GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

PERFORMANCE ANALYSIS OF SINGLE CYLINDER DIESEL ENGINE BY VARYING INJECTION TIMING USING MUSTARD OIL METHYL ESTER

ESWARAN.M
Lecturer, Department of Mechanical Engineering,PSNA College of Engineering And Technology.

ABSTRACT

As the fossil fuels are depleting day by day, there is a need tofind out an alternative fuel to fulfill the energy demand of theworld. Biodiesel is one of the best available sources to fulfill the energy demand of the world.In this project, the effect of injection timing and combustion of a Four stroke single cylinder (Kirloskar) diesel engine has been experimentally investigated by using Mustard oil methyl esters (further biodiesel) and regular diesel fuel. The mustard oil methyl ester was prepared from mustard oil through Transesterification process using methanol and sodium hydroxide. The flash point of biodiesel is high thus biodiesel is an extremely safe fuel to handle as compared to diesel. The calorific value of biodiesel is less than diesel fuel as it is oxygenated fuel. In the present investigation mustard oil methyl ester (MOME) as well as the blends of varying proportions of MOME(B25,B50,B75,B100) and diesel was used to run a compression ignition engine (CI) .performance of engine was investigated by using two hole nozzle and standard injection timing 20.36^0 crank angle before top dead centre (CABTDC) (STANDARD). Significant improvements in engine performance were observed. Highest brake thermal efficiency (BTE) is obtained at injection timing of 20.36^0 CABTDC at maximum load . Low brake specific fuel consumption (BSFE) is obtained at a injection timing of 20.36^0 CABTDC at maximum load.

Keywords: Mustard Oil Methyl Ester, BTE, BSFC

I. INTRODUCTION

In recent years, the demands for energy have grown very quickly due to the rapid development of certain growing economies, especially in Asia and the Middle East. The International Energy Agency (IEA) has forewarned of an oil shortage due to the imbalance between oil supply and demand. This supply deficit will have serious implications for many non-oil producing countries which are dependent on oil imports.The high energy demand in the industrialized world as well as in the domestic sector and pollution problems caused due to the widespread use of fossil fuels make it necessary to develop renewable energy sources. From the point of view of protecting the global environment and concerns for long-term energy security, it becomes necessary to develop alternative fuels with properties comparable to those that are petroleum based. The rapid depletion of petroleum reserves and fluctuating oil prices leads to the search for alternative fuels. This was the basic motivation behind the research in this paper. Non edible oils are promising fuels for agricultural applications. Vegetable oils have properties comparable to diesel and can be used to run compression ignition engines with little or no modifications. For diesel engines, a significant research effort has been directed towards using vegetable oils and their derivatives as fuels [1]. Most of the investigations reported in the literature on the usage of vegetable oil as engine fuels have emphasized modifying oil fuels to work in existing engine designs. Studies have shown that the usage of vegetable oils in neat form is possible but not preferable. The high viscosity of vegetable oils and the low volatility affects the atomisation and spray pattern of fuel, leading to incomplete combustion and severe carbon deposits, injector choking and piston ring sticking. There are a variety of methods used for improving fuel properties and decreasing viscosity and density of oils such as dilution of vegetable oils with solvents, pyrolysis, micro emulsification with alcohols and transesterification. Among the methods that have been investigated, transforming the oils to their corresponding esters proved to be the best alternative. The fuel characteristics of these esters are much closer to those of diesel fuel than the vegetable oils themselves. To reduce the viscosity, transesterification is the commonly used commercial process to produce clean and environmentally friendly fuel. However, this adds extra processing cost because of the transesterification reaction involving chemical and process heat inputs [3]. The difference between biodiesel and the diesel fuel is concerned with oxygen content. Biodiesel contains 10–12% oxygen by weight and this lowers the energy content. The lower energy content causes reductions in engine torque and power. Biodiesel containing oxygen reduces exhaust emissions such as CO, HC and Smoke mainly
due to the effect of complete combustion.

II. EXPERIMENTAL SETUP

A figure below shows the schematic diagram of the experimental setup. The set up consists of a single cylinder, four stroke Kirloskar 5Hp multi-fuelled engine coupled with an eddy current alternator for loading. Manual readings are taken for the calculation of the engine performance.

