Performance Of Diesel Engine By Using Pongamia Oil As Biodiesel Along With Piston Coating

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Abstract— In the earth resources like fossil fuels are limited which causes to energy Crisis in the upcoming years. This makes the researchers us to investigate the alternative fuels. India have different types of edible and non-edible oilseeds, they have a potential of overcoming the energy crisis. Pongamia is the highly yields and cultivated plants. This article investigates the performance for diesel engine by using pongamia blend. And also, piston is coated with $MgZrO_2$ to increase the performances of the engine. indicated thermal efficiency, Brake thermal efficiency, mechanical efficiency and brake specific fuel consumption are found and compared .it was found that with 20% of pongamia blend having minimum BSFC with maximum brake thermal efficiency. It is suggested to use 20% pongamia oil blend without any engine modification.

KEY WORDS- Pongamia oil, piston coating, engine performances.

1 INTRODUCTION

The world is presently confronted with twin crisis of fuel depletion and environment degradation. Indiscrimination extraction and lavish consumption of fossil fuels [1] have led to reduction in underground-based carbon resources. The search for alternative fuels, which promise a harmonious correlation with sustainable development, energy conservation, efficiency an environmental preservation [2] has become highly pronounced in present context. Even though new technologies have come up which have made solar, wind or tidal energy sources are easily usable but still they are not so popular due to problems and integration with the existing technology and processes. Gasoline and diesel driven automobiles are main reason for global warming. Various bio fuel energy resources are explored include biomass, biogas, primary alcohol, vegetable oils as blends with diesel, bio-diesel etc. Vegetable oils are good alternatives to fossil fuels for use in diesel engines. They are renewable in nature ad may generate opportunities for rural employment when employed on large scale. Since vegetable properties are similar to diesel, they can be used to run compressed ignition engines with little or no modifications. These alternatives resources are environment friendly but they need to be evaluated case to case basis for their advantages, disadvantages, properties, specific applications. Some of these fuels can be used directly while others are needed to be formulated to bring the relevant properties closer to conventional fuels. Due to recent widespread use of fuels in various sectors, this study concentrates on accessing the viability of using alternative fuels in the existing internal combustion engines without any modifications. An acceptable alternative fuel for engine has to fulfill the environment and energy security needs without sacrificing operating performance. Vegetable oils can be successfully used in CI engines without engine modifications and fuel modifications. Technologies must be developed for the use of vegetable oils as an alternative fuel. Vegetable oil cannot be used directly in its raw form in engine. So blends are made with diesel called bio-diesel. System design approach has taken care to see that these modified fuels can be utilized in the existing diesel engine without substantial hardware modification. Vegetable oils are nontoxic renewable sources of energy, which do not harm the nature. Vegetable fuels can be used as an emergency energy sources in the event of any of any petroleum shortages. Extensive studies on alternative fuels for diesel engines have been carried out since the fossil-based fuels are limited. Common vegetable oils are sunflower, cottonseed, olive, soybean, corn, nut etc.

1.1 PONGAMIA OIL

In this paper we used the pongamia oil, the physical properties of pongamia are given below

Properties	Pongamia oil
Density (Kg/m^3)	895
Viscosity (mm^2/s)	33.8
Flash point (°C)	90
Calorific value (MJ /kg)	39.323

1.2 PISTON COATING

Figure 1: plain piston

Figure 2 : $MgZrO_2$ coated piston

Thermal barrier coatings are duplex systems consisting of a ceramic topcoat and a metallic intermediate bond coat. Thermal barrier coatings help to achieve higher efficiency of combustion engines (internal combustion engines and gas turbine engines) due to an increase of their operating temperature. The topcoat consists of ceramic material whose function is to reduce the temperature of the underlying, less heat resistant metal part. The bond coat is designed to protect the metallic substrate from oxidation and corrosion and promote ceramic topcoat adhesion

1.3 NOTATIONS

PB = PONGAMIA BLEND
BHP = BRAKE HORSE POWER
BSFC = BRAKE SPECIFIC FUEL CONSUMPTION

1.2 BLENDS

The main aim of this project work is to evaluate performance characteristics of diesel and blends in CI engine. The procedure is to calculate performance characteristics with pure (100%) diesel and then compare the performance with blends. This procedure is conducted with and without piston coating.

