed of engine, torque and etc. were measured at different loads for diesel and with various combinations of biodiesel from pongamia pinnata with the petroleum diesel. Brake power, brake specific fuel consumption, brake thermal efficiency.

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IX. PERFORMANCE TEST FORMULAE

1. Dia of Brake drum : .96m

2. Brake Power (B.P) : $\frac{2\pi NT}{60}$, N - Speed , T - Torqe

T= F*R, F - Force , R - Radius

3. Total Fuel Consumption(T.F.C) : $\frac{x}{t} \times 10^{-6} \times 3600 \times \rho$

4. Specific Fuel Consumption(s.f.c) : $\frac{T.F.C}{B.P}$

Brake Thermal Efficiency: $\frac{B.P \times 3600 \times 100}{T.F.C}$

DATA FOR DIESEL (B00**)**

Table 1

S.N	LOAD IN KGF T_1 T_2 T_1- T_2			NET LOAD IN NEWTON (T_1-T_2)* KGF	CRANK SHAFT SPEED RPM	TIME FOR 5ML FUEL CONSUMPTION SEC	B.P KW	T.F.C KG/HR	S.F.C KG/KW HR	B.T.E %
1	4	1	3	29.43	1538	34.2	.720	.43	.60	13.7
2	7	1	6	58.46	1518	33.3	1.42	.49	.31	26.5
3	10	2	8	78.48	1530	25	1.77	.59	.31	27
4	15	3	12	117.72	1544	23.7	2.89	.63	.21	38.3

Data for Bio Diesel (B10)

Table 2

S.N	LOAD IN KGF T_1 T_2 T_1-T_2			NET LOAD IN NEWTON (T_1- T_2)*KGF	CRANK SHAFT SPEED RPM	TIME TAKEN FOR 5ML FUEL CONSUMPTION SEC	B.P KW	T.F.C KG/HR	S.F.C KG/KWHR	B.T.E %
1	4	1	3	29.43	1503	40	.70	.37	.53	17.4
2	7	1	6	58.86	1523	33.5	1.4	.44	.31	26.7
3	12	3	9	88.2	1528	27.2	2.1	.55	.25	32.5
4	15	3	12	117.7	1524	21.3	2.8	.79	.24	33.4

Data for Bio Diesel **(B20)**

Table 3

S.N	LOAD IN KGF T_1 T_2 T_1- T_2			NET LOAD IN NEWTON (T_1-T_2)* KGF	CRANK SHAFT SPEED RPM	TIME FOR 5ML FUEL CONSUMPTION SEC	B.P KW	T.F.C KG/HR	S.F.C KG/KW HR	B.T.E %
1	4	1	3	29.43	1503	39	.70	.38	.54	15.6
2	7	1	6	58.86	1523	33	1.43	.45	.31	26.8
3	10	2	8	88.29	1528	27	2.15	.55	.25	33
4	15	3	12	117.72	1530	20	2.85	.65	.26	37

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X. MAIN SPECIFICATIONS

Ester content, EN14103

The specification defines that biodiesel has to contain a minimum percentage of 96.5% (m/m) of methyl fatty acid esters. This parameter is a tool that allows regulating the mixture of other substances, such as diesel in the final product. When the value is below this limit it can indicate that the conditions of reaction have not been the adapted ones or that the final product contains the sum of several minority compounds coming from the oil.

The value of this parameter depends on the production process and is indicative of the biodiesel quality. If biodiesel shows a high value of this parameter it indicates that an insufficient washing has taken place and causes that during the storage a glycerine phase is formed in the bottom of the storage tank and attracts other polar compounds like the water, monoglycerides and soaps and cause damage in the injection systems. They cause nonferrous metal corrosion. Mono-, di- and triglycerides and total glycerol,

Free glycerol, EN14106

The monoglycerides specification limits the content in £ 0.80% (m/m), diglycerides £ 0.20% (m/m), triglycerides £ total 0.20% (m/m) and glycerol £ 0.25% (m/m). These values depend on the production process that is to be optimized to fulfil these parameters. High values can cause problems in the injectors, the pistons and the valves. A high content of these parameters causes in an indirect form that others as viscosity and the carbonaceous residue also present more high values. Density, EN ISO 3675, EN ISO 12185 The values of density of biodiésel are in general higher than the diesel ones. The specification limits the values 15º C in 860-900 kg/m3 . The presence of other substances in the product like methanol can cause lower value of the density.