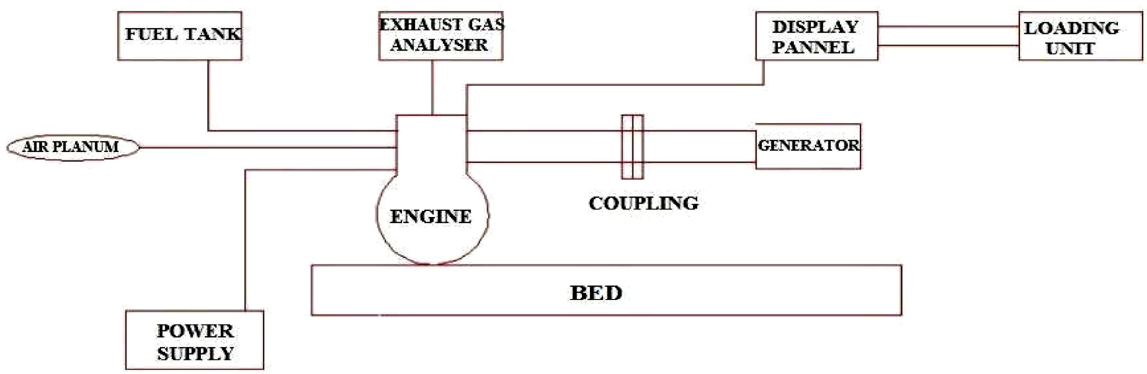

Fig.1 Line Diagram of Single Cylinder Direct Injection Diesel Engine

III. EXPERIMENTAL PROCETURE

Initially the arrangement of two hole nozzle setup is made. Keeping the cooling water flow at preset values 250 LPH and for engine cooling and exhaust gas calorimeter respectively and fuel supply intact , MCB fuse kit in off position start the engine by the starter switch or by cranking and run at no load for a few minutes (5minutes) so that engine gets warm. Select the require flow from fuel gauge and switch on and off the small toggle for the selected 5cc or 10 cc of fuel flow consumption at no load condition for which the time taken will be automatically recorded in by the computer or note down the time taken for 5cc or 10 cc of fuel flow manually operations. Note down the water flow rate from the turbine wheel floe meter and the temperature of the engine jacket exhaust gas calorimeter etc for manual operations or shift the selector switches of water flow meter and temperature indicator so that the corresponding readings will be automatically recorded in by the computer itself .simultaneous note down the readings of the ammeter, voltmeter and rpm indicator for manual operations. After no load readings were note down very carefully add bulb loading kit's electrical load by switching on off the bulb switches in steps keeping the MCB fuse kit in on position. Add the load till it reaches just above the calculated maximum load. Repeat the same procedure for each blends.

IV. RESULTS AND DISCUSSION

Performance Characteristics of Diesel Engine for Standard Injection timing using diesel and its blends as a fuel with 2-hole nozzle.

Brake thermal efficiency:

Brake thermal efficiency is defined as actual brake work per cycle divided by the amount of fuel chemical energy as indicated by lower heating value of fuel. It is well known that brake specific fuel consumption is inversely proportional to the brake thermal efficiency. Graph shows the variation of Brake Thermal Efficiency with load for MOME and its blends with Diesel in the test engine for two hole nozzle. Brake thermal efficiency of biodiesel blends was found to be slightly higher than that of diesel fuel at rated load conditions. Brake thermal Efficiency for pure MOME is higher than that of diesel. Maximum Brake thermal efficiency is obtained at 2.4 KW load. Brake thermal efficiency for pure MOME is higher by 12.80% compared to diesel at rated load as shown in graph . This is attributed to lower calorific value, high viscosity coupled with density of the fuel.

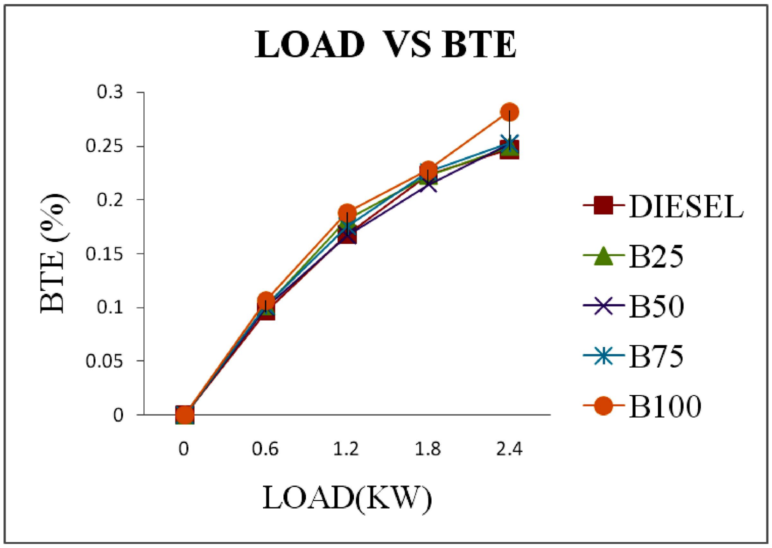

Fig.2 BTE vs Load at standard injection timing, two hole nozzle at crank angle 20.36°

