Experimental Investigation on Biofuel Made from Jatropha Seeds

Er. Mohammad Abrar Ul Haque[1] Neeraj Kumar[2]
[1]M Tech Student [2]Assistant Professor
[1,2]Department of Mechanical Engineering
[1,2]RNCET Madlauda Panipat Haryana, India

Abstract— It has been found by using Jatropha with pure diesel IC engine can run with optimum performance. It is also found from the experiments that 30 B Jatropha has good result as compared to 30 B mustard oil in Brake power v/s BSFC. India has gone biggest importer of edible oil so it is not favour to use mustard as bio diesel. Blending of mustard cost as higher than the cost of blending of Jatropha biodiesel. In the engine test rig tests were carried out using diesel and biodiesel to find out the effect of various blends on the performance of the engine. Investigations are carried out on the engine mainly to the effect of brake specific fuel consumption, bake thermal efficiency and exhaust gas temperature. From the experimental analysis it was found that the blends of the Jatropha oil with diesel could be successfully used with acceptable performance on 20 B. On the result of this study properties of Jatropha oil suggest that it can be used directly as C.I. engine fuel. It is possible to run diesel engine with mustard and Jatropha Carcus bio-diesel blends. Brake thermal efficiency is higher for neat diesel at all loads and lowers for blends of bio-diesel and difference of brake thermal efficiency between neat diesel and blended bio-diesel decreases as load increases. Fuel consumption is nearly same for neat diesel and blended diesel at all BMEP and have lower value at all BMEP for neat diesel. BSFC for bio-diesel increases for higher blending of bio-diesel, because of the lower heating value of bio- diesel as compared to diesel fuel.

Keywords: Biofuel, Jatropha Seeds

I. INTRODUCTION

A. *Background*

Rudolf Diesel invented Combustion Ignition (CI) engine during 1892. He tested it with peanut oil as fuel, but with the advent of cheap petroleum, appropriate crude oil fractions were refined to serve as fuel and people did not pay much attention over fuel potential of vegetable oils.

But gradual depletion of world petroleum reserves, increase in crude oil prices, and impact of environmental pollution results in renewed focus on vegetable oils and other renewable lipid sources. These resources have less environmental impact than the traditional ones. Therefore, in recent years systematic efforts have been made by several researchers to use vegetable oils and their esters (biodiesel) as fuel in CI engines. Vegetable oils have already been directly used in CI engines as they have a high Cetane number and calorific value very close to diesel. However, the brake thermal efficiency was lower to that of petro diesel. Beside this vegetable oils have high viscosity and low volatility; it leads to difficulty in atomizing the fuel and in mixing it with air. Therefore, engine emits more smoke, hydrocarbon and carbon-monoxide. Direct use of vegetable oils caused carbon build up in the combustion chambers and on the injector nozzle tip in long hours of operation.

But mono-alkyl esters of long chain fatty acids (biodiesel) is a promising substitute of petro diesel fuel that can be produced from natural, renewable resources such as wide variety of vegetable oils and animal fats. These resources are biodegradable and nontoxic. The term, biodiesel, was first introduced in the United States during 1992 by the National Soy development Board (presently National Biodiesel Board), which has pioneered the commercialization of biodiesel in the USA.

Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend or can be used in its pure form. It can be stored just like the petroleum diesel fuel and hence does not require separate infrastructure. Beside this biodiesel has almost no sulfur, no aromatics and has about 10% built in 02. Which helps it in complete combustion.

B. *Aim and Objectives*

The aim of the present study is to production of biodiesel from Jatropha curcus, Mustard oil and evaluation of performance test of different blends of SVO's and biodiesel with petro diesel in a CI engine. The following are the major objectives to fulfill the aim of present study.

1. Processing of biodiesel from SVO's Jatropha curcus and Mustard oil.
2. Performance evaluation of CI engine using different blends of SVO's, biodiesel and petro diesel.
3 .Comparison of performance of biodiesel blends and with petro diesel in an engine setup.

II. EXPERIMENTAL WORK

A. *About the Experimental Test-Rig*

1) Engine- The engine is water cooled single cylinder four stroke constant speed diesel engine 5 HP Make Kirloskar.
2) Rope Brake Dynamometer – A rope brake dynamometer is supplied with the engine coupled with the flywheel of engine.
3) Load indicator- It indicates the load in kg range 0-20 kg .Make Harrison
4) M.S. Base Frame-The engine and the dynamometer are mounted on a solid M.S. Channel Base Frame
5) Instrumentation for measuring various inputs/outputs- All instrumentation is incorporated on a control panel. The various factors to be measured are as follows:

1) Fuel measurement:

This is done by using burette which is mounted on the control panel. The fuel tank is mounted on panel. The fuel is supplied to engine using a fuel line to fuel injection system. The amount of fuel consumed is determined by the change in the readings shown on the burette. A three –way cock is used both to fill the burette and to allow the fuel to flow to the engine.