Methanol content, EN14110

The methanol content is limited in 0.20% (m/m) maximum. A high content of methanol in the final product indicates failure in the process, (distillation or washing part) reason why it is necessary to pay special attention to these parts of the process if the product is outside specification in this parameter. Flash Point (EN ISO 3679), which measures fuel flammability, also presents a high value when the content in the alcohol is high. The specification of the flash point for biodiesel is ³ 120ºC, and it is an important parameter from the point of view of security.

Iodine number, linolenic acid methyl ester and polyunsaturated FAME, EN14111

The iodine index is a measurement of the double bonds of the fatty matter. The value depends solely on the raw material used for the production of methyl ester. Raw materials like the neat soybean or sunflower, have an iodine number higher than 120 (g of I2/100 g). Mixing these raw materials with others with lower iodine number, we can be able to fulfil the specification of the mixture in this parameter. The linolenic acid methyl ester content is limited 12.0% (m/m) and the polyunsaturated fatty acid methyl esters in 1% (m/m). The compounds with a high number of double bonds are thought to be related to worse oxidation stability and that are the cause of the formation of degradation product which they can affect the engine operability, but is possible to have products with high iodine number and good oxidation stability. This can be obtained if the product has been aditivated or if it has the natural antioxidants after the production process.

Acid value, EN14104

Limited £ 0.05 mg KOH/g the value of the acidity is a measurement of the mineral acidity and free fatty acids content in the sample. The raw material influences in the value of the acidity and its degree of refinement. The production process also can affect to the value of this parameter as a result of adding mineral acid in the processes of soap elimination. The storage of the product usually increases this value gradually.

A high acidity is related to corrosion problems and deposits formation in the engine.

Content of phosphorus, EN14107

A maximum of 10 mg/kg is allowed in the samples of biodiésel. The phosphorus in the biodiesel comes from the phospholipids that the raw material contains. Also it can increase this value in case phosphoric acid for the neutralization of soaps is used or like catalyst.

An excess of phosphorus causes a bad separation of phases during the transesterificación process. Due to this reason in the refining process of the oil there is a degumming step to lower the phosphorus content.

Content of alkali and alkaline-earth metals, EN14108 and EN14109

The sum of the alkaline metal content (Na+K) as well as the sum of the alkaline earth metal content (Ca+Mg) are limited to a maximum of 5 mg/kg. The alkaline metals (Na+K) usually are remainders of the catalyst and it is thought that it is related to the ash formation in the engine, whereas the alkaline earth (Ca+Mg) correspond to remainders of the water of the washing, whose soaps can affect the bulk injection pumps. Other parameters are related to these like the sulphated a0sh content and the carbonaceous remainder. In the process we should revise the washing process if elevated values of these metals appear.

