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"STUDY AND PERFORMANCE OF UNREGULATED EMISSION OF BIODIESEL FUELLED ENGINE"

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ABSTRACT

Karanja oil methyl ester (KOME), a biodiesel prepared from Karanja oil, a potential source of non-edible oil in India. While India is short of petroleum reserves, it has a large land as well as good climatic conditions (tropical) with adequate rainfall in large parts of the area to account for large biomass production each year. This study is aimed at determining the use of Karanja biodiesel as an alternative fuel. For this the performance and different emissions have been studied and compared with the baseline diesel fuel. The fuels were tested at different loading conditions. The various performance parameters studied are BTE, BSFC, and different unregulated emissions. The result was compared and presented in this thesis. The karanja Biodiesel showed the comparable performance and emissions characteristics as that of diesel

Keyword: *Biodiesel, Transesterification, Performance, Exhaust Emissions, Diesel*

I. INTRODUCTION

Resource depletion is the consumption of a resource faster than it can be replenished. Natural resources are commonly divided between renewable energy and non-renewable resources (see also mineral resource classification). Use of either of these forms of resources beyond their rate of replacement is considered to be resource depletion. Minerals are needed to provide food, clothing, and housing. A USGS study found a significant long-term trend over the 20th century for non-renewable resources such as minerals to supply a greater proportion of the raw material inputs to the non-fuel, non-food sector of the economy; an example is the greater consumption of crushed stone, sand, and gravel used in construction.[1]. Large-scale exploitation of minerals began in the Industrial Revolution around 1760 in England and has grown rapidly ever since. Most of the world's mineral ores are still being extracted from mines over fifty years old. Miners cope by digging deeper, accepting lower grades of ore, and using technology to extract the minerals. Virtually all basic industrial metals (copper, iron, bauxite, etc.), as well as rate earth minerals, are facing output limitations.[2]. The United State Department of Energy in the Hirsch report indicates that "The peaking of world oil production presents the U. S. and the world with an unprecedented risk management problem. As peaking is approached, liquid fuel prices and price volatility will increase dramatically, and, without timely mitigation, the economic, social, and political costs will be unprecedented. Viable mitigation options exist on both the supply and demand sides, but to have substantial impact, they must be initiated more than a decade in advance of peaking.[3].

1.1 Advantages of Biodiesel

Biodiesel is a fuel that has gained a lot of public attention because it is environmentally friendly and renewable and is being appreciated all over the world. Among the many advantages of using biodiesel, some are listed as follows: the use of biodiesel is not dangerous to the environment. Petrodiesel-powered vehicles produce a considerable amount of emissions, and unfortunately the smokethese vehicles emit is hazardous to the environment.Biodiesel is agriculture oriented, nontoxic, biodegradable and a renewable fuel.

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1.2 Disadvantages Of Biodiesel fuels

Although biodiesel has gained much scientific attention in recent years, it is not without some few disadvantages. One of the problems encountered when using biodiesel is the increase in nitrogen oxides emissions which can result in the formation of smog and acid rain. Similarly, biodiesel when compared to petro-diesel have a lower energy output.In order to produce the same amount of energy, more biodieselis required than petro-diesel.

II. BIODIESEL PRODUCTIONS

2.1.1 Karanja Oil

The biodiesel production from karanja oil or waste vegetable oil must be moisture free because every molecules of water destroy the molecules of catalyst which decrease its concentration and results poor conversion. The FFA content of oil should be less than 1%. It was found that lesser the FFA in oil, the better is the biodiesel conversions. Higher FFA oil can also be used but the biodiesel conversions will depend upon the type of oil and amount of catalyst potassium hydroxide (KOH) or sodium hydroxide (NAOH) used [12].

2.1.2 Alcohol

The materials use as alcohols include methanol, ethanol, Propanol, Butanol, and amyl alcohol. Methanol (CH3OH) and ethanol (C2H5OH) are used most commonly alcohol [13]. Methanol or ethanol can used as near to absolute as possible. As with oil, the amount of water content in alcohol affect the extent of conversion enough to prevent the separation of glycerol from the reaction mixture.