2) Air flow measurement:

Air flow is measured using an air box Orifice is fixed in the inlet of air box suction pressure difference across the orifice is read on the U-tube manometer mounted on the panel. The outlet of the air suction box goes to the engine through the flexible hose for air suction.

3) Temperature measurement:

For heat balance analysis the PT-100 sensors are connected at exhaust gas calorimeter and engine cooling.

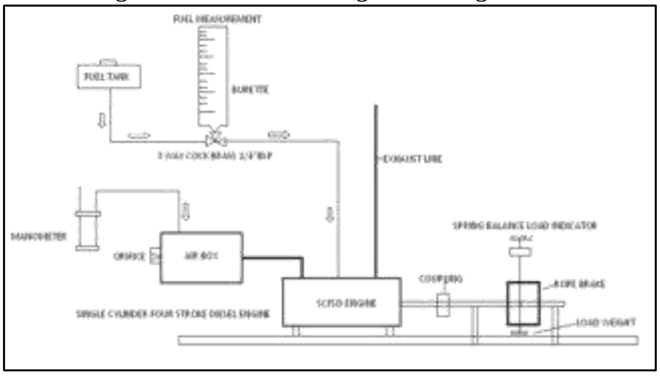

Fig. 2.1: Block diagram of single cylindrical four stroke diesel engine.

B. Experimental Precautions

1) Do not run engine without lubrication oil (oil HD-Type) in 'Lubrication oil sump.
2) Use only diesel as fuel
3) Keep the trainer on rigid surface & well-ventilated room. Keep the trainer at least 1 meter away from the nearest wall to allow sufficient air circulation.
4) Run the engine at no load for around 5 minutes. Do not remove the load suddenly. Load and unload the Engine gradually by adding weights to the weight hanger.

III. RESULTS AND DISCUSSION

A. Engine Performance Parameter Tests:

- Brake Power
- Brake thermal efficiency
- Brake specific fuel consumption
- Total fuel consumption
- Brake mean effective pressure

B. Variation of BSFC with BP for different blend of Jatropha oil with Diesel.

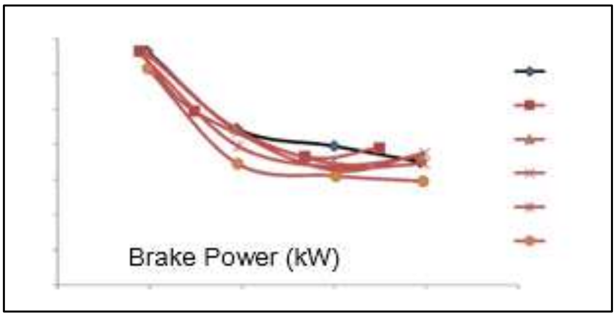

Fig. 3.1: BSFC with Brake Power for different blend of Jatropha oil and Diesel fuel

Figure 3.1 shows that variation of BSFC with BP. The curve shows that, BSFC for biodiesel blends is higher at low load and it decreases with the increase in load. It is also observed from the curve that, specific fuel consumption decreases with the increase in biodiesel blend. This is mainly due to the relationship among volumetric fuel injection system, fuel specific gravity, viscosity and heating value. As a result more biodiesel blend is needed to produce the same amount of energy due to its higher density and lower heating value in comparison to conventional diesel fuel. Again as biodiesel blends have Different viscosity than diesel fuel, so biodiesel causes poor atomization and mixture formation and thus increases the fuel consumption rate to maintain the power. In these curve are shows the B50 BSFC is lower than the other blends.

C. Variation of Brake thermal Efficiency with Brake Power for different blend of Jatropha oil with Diesel.

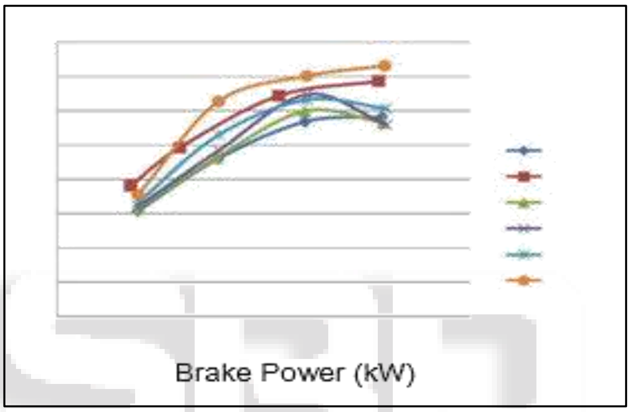

Fig: 3.2: Brake thermal Efficiency with Brake Power for different blend of Jatropha oil and Diesel fuel

Figure.3.2 shows the relation in between BP and brake thermal efficiency η for different fuels. BSFC is a measure of overall efficiency of the engine. BSFC is inversely related with efficiency. So lower the value of BSFC, higher is the overall efficiency of the engine. However, for different fuels with different heating values, the BSFC values are misleading and hence break thermal efficiency is employed when the engines are fueled with different type of fuels. From the figure, it is evident that BSFC for biodiesel blends is always higher and ηb is always lower than that of diesel fuel. This is because biodiesel has lower heating value than conventional diesel fuel. One other cause for lower ηb for biodiesel blends is the poor atomization which is attributed to higher density and kinematic viscosity of biodiesel blends.

