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Research Paper

THE EFFECT OF METHANOL - GASOLINE, ETHANOL-GASOLINE AND N-BUTANOL-GASOLINE BLENDS ON THE PERFORMANCE OF 2-STROKE PETROL ENGINE

R Ramachandra[1]*, V Pandurangadu[2] and S M Jameel Basha[3]

*Corresponding Author: R Ramachandra ✉ rrcrepana@gmail.com

This experimental study investigates the effect of using unleaded gasoline and alcohol as additives blends on spark ignition engine (SI engine) performance. Two strokes, single cylinder SI engine were used for conducting this study. Performance tests were conducted for fuel consumption, brake thermal efficiency, brake power, engine power, indicated thermal efficiency and brake specific fuel consumption using unleaded gasoline and additives blends with different percentages of alcohol at varying engine load condition and at constant engine speed. The result showed that blending unleaded gasoline with additives increases the brake power, indicated and brake thermal efficiencies, fuel consumption and mechanical efficiency. The addition of 5% methanol, 5% ethanol and 5% n-butanol to gasoline gave the best results for all measured parameters at all engine torque/power values.

Keywords: Fuel additive, Gasoline-additives blend, Methanol, Ethanol, n-Butanol

INTRODUCTION

Alcohols have been suggested as an engine fuel almost since automobile was invented (Wagner *et al.*, 1979). The alcohol used to change/modify the attitude toward the present fuel, i.e., gasoline and Search for new alternatives. In this study, the first approach was selected with the aim of improving the combustion characteristics of gasoline, which will be reflected in improving the engine performance and that is done by mixing methanol, ethanol and n-butanol. It is the dream of engineers and scientists to increase the performance of the engine a very limited techniques are available with safety. Additives are integral part of today's fuel. Together with carefully formulated base fuel composition they contribute to efficiency and long life. They are chemicals, which are added in small quantities either to enhance fuel performance or to correct a deficiency. They can have surprisingly large

[1] Principal, S. K. D. Engineering College, Gooty, Ananthapuramu (D.T), A.P, India.

[2] Rector & Professor of JNTUA, Ananthapuramu (D.T), A.P, India.

[3] Professor and HOD of Department of Mechanical engineering, SRIT, Anantapur (D.T), A.P, India.

effects even when added in little amount (Gulder, 1979).

In recent years several researches have been carried out to the influence of methanol and ethanol on the performance of spark ignition engines. Alvydas Pikunas *et al.* (2003) presented the influence of composition of gasoline-ethanol blends on parameters of internal combustion engines. The study showed that when ethanol is added, the heating value of the blended fuel decreases, while the octane number of the blended fuel increases. Also the results of the engine test indicated that when ethanol-gasoline blended fuel is used, the engine power and specific fuel consumption of the engine slightly increase.

Effect of ethanol–unleaded gasoline blends on engine performance and exhaust emission was studied by Al-Hasan (2003). A four stroke, four cylinder SI engine (type TOYOTA, TERCEL-3A) Experimental Study of Gasoline-Alcohol Blends on Performance of Internal Combustion Engine 17 was used for conducting the study. The study showed that blending unleaded gasoline with ethanol increases the brake power, torque, volumetric and brake thermal efficiencies and fuel consumption, while it decreases the brake specific fuel consumption and equivalence air-fuel ratio. The 20% vol. ethanol in fuel blend gave the best results for all measured parameters at all engine speeds.

Abu-Zaid *et al.* (2004) introduced an experimental study to investigate into the effect of methanol addition to gasoline on the performance of spark ignition engines. The performance tests were carried out, at variable speed conditions, over the range of 1000 to 2500 rpm, using various blends of methanol-gasoline fuel .It was found that methanol has a significant effect on the increase the performance of the gasoline engine. The addition of methanol to gasoline increases the octane number, thus engines performance increase with methanol-gasoline blend can operate at higher compression ratios.

Experimental Study of Exhaust Emissions and Performance Analysis of Multi Cylinder S.I.Engine When Methanol Used as an Additive studied by Mallikarjun and Venkata Ramesh Mamilla (2009). Experimental study in four cylinders, SI engine by adding methanol in various percentages in gasoline and also by doing slight modifications with the various subsystems of the engine under different load conditions. For various percentages of methanol blends (0-15) pertaining to performance of engine it is observed that there is an increase of octane rating of gasoline along with increase in brake thermal efficiency, indicated thermal efficiency and reduction in knocking.

Balaji (2010) introduced influence of isobutanol blend in spark ignition engine performance operated with gasoline and ethanol. A four stroke, single cylinder SI engine was used for conducting this study. Performance tests were conducted for fuel consumption, volumetric efficiency, brake thermal efficiency, brake power, engine torque and brake specific fuel consumption, using unleaded gasoline and additives blends with different percentages of fuel at varying engine torque condition and constant engine speed. The result showed that blending unleaded gasoline with additives increases the brake power, volumetric and brake thermal efficiencies and fuel consumption addition of 5% isobutanol and 10% ethanol to gasoline gave the best results for all measured parameters at all engine torque values. In this paper we studied the effect of ethanol gasoline blend, ethanol–gasoline blend and

mixture ethanol-methanol–gasoline blend, also compare between them.

By considering the environmental and the financial consideration, an attempt has been made to increase the performance of the engine by dealing with the alcohol additives. The engine performance analysis measured, running the engine at varying load and constant speed. Hopeful results were obtained and the work carried out is presented.