2.1.3 Catalyst

The catalyst Potassium hydroxide (KOH) or sodium hydroxide (NaOH). The catalyst Potassium hydroxide (KOH) or sodium hydroxide (NAOH) can be used for transesterification. The alkoxides also can be used as catalyst but it is prohibitively expensive. The best results are obtained if the catalyst is 85% potassium hydroxide (KOH). The best grades of potassium hydroxide (KOH) contain 14%-15% water which cannot be removed. It should be low in carbonate, because carbonate is not an efficient catalyst and may cause cloudiness in the final ester.
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2.2 Parameters affecting Biodiesel Production

However, both biodiesels behaved similarly when used in diesel engine with engine parameters of compression ratio and injection pressure. For biodiesel and diesel blends operation, KB20 and KB100 resulted in overall smooth engine operation. For biodiesel blends of KOME engine operation, KB20 and KB100 performs better compared to other combination of biodiesel blends. Smoke, CO and HC emissions increased with increased percentage of KOME blends while the NOx values decreases [14]. A. Demirbas investigated the brake power of biodiesel was nearly the same as with petro diesel, while the brake specific fuel consumption was higher than that of diesel. Carbon deposits inside the engine were normal, with the exception of intake valve deposits. In compression ignition engines biodiesel fuels can be used as performance improving additives [15].

Jen-Hsiung Tsai et al. compared to pure diesel oil (D100) and four fuel blends containing different percentages of waste edible- oil biodiesel (W20) in terms of emissions of PM, carbonaceous PM, Total-PAHs, and Total-BaPeq. in spite of mixing ratio, all fuel blends had lower PM emission factors (range, 13.7–52.3 % lower, average = 30.5 % lower) than D100 (pure diesel) did when the generator was operated under 0, 1.5, and 3 kW loads. The W20 blend attained the major reduction (range, 25.4–52.3%; average, 37.3 %) in PM emission factor [16].

Ganesh Shirsath studied that each biodiesel behave differently when used in diesel engines in terms of injection timings. For biodiesel and diesel blends operation, KB20 resulted in overall smooth engine operation. For biodiesel blends of KOME engine operation, KB20 performs better compared to other combination of biodiesel blends. Smoke, CO and HC emissions increased with increased percentage of KOME in blends while the NOx values decreases [17].

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III. EXPERIMENTAL SETUP

Four cylinder 4-stroke diesel engine was used for the study the complete technical specification and CI engine test kit used for performance testing is given below.

Table 3.1.: Feature of the 4 stroke, 4 Cylinder

Make	Force motors
Bore (mm)	78
Stroke (mm)	95
Compression ratio	18.65:1
Rated power (H.P.)	27
Rated speed (rpm)	2200
Cylinder number and type	Four and four stroke

3.1 Diesel Engine

3.1.1. Introduction - Four cylinder 4 Stroke diesel engine (also known as a compression-ignition or 'CI' engine) is an internal combustion engine in which ignition of the fuel that has been injected into the combustion chamber is initiated by the high temperature which a gas achieves when greatly compressed (adiabatic compression).

The diesel engine has the highest thermal efficiency of any standard internal or external combustion engine due to its very high compression ratio and inherent lean burn which enables heat dissipation by the excess air. A small efficiency loss is avoided compared to two-stroke non-direct-injection gasoline engines since un-burnt fuel is not present at valve overlap and therefore no fuel goes directly from the intake/injection to the exhaust. Low-speed diesel engines (as used in ships and other applications where overall engine weight is relatively unimportant) can have a thermal efficiency that exceeds 50%.

IV. PERFORMANCES OF DIESEL AND BIODIESEL

The test fuels used during this study were Karanja Biodiesel and neat diesel fuel. Experiments were conducted at a constant speed and by varying the loads.