IV. CONCLUSIONS AND SCOPE FOR FUTURE WORK

A. Conclusions

1) It has been found by using Jatropha Carcus and mustard oil with pure diesel IC engine can run with optimum performance.
2) It is also found from the experiments that 30 B Jatropha has good result as compared to 30 B mustard oil in Brake power v/s BSFC.
3) India has gone biggest importer of edible oil so it is not favour to use mustard as bio diesel.

4) Of mustard cost as higher than the cost of blending of Jatropha biodiesel.
5) Brake thermal efficiency is higher for neat diesel at all loads and lowers for blends of bio-diesel and difference of brake thermal efficiency between neat diesel and blended bio-diesel decreases as load increases.

B. Scope for Future Work

The experimental analysis it was found that the blends of Jatropha oil with diesel could be used with higher performance up to certain extent.

Analysis of composition of exhaust emission can be done with prolonged service with neat bio-diesel.

Performance of engine can be compared for various blends of biodiesel with neat diesel; present study is focused only to blend bio-diesel fuels.

By computation analysis performance parameters can be extrapolated and compared with experimental results.

Design changes can be studies and can be proposed after studying the problems encountered after prolonged service of engines with these alternate fuels.

Emission studies can also be done.

REFERENCES

[1] Ramadhas, A. S., Jayraj, S., and Muraleedharan C., 2004, "Use of vegetable oils as I. C. engine fuels – A review", Renewable Energy, (29), 727-742.
[2] Report of the committee on development of BIO-FUEL (2003), Planning commissions, Govt. of India.
[3] Srivastava A., and Prasad R., 2000, "Tryglycerides based diesel fuels", Renewable and Sustainable Energy Review, 4(2), 111-113.
[4] Kumar S., Gupta A. K., and Naik S. N., 2003, "Conversion of non-edible oil in to biodiesel", Journal of Scientific and Industrial Research, 62(1, 2), 124-132.
[5] Foidl N., Foidl G., Sannchez M., Mittelbach M. and Hackel S., Jatropha curcus L. as a source for the productions of biofuels in Nicaragua, Bioresource Technology, (1996), 58, 77-82.
[6] Ramadhas A. S., Jayraj S., and Muraleedharan C., Use of vegetable oils as I. C. engine fuels – A review, Renewable Energy (2004), (29), 727-742.
[7] Bradshaw G. B., and Meuly W. C., Process of making pure soaps. U. S. Patent No. 2, 271, 619(1942).
[8] Bradshaw G. B., and Meuly W. C., Preparation of detergents, U. S. Patent No. 2, 360, 844 (1944).
[9] Kandpal J. B., and Madan M., Jatropha curcus: a renewable source of energy for meeting future energy needs, Renewable Energy, 1995, 6(2), 159-160
[10] Barminas J. T., Maina H. M., Tahir S., Kubmarawa D., and Tsware K., A preliminary investigation into the biofuels characteristics of tiger nut (Cyper esculent us) oil, Bioresource Technology, (2001), 79, 87-89.
[11] Meher L. C., Vidya Sagar D., and Naik S. N., Technical aspects of biodiesel production by transesterification- a review, Renewable and Sustainable Energy , (2004), 1-21.
[12] Du W., Xu Y., Liu D., and Zeng J., comparative study on lipase-catalyzed transformation of soybean oil for biodiesel production with different acyl acceptors, Journal of Molecular Catalysis B: Enzymatic, (2004), 30, 125-129.
[13] Knothe G., Analytical methods used in the production and fuel quality assessment of biodiesel, Transaction of ASAE, (2001), 44 (2), 193-200.
[14] Kumar M. S., Ramesh A., and Nagalingham B., An experimental comparison of methods to use methanol and Jatropha oil in a CI engine, Biomass and Bioenergy, (2003), 25, 309-318.
[15] Kumar M. S., Ramesh A., and Nagalingham B., Use of hydrogen to enhance the performance of a vegetable oil fuelled CI engine, International Journal of Hydrogen Energy, (2003), 28, 1143-1154.
[16] Forson F. K., Oduro E. K., Donkoh E. H., Performance of Jatropha oil blends in a diesel engine, Renewable Energy, (2004), 29, 1135-1145
[17] Sharma Gaurav, 2013, Experimental Investigation of Performance Parameters of Single Cylinder IC Engine using Mustard Oil, M. Tech. Dissertation report SRCEM, Morena.

