

PERFORMANCE CHARACTERISTICS AND ANALYSIS OF JATROPHA OIL IN MULTI- CYLINDER DIESEL ENGINE

¹S Abdur Rahman, ¹ Ramkumar Sathiyamourthy

¹Assistant Professor

¹Department of Mechanical Engineering,

¹Aalim Muhammed Salegh College of Engineering, Avadi, Chennai, India.

Abstract :

The quickly exhausting ordinary oil assets have advanced research for elective powers for inner ignition motors. Among different potential alternatives, energizes got from triglycerides (vegetable oils/creature fats) present promising "greener" substitutes for non-renewable energy sources. Vegetable oils, because of their farming starting point, can decrease net CO₂ outflows to the climate alongside import substitution of oil based goods. An assortment of consumable and non-palatable oils are considered for bio-diesel generation. In the present work, Jatropha Biodiesel obtained from approved organizations, and their significant physical and compound properties were tried and thought about. It is discovered that these properties are around like diesel fuel and reasonable to use in diesel motor. Likewise petro-diesel is obtained from nearby approved office and utilized when the biodiesels for checking the motor condition due to biodiesels. The biodiesel from jatropha oil is utilized in a M&M Turbo Charged make four stroke, four chambers, and water cooled diesel motor in unadulterated and mixed structure with no change in motor plan or fuel framework. The presentation qualities of a motor are examined with various extents of biodiesel and petro-diesel .The power, torque, and brake warm effectiveness utilizing biodiesel are discovered higher at different burden conditions than the petro-diesel; anyway explicit fuel utilization is discovered marginally more. The biodiesel mix JBD20 have indicated preferred execution over the diesel and different mixes.

IndexTerms - Jatropha, transesterification, Bio-diesel blend, JbD20, JBD30, JBD60.

I. INTRODUCTION

Diesel motors are the most proficient prime movers. From the perspective of ensuring worldwide condition and worries for long haul vitality security, it winds up important to create elective energizes with properties practically identical to oil based fills. In contrast to rest of the world, India's interest for diesel fills is around multiple times that of fuel consequently looking for option in contrast to mineral diesel is a characteristic decision . Biodiesel creation is experiencing quick innovative changes in ventures and the scholarly world. This has turned out to be increasingly clear and significant since the ongoing increment in the oil costs and the developing mindfulness identifying with the ecological outcomes of the fuel over reliance.

Lately a few looks into have been made to utilize vegetable oil, creature fats as a wellspring of sustainable power source known as bio diesel that can be utilized as fuel in CI motors. Vegetable oils are the most encouraging elective powers for CI motors as they are sustainable, biodegradable, non poisonous, ecological well disposed, a lower discharge profile contrasted with diesel fuel and the vast majority of the circumstance where regular oil diesel is utilized. Despite the fact that "diesel" is a piece of its name there is no oil or other non-renewable energy sources in bio diesel. It is 100% vegetable oil based, that can be mixed at any level with oil diesel to make a bio diesel mix or can be utilized in its unadulterated structure. Non consumable vegetable oils are the most critical to use as a fuel contrasted with eatable vegetable oils as it has an enormous interest for utilizing as a sustenance and furthermore the high cost for creation. Along these lines numerous specialists are investigating non palatable vegetable oils. In India the practicality of creating bio diesel as diesel substitute can be essentially thought as there is a huge garbage of debased backwoods land, unutilized open land, and decrepit grounds of ranchers, even provincial territories that will be gainful for generally speaking monetary development.

There are many tree species that bear seeds wealthy in non eatable vegetable oils. A portion of the promising tree species are Pongamia pinnata (karanja), Jatropha curcas (Ratanjyot) and so forth. In any case, most shockingly according to their potential just a limit of 6% is utilized. Biodiesel is a low-outflows diesel substitute fuel produced using sustainable assets and waste lipid. The most widely recognized approach to deliver biodiesel is through transesterification, particularly antacid catalyzed transesterification . For the land use sway, Jatropha improved the auxiliary biological system quality when planted on no man's land, however diminished the useful environment quality. Manure application (predominantly N) is a significant supporter of most negative effect classes. Advancing treatment, agronomic practices and hereditary qualities are the real framework improvement alternatives.