1) Diesel Blends:

a. Pure diesel (100%)
b. Diesel (80%) + PB (20%)
c. Diesel (60%) + PB (40%)
d. Diesel (40%) + PB (60%)
e. Diesel (20%) + PB (80%)

2) Piston Coating:

a. Without piston coating
b. With piston coating (MgZrO2)

2 EXPERIMENTAL PROCEDURE

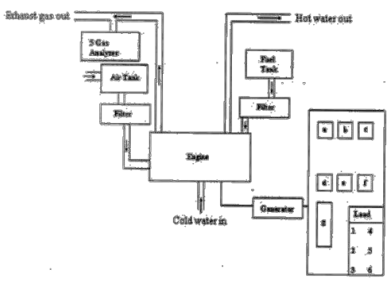

Figure 3: flow diagram

Figure 4: experimental setup

A single cylinder 4 – stroke water cooled diesel engine having 5HP as rated power at 1500 rpm was used for the present work. The engine is coupled to belt to apply mechanical loading. A photo sensor along with digital sensor is used to measure speed of the engine. The fuel flow rate is measured on volumetric basis using burette and stopwatch. Thermocouples in conjunction with a digital temperature indicator were used for measuring the engine and exhaust gas temperatures. The engine is water cooled.
The engine Specifications are
Bore 80mm
Stroke 110mm
RPM 1500
BHP 5HP
Compression ratio 16:1
Generator efficiency 0.6
Procedure of the experiment:

The various steps in doing the experiment are

The tank is filled with the fuel blend taken. The pipe should be checked that there should be no air bubbles and the pipe is connected to the engine.
The decompression lever is pressed on so that there will be no air trapping in between cylinder and the piston. Make sure the water is supplied to the engine.
Then the engine is started by rotating the crank by means of hand crank lever by throwing of the decompression lever at sufficient speed.
The engine is allowed to pick up the speed and run at speed, smoothly for a few seconds.
Record the time taken for 10cc of fuel consumption at no load and the manometer reading on the panel board.
Then the engine is slowly loaded using belt on the drum connected to the engine. The drum is cooled with water supply.
After applying of load the time required for 10cc of fuel is measured and difference in manometer is observed.
The same procedure is repeated for different blends with plain piston and coated piston
Schematic diagram of experimental setup

3 RESULTS AND DISCUSSION

The results are obtained from plain and coated piston of all blends of pongamia oil are analyzed. The results thus obtained are compare with that of base line diesel engine. Based on the output results the discussion are presented in the following.