Kinematic viscosity 40ºC, EN ISO 3104

Oil has very much higher viscosity than diesel (~ 30 mm2/s at 40º C). The fatty acid methyl ester (biodiesel) has lower viscosity than the oil and slightly higher to the one of the diesel. The specification for the FAME limits the value of this parameter in 3.50 - 5.00 mm2/s to 40º C and for diesel 2.00 - 4.50 mm2/s 40º C. The viscosity value is related directly to the fatty acid distribution of biodiésel, and therefore of the raw material. The viscosity can be increased due to an increase of other parameters as they are the content in mono-, di- and tri-glycerides, or polymers; in this case it would be necessary to act on the process to correct these values. Final Publishable Report Page nº 22 Sulphur content, prEN ISO 20846, prEN ISO 20884 and Cetane number EN ISO 5165 Sulphur content, limited in max 10 mg/kg, and cetane number, min 51, depend solely on the raw material for the production of biodiesel. All the raw materials evaluated in this project do not present any problem to fulfil these parameters. Conradson carbon residue, EN ISO 10370 The diesel and biodiesel specification is the same one, allowing a maximum of 0.30% (m/m). This test measures the tendency of the fuel to produce deposits in the injectors within the combustion chamber. The value of this parameter seems to be related to others like the glycerine content, free fatty acids, soaps and remainders of the catalyst, that are parameters that we can correct acting in the production process. Sulphated ash content, EN ISO 3987 The sulphated ash content (max. 0.02% (m/m)) is a measurement of the amount of inorganic polluting agents that has the biodiésel. These polluting agents can come from rest of the catalyst that could cause deposits in the engine. Water content, EN ISO 12937 This parameter depends completely on the production process. It is limited 500 mg/kg maximum and it is necessary to be careful of the product once produced and before the consumption so that it does not increase the water content. Biodiesel is very hygroscopic, for this reason it can absorb water over the specification during the storage. In order to assure the fulfilment this parameter it is important to produce very below the specification and to extreme the measures to try not to catch humidity. Total contamination, EN 12662 It is a measurement of the amount of insoluble matter that is retained in a filter of 0.8 mm filter when the heated fuel passes through.

XI. ADVANTAGES AND APPLICATION

1. An alternative to petrol and diesel.
2. A renewable energy source.
3. Environmental friendly (Reduces the emission of harmful pollutants.)
4. Good lubricity. (high cetane number contribute to cold starting and low idle noise
5. Good combustibility (extend the life of diesel engines)

APPLICATION

Biodiesel can be used with some precautions in diesel engines in many sectors including on-road vehicles, off-road mobile equipment and vehicles and stationary equipment.

On-road

1. Fleet vehicles
2. Heavy-duty trucks
3. School buses
4. Urban transit buses

Off-road

1. Agricultural equipment
2. Construction equipment
3. Forestry equipment
4. Locomotives (trains)
5. Marine vessels
6. Mining equipment

Stationary

1. Electricity generators (gensets)
2. Furnaces

XII. RESULT AND DISCUSSION

In a single cylinder four stroke diesel engine made of Kirloskar was run using different types of sample that is petroleum diesel, blends of diesel and biodiesel, pure biodiesel made from the seed of pongamia pinnata at different loads to analyse the performance of the engine. To determine the performance of the engine, the values of the brake power, specific fuel consumption, heat supplied, brake thermal efficiency, were calculated (table).

Brake thermal efficiency increases with respect to load increases as shown in the figure 6. The B100 or pure biodiesel gives better brake thermal efficiency with comparison to other sample. In between the sample B00 and B100, it is seen that with increase in load, the sample B10 gives good result of brake thermal efficiency, therefore the B10 sample may be the better sample as compared to the other samples that is B00, B20, B30 and B100.

XIII. CONCLUSION

In the end, biodiesel is a new renewable energy that has the perfect opportunity to replace the current diesel.

Its production is simpler, requires few resources, farm crops on site are more environmentally friendly than oil drilling in the middle of the Pacific or the South Pole.

However this balance is nuanced, because using the agricultural surfaces to roll rather than to feed the populations makes the raw material more rare, therefore. In addition, the excesses of these farms such as deforestation or the use of oil palm can have serious ecological impacts.

Biodiesel can therefore be a viable alternative to current hydrocarbons, provided that its production and use is controlled to limit the negative aspects. However, there is still a partial solution, since the power / energy balance on the use of surfaces limits its development, and the economic gain is not as significant as the ecological contribution. The main difference we get in performance test is the brake thermal efficiency of the blends of diesel and biodiesel are almost similar .brake thermal efficiency of biodiesel like (B20, B10, B00).

REFERENCES

[1] Thooyamani, K.P., Khanaa, V., & Udayakumar, R. (2014). Virtual instrumentation based process of agriculture by automation. *Middle-East Journal of Scientific Research*, *20*(12): 2604-2612.