There are four essential approaches to make biodiesel, direct use and mixing, microemulsions, warm splitting (pyrolysis) and transesterification. The most generally utilized strategy is transesterification of vegetable oils and creature fats. The transesterification response is influenced by molar proportion of glycerides to liquor, impetuses, response temperature, response time and free unsaturated fats and water substance of oils or fats . Asia could possibly turn into a noteworthy market for, and exporter of biofuels. A few Asian nations are growing quickly and the interest for vehicles is relied upon to rise exponentially. Correspondingly, the interest for street transportation energizes is relied upon to take off.

The diesel motor has been connected to numerous fields, for example, diesel generator; control plant for vehicles, transports, boats, vessels and Lorries. One of the principle explanations behind its wide applications is on the grounds that diesel motor has its specific focal points of higher effectiveness, lower fuel utilization; higher dependability and solidness, contrasted and different sorts of motors, for example, oil motor, gas turbine. Another purpose behind diesel motor generally being utilized is

because of the fuel that it utilizes - diesel. Diesel is a sort of generally accessible and moderately shoddy non-renewable energy source separated from oil. Huge improvement in motor execution is watched contrasted with vegetable oil alone. The particular fuel utilization and the fumes gas temperature are diminished because of lessening in consistency of the vegetable oil .

PROBLEMS WITH BIODIESEL

Major problems encountered with vegetable oil as bio diesel used in CI engine are its low volatility and high viscosity due to long chain structure. The common problems faced are excessive pumping power, improper combustion and poor atomization of fuel particles. The conversion of the vegetable oil as a CI engine fuel can be done any of the four methods; pyrolysis, micro emulsification, dilution/blending and transesterification.

PREPARATION OF LABORATORY SAMPLES OF ESTERIFIED JATROPHA OIL (BIO DIESEL) :

The oil yielding plant *Jatropha curcas* L. is a multipurpose and drought resistant large shrub, which is widely cultivated in the tropics as a live fence. The *Jatropha* plant can reach a height up to 5 m and its seed yield ranges from 7.5 to 12 tonnes per hectare per year, after five years of growth. The oil content of whole *Jatropha* seed is 30-35 % by weight basis.