4.1Fuel Properties

Table: 4.1 The Fuel properties were

Properties	Test Method	Diesel	KOME
Kinematic viscosity @400 C, cSt	D445	2.4	5.5
Density@150c, kg/m3	D1298	822.4	891.8
Flash Point, 0C	D93	67	136
Net Calorific Value, MJ/kg	D240	42.7	37.58
Water &sediments % volume	D2709	.01	0.02
Sulfer, %wt	D4294	0.28	Nil

4.2Fuel Consumption

Figure 4.2 shows the variation in fuel consumption for diesel B20 and B100 when various blends are used in diesel engine. As the loads are increased the diesel engine consumed more fuel in comparison to diesel fuel. The fuel consumption (FC) of B20 and B 100 was increased than that of diesel. It is observed that at the same brake load engine consumed more fuel (B20 & B100) in comparison to conventional diesel fuel.

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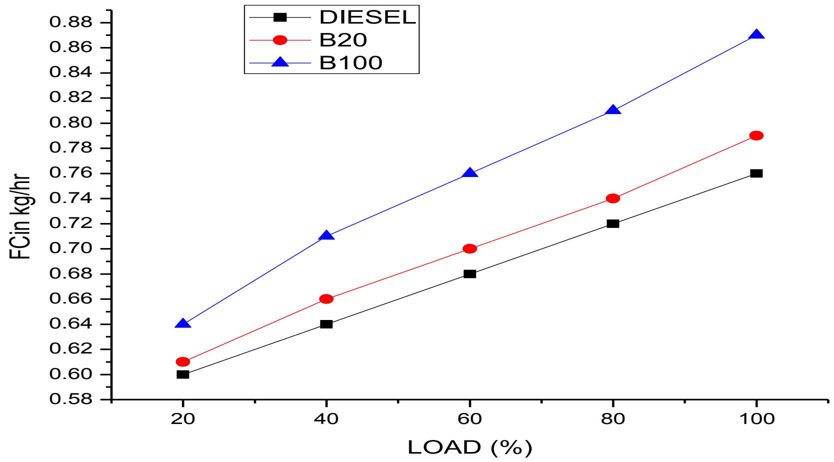

Figure- 4.2 Variation in Fuel Consumption with Varying Load for Diesel, B20 &B100 blends

4.3 Brake Thermal Efficiency

Figure 4.4 shows the variation in the brake thermal efficiency (BTE) of diesel engine fuelled with diesel, B20 and B100 blends at various load. The brake thermal efficiency (BTE) of B20 and B100 is decreased as the blends were increased. The brake thermal efficiency of B20 and B100 is less than that of diesel fuel at 1500 rpm constant engine speed. It is observed that the brake thermal efficiency of B100 was decreased in comparison to diesel.

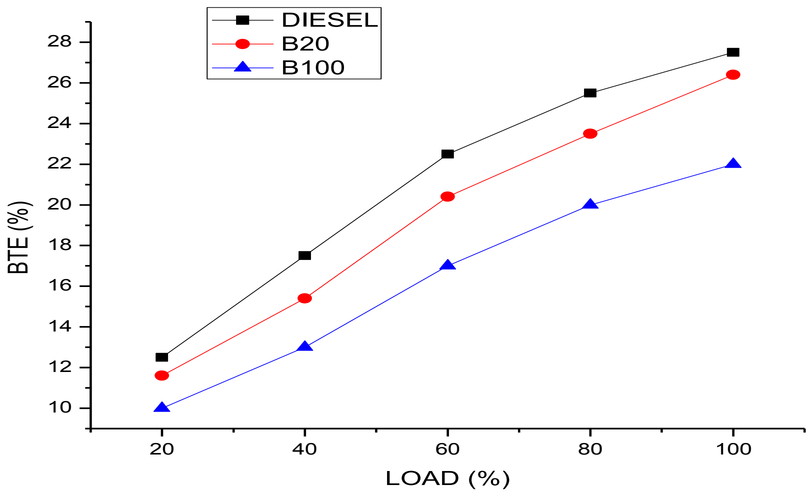

Figure 4.3 Variation in Brake Thermal Efficiency with Varying Load for Diesel, B20 & B100 blends

4.4 Brake Specific Fuel Consumption

Figure 4.3 shows the variation in brake specific fuel consumption (BSFC) with varying load for diesel, B20 & B100 blends. It was resulted that the brake specific fuel consumption (BSFC) is higher than that of diesel when the B20 and B100 blends were used in diesel engine. The BSFC of diesel engine was slightly decreased as the engine brake load increased. The brake specific fuel consumption is an essential parameter by which compare the engines and determine the fuel efficiency of engines.