[2] Udayakumar, R., Kaliyamurthie, K.P., & Khanaa, T.K. (2014). Data mining a boon: Predictive system for university topper women in academia. *World Applied Sciences Journal*, *29*(14): 86-90.

[3] Anbuselvi, S., Rebecca, L.J., Kumar, M.S., & Senthilvelan, T. (2012). GC-MS study of phytochemicals in black gram using two different organic manures. *J Chem Pharm Res*., *4*, 1246-1250.

[4] Subramanian, A.P., Jaganathan, S.K., Manikandan, A., Pandiaraj, K.N., Gomathi, N., & Supriyanto, E. (2016). Recent trends in nano-based drug delivery systems for efficient delivery of phytochemicals in chemotherapy. *RSC Advances*, *6*(54), 48294-48314.

[5] Thooyamani, K.P., Khanaa, V., & Udayakumar, R. (2014). Partial encryption and partial inference control based disclosure in effective cost cloud. *Middle-East Journal of Scientific Research*, 20(12), 2456-2459.

[6] Lingeswaran, K., Prasad Karamcheti, S.S., Gopikrishnan, M., & Ramu, G. (2014). Preparation and characterization of chemical bath deposited cds thin film for solar cell. *Middle-East Journal of Scientific Research*, *20*(7), 812-814.

[7] Maruthamani, D., Vadivel, S., Kumaravel, M., Saravanakumar, B., Paul, B., Dhar, S.S., Manikandan, A., & Ramadoss, G. (2017). Fine cutting edge shaped Bi2O3rods/reduced graphene oxide (RGO) composite for

supercapacitor and visible-light photocatalytic applications. *Journal of colloid and interface science*, *498*, 449-459.

[8] Gopalakrishnan, K., Sundeep Aanand, J., & Udayakumar, R. (2014). Electrical properties of doped azopolyester. *Middle-East Journal of Scientific Research*, *20*(11). 1402-1412.

[9] Subhashree, A.R., Parameaswari, P.J., Shanthi, B., Revathy, C., & Parijatham, B.O. (2012). The reference intervals for the haematological parameters in healthy adult population of chennai, southern India. *Journal of Clinical and Diagnostic Research: JCDR*, *6*(10), 1675-1680.

[10] Niranjan, U., Subramanyam, R.B.V., & Khanaa, V. (2010, September). Developing a web recommendation system based on closed sequential patterns. In *International Conference on Advances in Information and Communication Technologies, 101,* 171-179. Springer, Berlin, Heidelberg.

[11] Slimani, Y., Baykal, A., & Manikandan, A. (2018). Effect of Cr3+ substitution on AC susceptibility of Ba hexaferrite nanoparticles. *Journal of Magnetism and Magnetic Materials*, *458*, 204-212.

[12] Premkumar, S., Ramu, G., Gunasekaran, S., & Baskar, D. (2014). Solar industrial process heating associated with thermal energy storage for feed water heating. *Middle East Journal of Scientific Research*, *20*(11), 1686-1688.

[13] Kumar, S.S., Karrunakaran, C.M., Rao, M.R.K., & Balasubramanian, M.P. (2011). Inhibitory effects of Indigofera aspalathoides on 20-methylcholanthrene-induced chemical carcinogenesis in rats. *Journal of carcinogenesis*, *10*.

[14] Beula Devamalar, P.M., Thulasi Bai, V., & Srivatsa, S.K. (2009). Design and architecture of real time web-centric tele health diabetes diagnosis expert system. *International Journal of Medical Engineering and Informatics*, *1*(3), 307-317.

[15] Ravichandran, A.T., Srinivas, J., Karthick, R., Manikandan, A., & Baykal, A. (2018). Facile combustion synthesis, structural, morphological, optical and antibacterial studies of Bi1− xAlxFeO3 (0.0≤ x≤ 0.15) nanoparticles. *Ceramics International*, *44*(11), 13247-13252.

[16] Thovhogi, N., Park, E., Manikandan, E., Maaza, M., & Gurib-Fakim, A. (2016). Physical properties of CdO nanoparticles synthesized by green chemistry via Hibiscus Sabdariffa flower extract. *Journal of Alloys and Compounds*, *655*, 314-320.