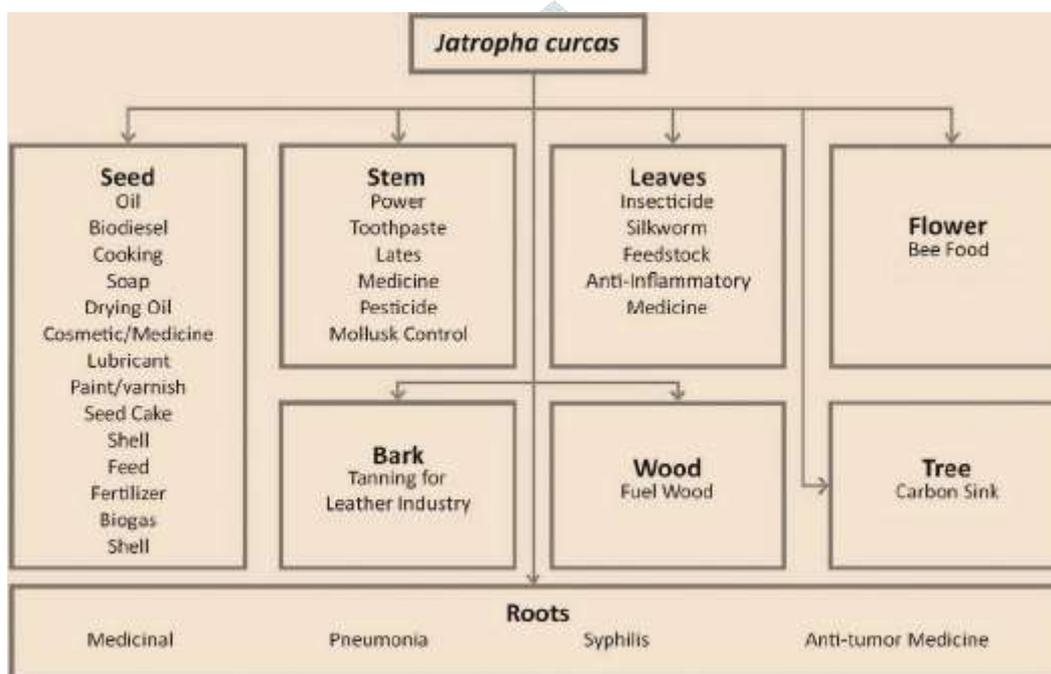


Fig. 1 Process flowchart for biodiesel production from jatropha seeds and by products

Jatropha oil is blended with alcohol and catalyst mixture in transesterification reactor. The reactor is kept at reaction temperature for specific duration with vigorous agitation. After reaction, the biodiesel and glycerol mixture is sent to the glycerol settling tank. The crude biodiesel is collected and washed to get pure biodiesel. Depending upon the need, the size of the unit can be scaled up to get higher production capacity. The fuel properties of *jatropha* biodiesel produced in th e pilot plant are given in the table 4.





Fig. 2 Jatropha Plant



Fig. 3 Jatropha Seed and oil

OBJECTIVES OF PROJECT:

Keeping in mind the benefits of biodiesel and so the consequential importance renewable in the near future, the work was undertaken with following specific objectives:

1. To conduct short term field test on C.I. engine.
2. To study performance of C.I. engine with biodiesel produced from Jatropha oil

In the present work, karanja biodiesel purchased from Mint-bio fuels ltd., Pirangut Pune. And their physico-chemical combustion properties were provided by same company. And then used for performance analysis in “4-stroke 4-cylinder water cooled diesel engine.”

EXPERIMENTAL SETUP

Study of Engine Performance has been an important process since the evolution of the engines. In the very early stages, only the external performance was studied with help of loading with a Dynamometer and measuring the parameters like Torque, Output power, Specific Fuel Consumption etc as the world progressed further, the necessity of refinement of engine design led to study the combustion events occurring inside the cylinder head. For this, in the earlier research, Mechanical Spring and piston type recorders were used. But, these had certain disadvantages like effects of spring stiffness etc. Further, with the advent of Piezo electric crystals, the Piezo Sensors have started been used with the amplification systems. Earlier the data was displayed on a Cathode Ray Oscilloscope, further recorded on Strip chart recorders and then analyzed separately. Now with help of Data Acquisition devices and using a PC, we can get this work done quite accurately. ATE has developed the Computerized IC engine Test Rigs with an intent not only to give the students how the testing is done and data is acquired, but to give them a more clear idea about the real time combustion by developing the combustion analysis system with Updates of the Pressure-Crank angle and Pressure Volume Curves every cycle. Along with that, one can get all other data like Heat Balance Sheet, Thermal efficiencies, BSFC, ISFC, Mech. Efficiency, Air-fuel ratio etc. Further the test rig is designed such that, if regular testing is to be carried out without using the Data Acquisition, it is possible to do that.