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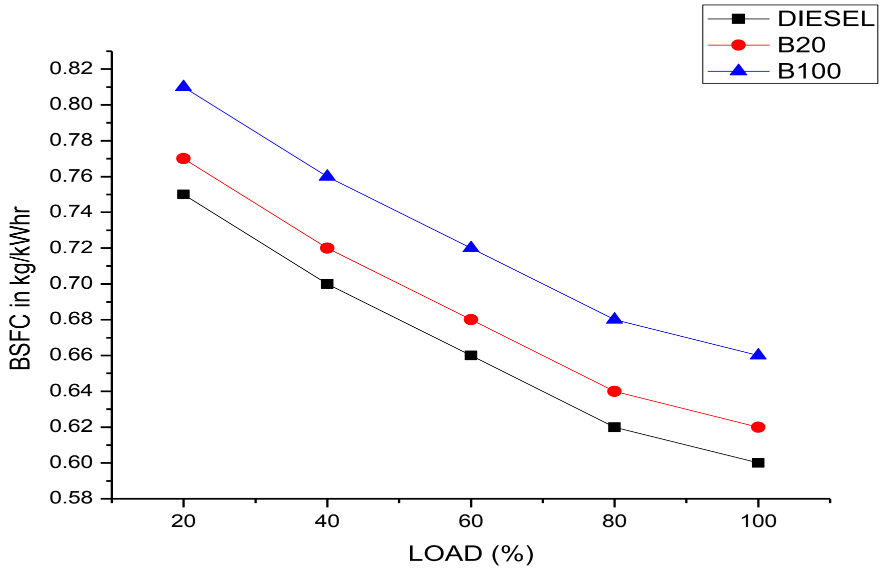

Figure 4.4: Variation in Brake Specific Energy Consumption with Varying Load for Diesel, B20, B100 blends

4.5 Brake Specific Energy Consumption

Figure 4.5 shows variation in brake specific energy consumption (BSEC) with varying load for diesel, B20 and B100 blends. It was resulted that the BSEC of diesel engine has higher energy consumption that of diesel when the blends were used 20% and 100%. The BSEC of diesel engine was slightly decreased as the engine brake loads were increased. The BSEC of B20 and B100 blends were increased and consumed more energy as compared to diesel fuel when engine runs at constant speed of 1500 rpm.