[17] Thooyamani, K.P., Khanaa, V., & Udayakumar, R. (2014). Wide area wireless networks-IETF. *Middle-East Journal of Scientific Research*, *20*(12), 2042-2046.

[18] Sundar Raj, M., Saravanan, T., & Srinivasan, V. (2014). Design of silicon-carbide based cascaded multilevel inverter. *Middle-East Journal of Scientific Research*, *20*(12), 1785- 1791.

[19] Achudhan, M., Jayakumar M.P. (2014). Mathematical modeling and control of an electrically-heated catalyst. *International Journal of Applied Engineering Research, 9*(23), 23013.

[20] Thooyamani, K.P., Khanaa, V., & Udayakumar, R. (2013). Application of pattern recognition for farsi license plate recognition. *Middle-East Journal of Scientific Research*, *18*(12), 1768-1774.

[21] Jebaraj, S., Iniyan S. (2006). Renewable energy programmes in India. *International Journal of Global Energy Issues*, *26*(43528), 232-257.

[22] Sharmila, S., & Jeyanthi Rebecca, L. (2013). Md Saduzzaman., Biodegradation of domestic effluent using different solvent extracts of Murraya koenigii. *J Chem and Pharm Res*, *5*(2), 279-282.

[23] Asiri, S., Sertkol, M., Guner, S., Gungunes, H., Batoo, K.M., Saleh, T.A., Manikandan A., & Baykal, A. (2018). Hydrothermal synthesis of CoyZnyMn1-2yFe2O4 nanoferrites: magneto-optical investigation. *Ceramics International*, *44*(5), 5751-5759.

[24] Rani, A.J., & Mythili, S.V. (2014). Study on total antioxidant status in relation to oxidative stress in type 2 diabetes mellitus. *Journal of clinical and diagnostic research: JCDR*, *8*(3), 108-110.

[25] Karthik, B. (2014). Arulselvi, Noise removal using mixtures of projected gaussian scale mixtures. *Middle-East Journal of Scientific Research*, *20*(12), 2335-2340.

[26] Karthik, B., Arulselvi, & Selvaraj, A. (2014). Test data compression architecture for low power VLSI testing. *Middle - East Journal of Scientific Research, 20*(12), 2331-2334.

[27] Vijayaragavan, S.P., Karthik, B., & Kiran Kumar, T.V.U. (2014). Privacy conscious screening framework for frequently moving objects. *Middle-East Journal of Scientific Research*, *20*(8), 1000-1005.

[28] Kaliyamurthie, K.P., Parameswari, D., & Udayakumar, R. (2013). QOS aware privacy preserving location monitoring in wireless sensor network. *Indian Journal of Science and Technology*, *6*(5), 4648-4652.

[29] Silambarasu, A., Manikandan, A., & Balakrishnan, K. (2017). Room-temperature superparamagnetism and enhanced photocatalytic activity of magnetically reusable spinel ZnFe 2 O 4 nanocatalysts. *Journal of Superconductivity and Novel Magnetism, 30*(9), 2631-2640.

[30] Jasmin, M., Vigneshwaran, T., & Beulah Hemalatha, S. (2015). Design of power aware on chip embedded memory based FSM encoding in FPGA. *International Journal of Applied Engineering Research*, *10*(2), 4487-4496.

[31] Philomina, S., & Karthik, B. (2014). Wi-Fi energy meter implementation using embedded linux in ARM 9. *Middle-East Journal of Scientific Research*, *20*, 2434-2438.

[32] Vijayaragavan, S.P., Karthik, B., & Kiran Kumar, T.V.U. (2014). A DFIG based wind generation system with unbalanced stator and grid condition. *Middle-East Journal of Scientific Research*, *20*(8), 913-917.

[33] Rajakumari, S.B., & Nalini, C. (2014). An efficient data mining dataset preparation using aggregation in relational database. *Indian Journal of Science and Technology, 7*, 44-46.