COMPONENTS OF THE COMPUTERIZED TEST RIG

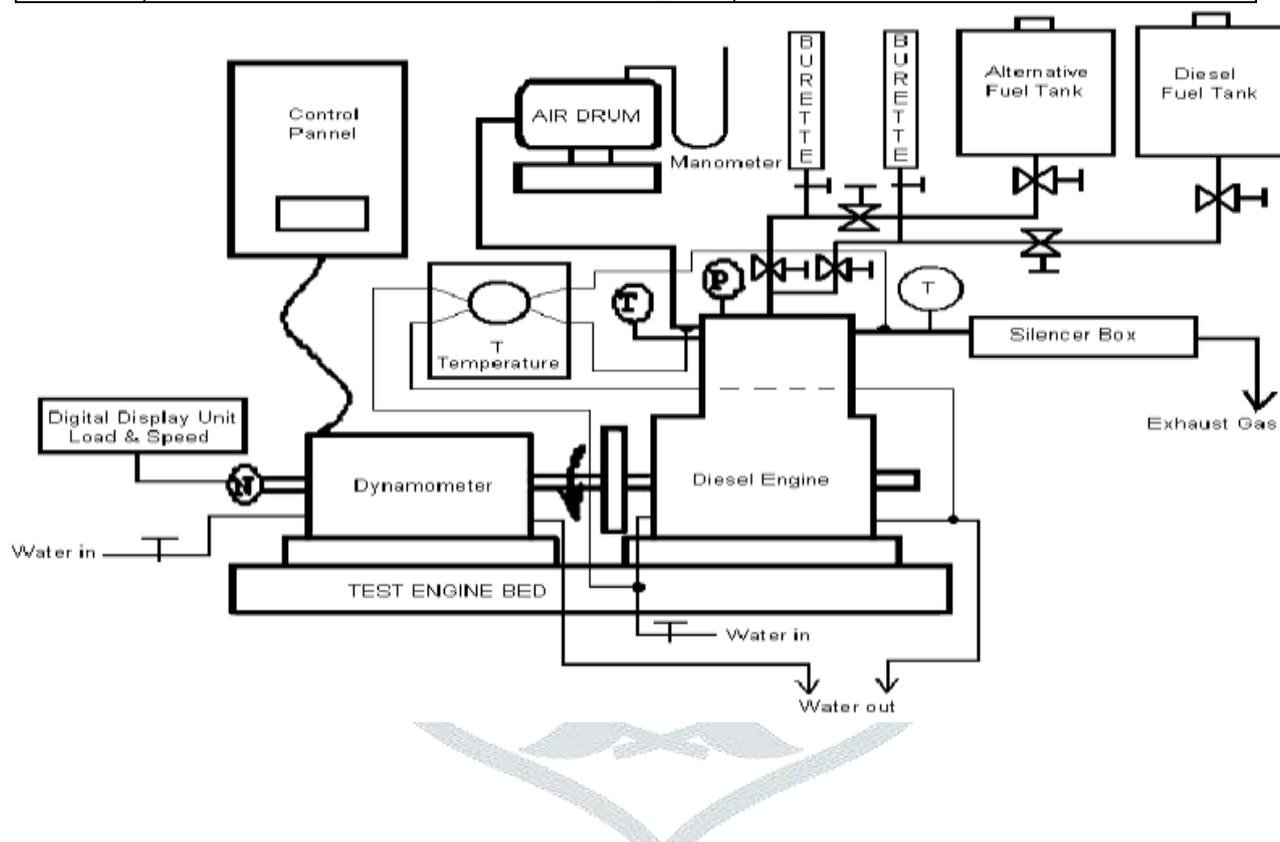
A Computerized Engine Test Rig consists of the following systems.

- 1) Dynamometer – Eddy Current type with computerized torque measuring
- 2) Engine fitted with a Piezo sensor for Pressure measurement

- 3) Connection between Dynamometer and Engine
- 4) Computerized Air Flow measurement system
- 5) Computerized Fuel Flow measurement system
- 6) Computerized Water Flow measurement system
- 7) Exhaust Gas Calorimeter with Computerized Temperature measurement system

ENGINE SPECIFICATION

Sr. No.	Particulars	Specification
1	Model	MDI 3200 TCA
2	Make	M&M
3	Power (kW)	27.6 KW
4	Speed (rpm)	5000 RPM
5	Cylinder Bore (mm)	88.9
6	Stroke Length (mm)	101.6
7	Connecting Rod Length (mm)	177.8
8	Cubic Capacity	2523 C.C.
9	Compression Ratio	18.1 : 1
10	No. of Strokes	4
11	No of Cylinders	4
12	Cooling	Water cooled
13	Fuel	Diesel