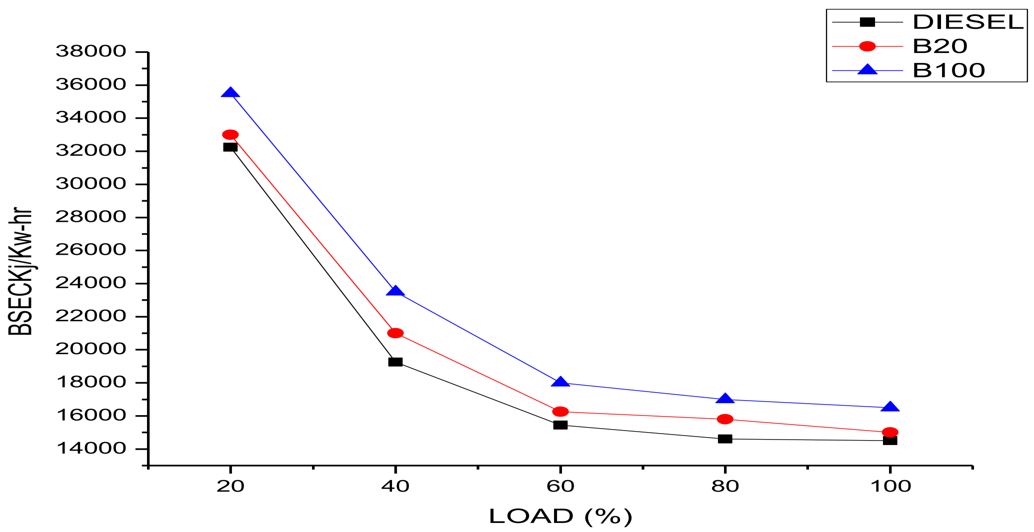

Figure 4.5: Variation in Brake Specific Energy Consumption with Varying Load for Diesel, B20& B100

4.6 Unregulated Emissions

The results of emission analysis to find the all types of unregulated and carcinogenic emissions of 4-stroke, four cylinder diesel engine are presented here. Exhaust gases compounds are tested through Gas Chromatography and Mass Spectrometer (GC-MS) with Finite Element (FID) detector.

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Table 4.6 all types of unregulated and carcinogenic emissions

S.no	Name of Carcinogenic compound	Health effect
1	2',6'-Dihydroxyacetophenone, bis(trimethylsilyl) ether	Headache, dimness of vision.
2	2',3'-Dihydroxyacetophenone, bis(trimethylsilyl) ether	Blindness
3	Cyclotetrasiloxane, octamethyl	loss of libido, liver toxicity
4	Benzoic acid, 4-methyl-2-trimethylsilyloxy-, trimethylsilyl ester	hypertension,
5	Benzaldehyde, 2,5-bis[(trimethylsilyl)oxy]-	*kidney failure,* chronic kidney disease
6	2',5'-Dihydroxyacetophenone, bis(trimethylsilyl) ether	blood pressure
7	3,4dihydroxymandelic acid	Skin problem
8	Hexanoic acid, 2-ethyl-, oxybis(2,1-ethanediyloxy-2,1-ethanediyl) ester	*Irritation problem*
9	9,12-Octadecadienoic acid, (2-phenyl-1,3-dioxolan-4-yl)methyl ester, cis-	Genome problem
10	1,2-Benzenecarboxilic acid	Irritating to skin, eyes
11	Pentanoic acid, 5-hydroxy-, 2,4-di-t-butylphenyl esters	hair loss
12	Hexadecanoic acid, 15-methyl-, methyl ester	Ecosystem damage
13	Phenol, 2,4-bis(1,1-dimethylethyl)-	Swelling
14	Phenol, 2,5-bis(1,1-dimethylethyl)-	Swelling, tears
15	Tridecanoic acid, 12-methyl-, methyl ester	vomiting, anorexia, constipation, dry mouth
16	Hexadecanoic acid, 15-methyl-, methyl ester	*brain* injury, heart surgery
17	Methyl 8-methyl-nonanoate	haemolysis, methemoglobinemia, coma,
18	11-Octadecenoic acid, methyl ester	kidney and liver damage.

The carcinogenic compounds emissions were investigated on a diesel engine fuelled with biodiesel derived from Karanja oil.

When the engine is fuelled with biodiesel the specific emissions of carcinogenic compounds increase and the emission concentrations slightly decrease with decreasing engine loads. The carcinogenic compounds emissions at high engine speed are distinctly higher than those at low engine speed for both biodiesel and diesel.

V. CONCLUSION

A discussion of the research results and the conclusions that have been drawn in the thesis are presented in the chapter.

In this study, experiments were conducted with a direct injection, naturally aspirated diesel engine to investigate the performance and emission of the biodiesel and its blends prepared from Karanja oil. This chapter describes the conclusions for Performance and unregulated emission of diesel and biodiesel fuelled engine.It is concluded that the use of biodiesel blends slightly increases the brake specific fuel consumption (BSFC) in comparison to the diesel fuel at the same load condition. The brake thermal efficiency of biodiesel fuel was found to be comparable as that of diesel fuel when the blends were 20 %.