[34] Karthik, B., Kiran Kumar, T.V.U., Vijayaragavan, P., & Bharath Kumaran, E. (2013). Design of a digital PLL using 0.35 Î¼m CMOS technology. *Middle-East Journal of Scientific Research*, *18*(12), 1803-1806.

[35] Sudhakara, P., Jagadeesh, D., Wang, Y., Prasad, C.V., Devi, A.K., Balakrishnan, G., Kim B.S., & Song, J.I. (2013). Fabrication of Borassus fruit lignocellulose fiber/PP composites and comparison with jute, sisal and coir fibers. *Carbohydrate polymers*, *98*(1), 1002-1010.

[36] Kanniga, E., & Sundararajan, M. (2011). Modelling and characterization of DCO using pass transistors. In *Future Intelligent Information Systems,* 86(1), 451-457. Springer, Berlin, Heidelberg.

[37] Sachithanandam, P., Meikandaan, T.P., & Srividya, T. Steel framed multi storey residential building analysis and design. *International Journal of Applied Engineering Research*, *9*(22), 5527-5529.

[38] Kaliyamurthie, K.P., Udayakumar, R., Parameswari, D., & Mugunthan, S.N. (2013). Highly secured online voting system over network. *Indian Journal of Science and Technology*, *6*(S6), 4831-4836.

[39] Sathyaseelan, B., Manikandan, E., Lakshmanan, V., Baskaran, I., Sivakumar, K., Ladchumananandasivam, R., Kennedy, J., & Maaza, M. (2016). Structural, optical and morphological properties of post-growth calcined TiO2 nanopowder for opto-electronic device application: Ex-situ studies. *Journal of Alloys and Compounds*, *671*, 486-492.

[40] Saravanan, T., Sundar Raj M., & Gopalakrishnan K. (2014). SMES technology, SMES and facts system, applications, advantages and technical limitations. *Middle - East Journal of Scientific Research, 20*(11), 1353-1358.

[41] Sumangala, K. (2019). A Smart System for Indoor Plant Care. *Journal of Computational Information Systems, 15*(1), 61-64.

[42] Satheeshkumar, R. (2019). Real Time Virtual Human Hand for Robotics. *Journal of Computational Information Systems, 15*(1), 82-89.

[43] Santhosh kumar, K. (2019). A Systematic Review on Finger Vein Recognition Techniques Based on Template Matching. *Journal of Computational Information Systems, 15*(1), 114-122.

[44] Priyadharshini, M., & Amsaveni, R. (2015). Case Based Automatic Text Classification Using Semantic Relationship. *International Journal of Advances in Engineering and Emerging Technology, 7*(9), 586-596.

[45] Sivakumar, R., & Dr. Duraisamy, S. (2015). Designing a Novel Framework of Load Balancing Cluster with Target Coverage Problem and Trust Evaluation for Military Wireless Sensor Networks. *International Journal of Advances in Engineering and Emerging Technology, 7*(9), 597-614.

[46] Yamuna, B., & Girija, T. (2015). Enhanced Fully Distributed Load Rebalancing in Cloud Computing. *International Journal of Advances in Engineering and Emerging Technology, 7*(10), 615-626.

[47] Priya, P., & Mercy Gnana Rani, A. (2015). An ANT Based Intelligent Routing Algorithm for MANET. *International Journal of Advances in Engineering and Emerging Technology*, *7*(10), 627-639.

[48] Dr.Sankarganesh, R., & Ilango, M. (2018). Simple Four-Quadrant Grid-Tie Fuzzy Logic Control Scheme with Single-Phase DC/AC Converters. *Excel International Journal of Technology, Engineering and Management*, *5*(2), 36-41.

[49] Dr.Selvam, P., & Karl Marx, P.S. (2018). A New Harmonic Reduced 3-Phase Thyristor Controlled Reactor for Static VAr Compensators. *Excel International Journal of Technology, Engineering and Management*, *5*(2), 42-46.

[50] Loganathan, P., & Sridevi, S. (2018). Power Quality Analysis of Grid Connected Solar Power Inverter. *Excel International Journal of Technology, Engineering and Management*, *5*(2), 47-51.