I. PERFORMANCE ANALYSIS OF JATROPHA BIODIESEL

Performance tests were conducted on stationary cylinders, diesel engine, by using Jatropa Biodiesel and its various blends with diesel from no load to full load condition. The tests were also conducted with conventional diesel fuel for comparison; Biodiesel is blended with diesel in proportion like 20%, 30%, and 40%. These blends are termed as JBD20 (20% Jatropa Biodiesel + 80% diesel), JBD40 (30% Jatropa Biodiesel + 70% diesel), JBD60 (40% Karanja Biodiesel + 60% diesel). Petro diesel is used before and after the Jatropa Biodiesel and their blends for verifying the engine performances because biodiesel and blends. The diesel used before the Jatropa is denoted as Diesel2 and after the Jatropa denoted as Diesel3 for convenience. All the performance tests were conducted in the I.C. Engine laboratory.

ENGINE PERFORMANCE ANALYSIS

The performance of an internal combustion engine is mainly studied with the help of combustion and operating characteristics. These characteristics obtained by using diesel and Jatropa biodiesel in 4 cylinders, 4 strokes, M&M make, turbo charge diesel engine. Performance tests were conducted from no load to full load conditions at 2000rpm for diesel, JBD20, JBD40 and JBD60.

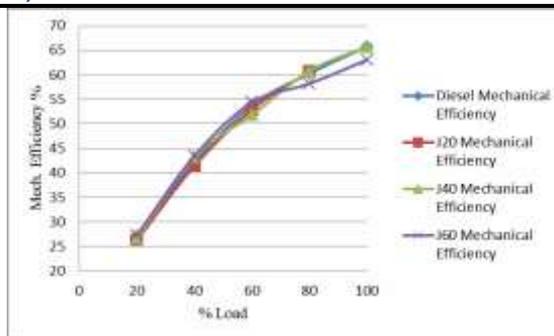


Fig. 5 % Load Vs Mechanical efficiency

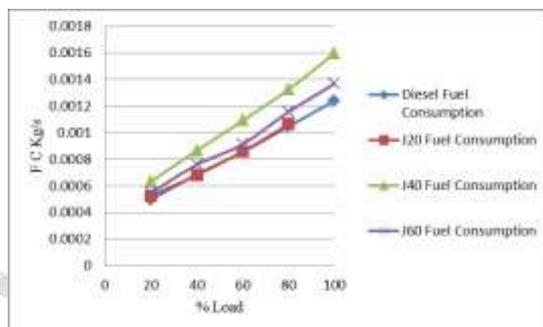


Fig. 6 % Load Vs Fuel consumption

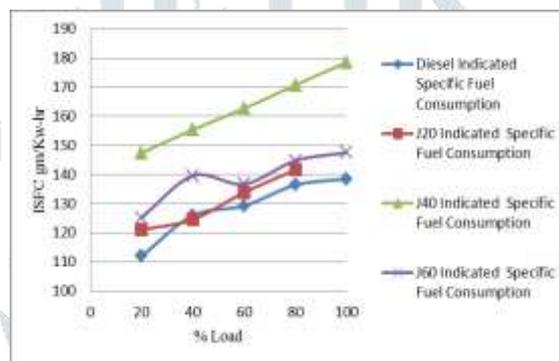


Fig. 7 % Load Vs Indicated specific Fuel consumption

According to the test, it was observed that at low load, mechanical efficiency of diesel and all consider blends of biodiesel were same but the load increased, the mechanical efficiency was varised. At full load, JBD40 shows same efficiency as diesel.

It is shown in figure 6. Fuel consumption for JBD40 at full load shows higher than diesel. JBD20 shows less fuel consumption than other blends. Break specific fuel consumption is more for JBD40 and less for JBD20. At low load brake power is same for diesel and JBD20, JBD40 and JBD60. Brake specific fuel consumption decreased with increasing load, JBD20 shows less brake specific fuel consumption .