Brake-specific fuel consumption:

BSFC is the ratio between mass fuel consumption and brake effective power, and for a given fuel, it is inversely proportional to thermal efficiency. Here in above graph shows the various blend of mustard oil bio diesel were compared with each at various load along with the pure diesel at different injection timing. For all injection timing the BSFC would be very closer to the standard diesel when compared to other blends. BSFC for b75 is higher by 6% compared to diesel at rated load as shown in graph .The percent increase in specific fuel consumption was increased with decreased amount of diesel in the blended fuels. This may be due to higher density and lower calorific value of the biodiesel fuel as compared with diesel.

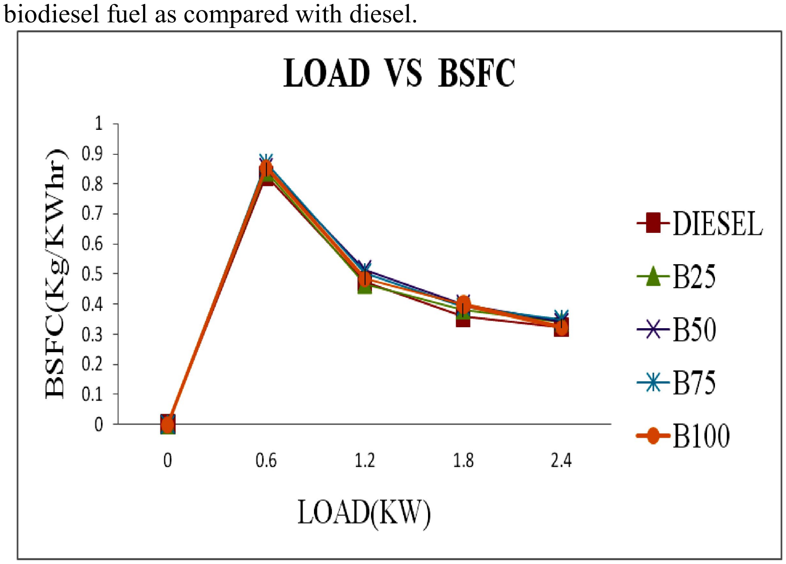

Fig. 3 BSFC vs Load at standard injection timing, two hole nozzle at crank angle 20.36°

Volumetric efficiency:

Volumetric efficiency is a ratio between the actual mass of air and theoretical mass of air. Here in above graph from 13-18 shows the various blends of MOME were compared with each at various loads along with the standard diesel at different injection timing. It was observed that volumetric efficiency of biodiesel was slightly higher than that of diesel by about 2% of standard rated engine parameter as we seen in the graph .For standard injection timing 20.36^0 higher volumetric efficiency is obtained for b100 when compared to other blends and standard diesel. For other injection timing the volumetric efficiency would be very closer to the standard diesel because of the lower viscosity and lower heating values .

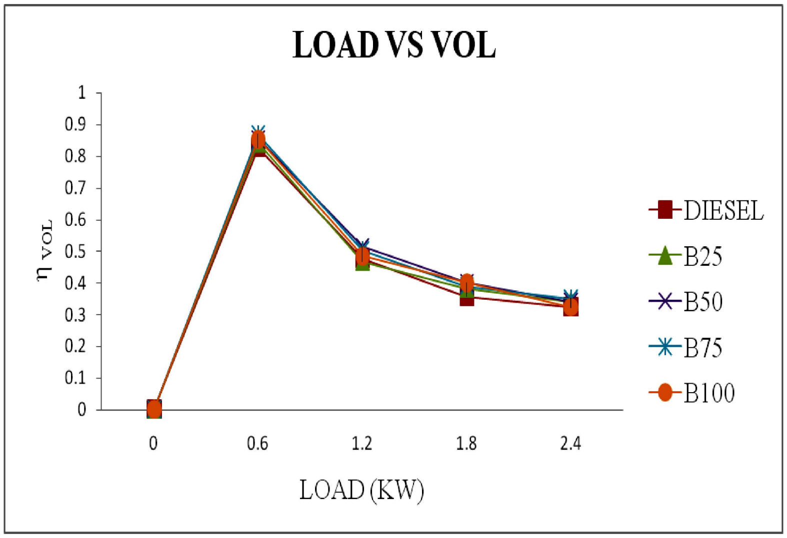

Fig.4 η_{VOL}vs Load at standard injection timing, two hole nozzle at crank angle 20.36°

Total fuel consumption:

The above graph shows the various blend of mustard oil bio diesel were compared with each at various load along with the pure diesel at standard injection timing. For standard timing the TFC would be very closer to the std diesel when compared to other blends. TFC for b75 is higher by 8% compared to diesel at rated load as shown in graph .The percent increase in TFC was increased with decreased amount of diesel in the blended fuels. This may be due to higher density and lower calorific value of the biodiesel fuel as compared with diesel.