REFERENCES

[1] Depletion and Conservation of Natural Resources: The Economic Value of the World's Ecosystems — How Much is Nature Worth? The Role of Forests and Habitat
[2] Materials Flow and Sustainability, US Geological Survey, Fact Sheet FS-068-98, June 1998
[3] Demirbas. A. Biodiesel fuels from vegetable oils via catalytic and non-catalyticsupercritical alcohol transesterifications and other methods: a survey Energy Conversion and Management 2003(44). pp. 2093-2109
[4] 4S.S.Thipse, "Alternate Fuels," Concepts technologies and Development. Jaico, Publishing House Mumbai, 2011, pp. 233-35.
[5] Clark, N.; Gautam, M.; Wayne, W.; Lyons, D.; Thompson, G.; Zielinska,B. Heavy-Duty Vehicle Chassis Dynamometer Testing for Emissions Inventory, Air Quality Modeling, Source Apportionment and Air Toxics Emissions Inventory; Coordinating Research Council (CRC) Report RE55/E59; CRC: Alpharetta, GA, 2007.
[6] Bert Metz, "Special Report on Carbon Dioxide Capture and Storage", 2001, Intergovermental Panel on Climate Change, Cambridge University Press
[7] Usta, N., Oztürk, E., Can, O., Conkur, E. S., Nas, S., Con, A. H., Can, A. C., and Topcu,M., "Combustion of biodiesel fuel produced from hazelnut soapstock / waste sunflower oil
[8] Wiltsee, G., "Waste grease resource in 30 US metropolitan areas. In: The Proceedings of Bioenergy 98 Conference," Wisconsin, 1998, pp: 956–963.
[9] Supple, B., Howard-Hildige, R., Gonzalez-Gomez, and E., Leahy, J.J., "The effect of steam treating waste cooking oil on the yield of methyl ester," J. Am. Oil Soc. Chem. 79 (2), 1999, pp: 175–178
[10] Vicente, G., Martinez, M., and Aracil, J., "A comparative study of vegetable oils for biodiesel production in Spain," Energy Fuels, 20, 2006, pp: 394–398.
[11] Sahoo, P.K., et al., "Biodiesel development from high acid value polanga seed oil and performance evaluation in a CI engine," Fuel, 86, 2007, pp: 448–454.
[12] Freedman, B.E., Pryde, H., and Mounts, T.L., "Variables affecting the yields of fatty esters from transesterified vegetable oils," JAOCS, 61, 1984, pp: 1638–1643.
[13] Vicente, G., et al., "Application of the factorial design of experiments and response surface methodology to optimize biodiesel production," Industrial Crop Production, 8, 1998, pp: 29–35.

ISSN : 2455-9679
Impact Factor : 2.865

[14] Feuge RO and Gros AT, 1949, Modification of vegetable oils, VII, Alkali catalyzed in teresterification of peanut oil with ethanol, Journal of the American Oil Chemists' Society, 26: 97-103.

[15] Chowdhury DK and Mukherji BK, 1954, Ethanolysis of vegetable oils using sodium hydroxide as catalyst, II, Effect of temperature and moisture, Journal of the Indian Chemical Society, 31(125-128).

[16] Gauglitz EH and Lehman LW, 1963, The preparation of alkyl esters from highly unsaturated triglycerides, Journal of the American Oil Chemists' Society, 40: 197-198.

[17] Glass RL, 1963, Alcoholysis, saponification and the preparation of fatty acid methyl esters, Lipids, 6:919-925.

[18] Freedman, B.E., Pryde, H., and Mounts, T.L., “Variables affecting the yields of fatty esters from transesterified vegetable oils,” JAOCS, 61, 1984, pp: 1638–1643.

[19] Szpiz RR, Jablonka FH, Pereira DA, Lago RCA and Hartman L, 1984, Processo da transesterificacao de oleos vegetais, BR8300429 (patent), Brasil Pesquisa Agropec, Brazil.