3.1 PONGAMIA OIL BLENDS

BRAKE THERMAL EFFICIENCY

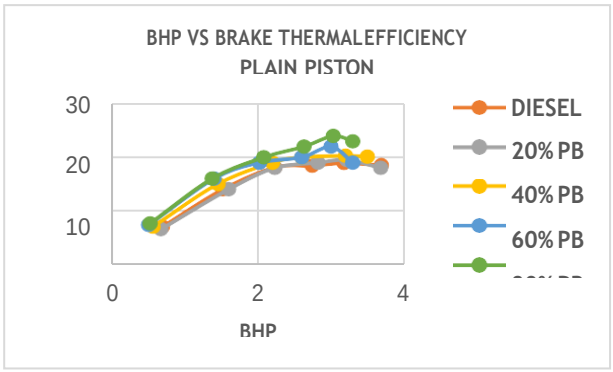

Figure 1: BHP VS Brake thermal efficiency

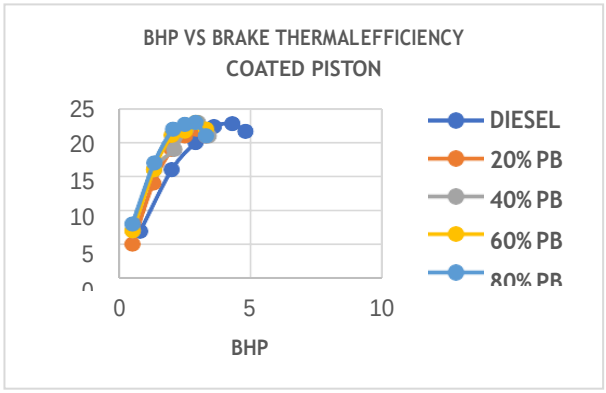

Figure 2-BHP VS Brake Thermal Efficiency

Indicated Thermal Efficiency

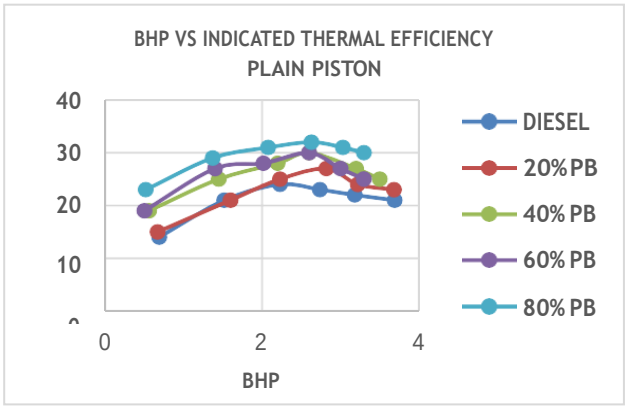

Figure 3-BHP VS Indicated Thermal Efficiency

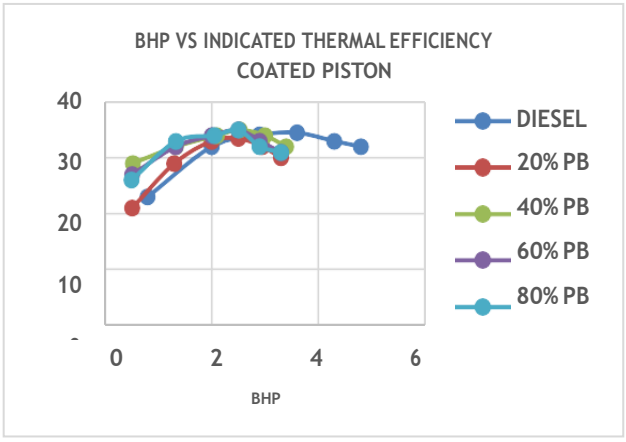

Figure 4-BHP VS Indicated Thermal Efficiency

Mechanical Efficiency

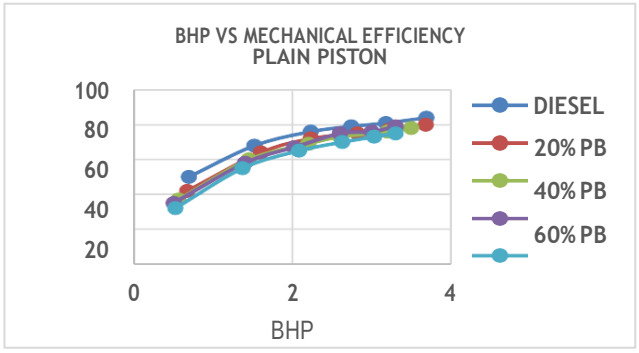

Figure 5-BHP VS Mechanical efficiency

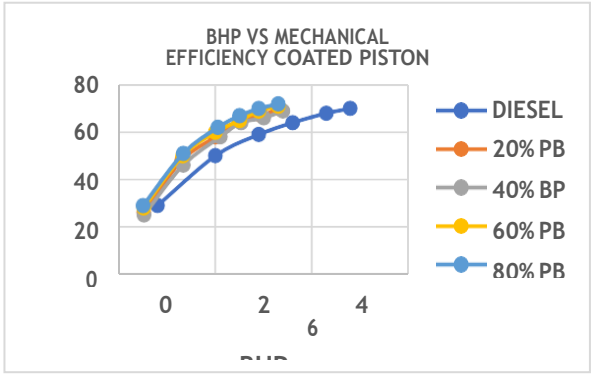

Figure 6-BHP VS Mechanical Efficiency

Brake Specific Fuel Consumption

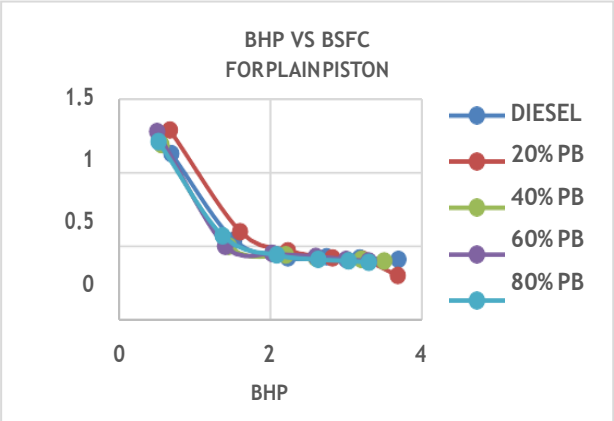

Figure 7-BHP VS BSFC

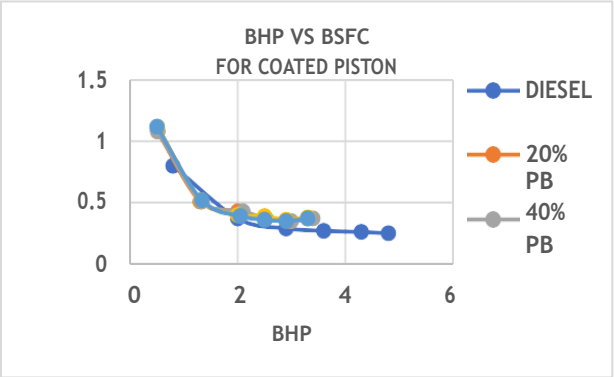

Figure 8-BHP VS BSFC

4. CONCLUSIONS

The performance of four stroke single cylinder diesel engine fueled with diesel and pongamia oil blends are evaluated with plain and coated piston respectively. The experiment results of this research work can be summarized as follows. Compared to diesel fuel, brake thermal, indicated thermal and mechanical efficiency for biodiesel blends were decreased, the BSFC values for biodiesel blends were higher when compared to diesel fuel in plain piston By using coated piston, the efficiencies of brake thermal, indicated thermal, mechanical and BSFC were increases It is recommended for the existing engine with 20% pongamia oil with 80% diesel blend without any engine modification and have beneficial effects in terms of alternative diesel fuel. Due to use of pongamia oils blended fuel economical condition of farmer can also be improved. By using above blended fuel importing of petroleum products from other country is reduced to some extent. It may help to improve the Indian economy.

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