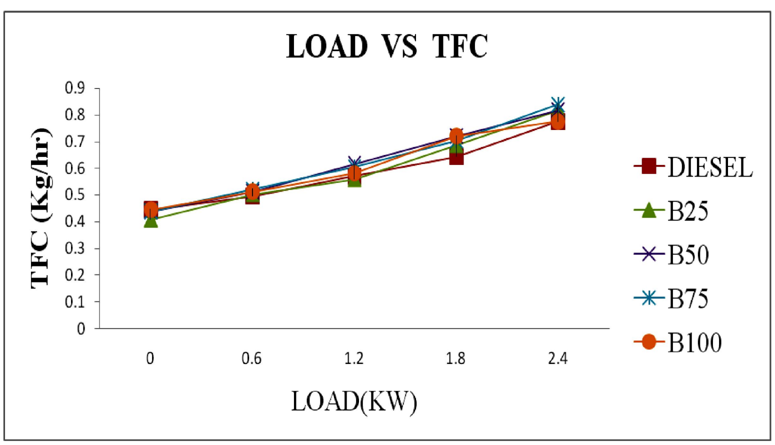

Fig.5 TFC vs Load at standard injection timing, two hole nozzle at crank angle 20.36°

V. CONCLUSION

Brake thermal efficiency of biodiesel blends was found to be slightly higher than that of diesel fuel at rated load conditions. Brake thermal Efficiency for pure MOME is higher than that of diesel. Maximum Brake thermal efficiency is obtained at 2.4 KW load. Brake thermal efficiency for pure MOME is higher by 12.80% compared to diesel at rated load.

For standard injection timing 20.36^0 higher volumetric efficiency is obtained for b100 when compared to other blends and standard diesel. For standard timing the TFC would be very closer to the standard diesel when compared to other blends. TFC for b75 is higher by 8% compared to diesel at rated load

VI. REFERENCES

1. *R. Bano, M. H. Khan, R. S. Khan, H. Rashid, and Z. A. Swati, "Development of an efficient regeneration protocol for three genotypes of Brassica juncea", Pak. J. Bot., 42(2): 963-969, 2010.*

2. *M. Lapuerta, O. Armas, J. Rodrıguez-Fernandez, "Effect of biodiesel fuels on diesel engine emissions", Progress in Energy and Combustion Science, 34 (2008), 198–223.*

3. *F. A. Khan, M. Younas, and G. Mustafa, "Metroglyph Analysis for the Yield and Quality Related Characters of Brassica juncea L", Int. J. Agri. Biol., Vol. 7, No. 2, 2005*

4. *R. Bano, M. H. Khan, H. Rashid R. S. Khan, I. Munir, Z. A. Swati, and Z Chaudhry, "Gallogenesis and organogenesis in three genotypes of Brassica juncea affected by explants source", Pak. J. Bot., 42(6): 3925-3932, 2010.*

5. *ISO 8178-1: 2006. Reciprocating internal combustion engines – Exhaust emission measurement – Part 1: Test-bed measurement of gaseous and particulate exhaust emissions.*

6. *ISO 8178-4: 2007. Reciprocating internal combustion engines – Exhaust emission measurement – Part 4: Steasy-state test cycles for different engine applications.*

7. *Sharma YC, Singh B, Upadhyay SN. Advancements in development and characterization of biodiesel: a review. Fuel 2008;87:2355–73.*

8. *Carraretto C, Macor A, Mirandola A, Stoppato A, Tonon S. Biodiesel as alternative fuel: experimental analysis and energetic evaluations. Energy 2004;29:2195–211.*

9. *Hu ZY, Tan PQ, Yan XY, Lou DM. Life cycle energy, environment and economic assessment of soybean-based biodiesel as an alternative automotive fuel in China. Energy 2008;33:1654–8.*

10. *Candeia RA, Silva MCD, Filho JRC, Brasilino MGA, Bicudo TC, Santos IMG, et al. Influence of soybean biodiesel content on basic properties of biodiesel–diesel blends. Fuel 2009;88:738–43.*