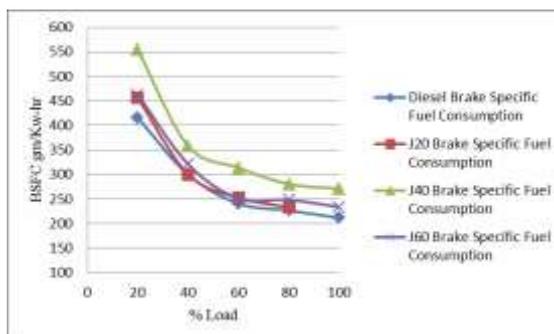


Fig. 8 % Load Vs Brake specific fuel consumption

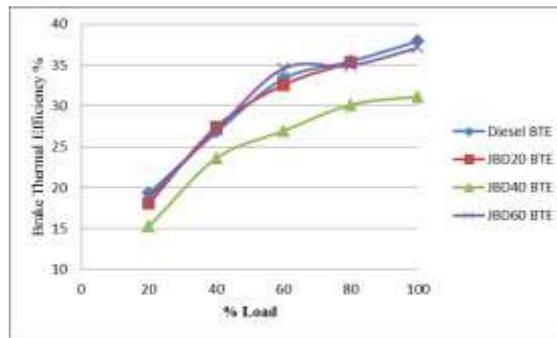


Fig. 9 % Load Vs Brake thermal efficiency

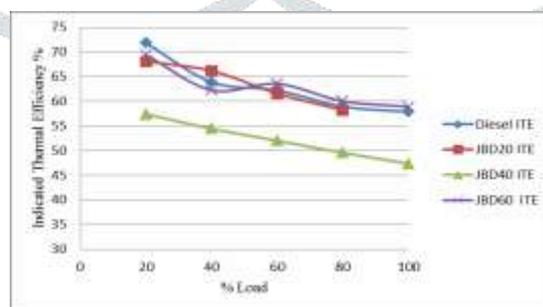


Fig. 10 % Load Vs Indicated thermal efficiency

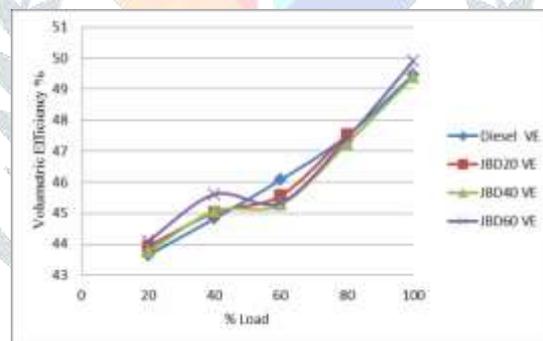


Fig. 11 % Load Vs Volumetric efficiency

JBD40 shows less brake thermal efficiency and more indicated thermal efficiency than diesel and other blends. Air-fuel ratio decreases with increasing load. At full load condition, JBD60 shows higher volumetric efficiency.

The main objective of the present investigation was to evaluate the performance characteristic of engine with the jatropha biodiesel. Biodiesel production is modern and technological area for researchers due to constant increase in prices of petroleum diesel and environmental advantages. Biodiesel from jatropha oil was produced by alkali catalysed transesterification process.

According to the present investigation, it was observed that JBD40 shows less indicated and brake thermal efficiency and more specific fuel consumption than diesel and other blends viz JBD20, JBD60. Performance of JBD20 at full load condition shows same to diesel. JBD20 is more suitable blend of jatropha oil. It shows high BTE, ITE and less specific fuel consumption.

The performance tests were conducted with diesel and various blend of Jatropha biodiesel at different loads and constant speed (2000rpm). From the experimental results obtained, Jatropha biodiesel is found to be a promising alternative fuel for economic running of compression ignition engines.

CONCLUSION

The main objective of the present investigation was to evaluate the performance characteristic of engine with the jatropha biodiesel. Biodiesel production is modern and technological area for researchers due to constant increase in prices of petroleum diesel and environmental advantages. Biodiesel from jatropha oil was produced by alkali catalysed transesterification process.

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