Statement of the Problem

As the two stroke engines are using different types of fuels like petrol, diesel, gas, etc. In current days the use of two stroke petrol engines is reduced because of emission of harm full gasses, maximum fuel consumption, less efficient. To overcome these difficulties the methanol, ethanol and n-butanol are used as an additive with gasoline to increase the performance of engine and minimize the fuel consumption.

Objective of the Study

The objective of the study is to analyze the performance of the two stroke petrol engine using methanol, ethanol and n-butanol as an additive with the gasoline so as to overcome the above stated difficulties.

Scope of the Study

To increase the performance of the two stroke petrol engine the methanol, ethanol and n-butanol been used as an additive with gasoline. The readings obtained from the conducted tests have been evaluated and the results and graphs are compared.

EXPERIMENTAL SET UP AND PROCEDURE

The engine is 150 cc 2 strokes, single cylinder SI engine loaded by a rope toll dynamometer. Table 1 lists some of the important specification of the engine under test. The schematic layout of the experimental set up is shown in Figure 1. Fuel consumption was measured by using a calibrated burette and a stopwatch with an accuracy of 0.2 sec.

Table 1: Engine Specifications

S. No.	Description	Data
1	Type of engine	Two stroke cycle, single acting air cooled petrol engine
2	No. of cylinder	Single cylinder
3	Max B.P	7.48 HP (5.93 Kw)
4	Max speed	5200 rpm
5	Direction of rotation	Clock wise
6	Bore diameter	57 mm
7	Stroke length	57 mm
8	Cubic capacity	145.45 cc

Figure 1: Experimental Setup for the Effect of Methanol-Gasoline, Ethanol-Gasoline and n-Butanol-Gasoline Blends

Specifications of Other Device and Fluid Used in Experiment

1. Co-efficient of discharge of orifice = 0.6
2. Orifice diameter = 20 mm
3. Density of petrol = 720 Kg/m^3
4. Density of water = 1000 Kg/m^3
5. Calorific value of petrol = 48000 KJ/Kg
6. Calorific value of methanol = 22700 KJ/Kg

7. Calorific value of ethanol = 29700 KJ/Kg
8. Calorific value of n-butanol = 33075 KJ/Kg

The engine was started and allowed to warm up for a period of 15-20 min. The fuel consumption was constant at 10 cc for each performance. Engine test were performed by constant speed and varying the loading condition for each individual fuel. Before running the engine to a new fuel blend, it was allowed to run for sufficient time to consume the remaining fuel from the previous experiment. For each experiment, four runs were performed to obtain an average value of the experimental data.

EXPERIMENTAL DATA

Table 2: For Petrol

Wt in Kg	Speed in rpm N	Time to Consume 10 cc of Fuel in sec	Manometer Reading		
			H1 in cm	H2 in cm	Hw = H1-H2 in mt
2	2950	55	15.1	14.8	0.003
4	2470	53	15.1	14.8	0.003
6	2325	49	15.1	14.8	0.003
8	2200	44	15.1	14.8	0.003

Table 3: For M-5

Wt in Kg	Speed in rpm N	Time to Consume 10 cc of Fuel in sec	Manometer Reading		
			H1 in cm	H2 in cm	Hw = H1-H2 in mt
2	2745	49	15.1	14.8	0.003
4	2150	44	15.1	14.8	0.003
6	1975	41	15.1	14.8	0.003
8	1850	38	15.1	14.8	0.003

Table 4: For E-5

Wt in Kg	Speed in rpm N	Time to Consume 10 cc of Fuel in sec	Manometer Reading		
			H1 in cm	H2 in cm	Hw = H1-H2 in mt
2	2700	59	15.1	14.8	0.003
4	2450	56	15.1	14.8	0.003
6	2340	52	15.1	14.8	0.003
8	2150	49	15.1	14.8	0.003

Table 5: For B-5

Wt in Kg	Speed in rpm N	Time to Consume 10 cc of Fuel in sec	Manometer Reading		
			H1 in cm	H2 in cm	Hw = H1-H2 in mt
2	2550	61	15.1	14.8	0.003
4	2100	57	15.1	14.8	0.003
6	2000	54	15.1	14.8	0.003
8	1950	51	15.1	14.8	0.003

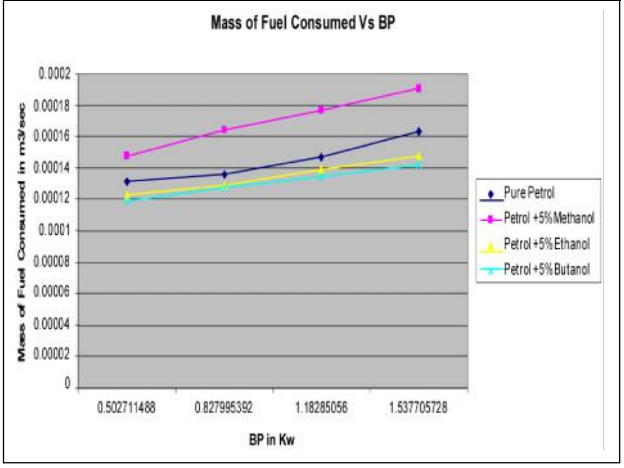
RESULTS AND DISCUSSION

The effect of methanol, ethanol and n-butanol addition to unleaded gasoline on SI engine performance at various engine powers was investigated.

Fuel Consumption

The effect of methanol, ethanol, n-butanol-unleaded gasoline blends on the fuel consumption is shown in Figure 2. From Figure 2, the fuel consumption increases on the engine power increases at engine speed. This behavior is

Figure 2: Fuel Consumption vs Brake Power at Various Loads

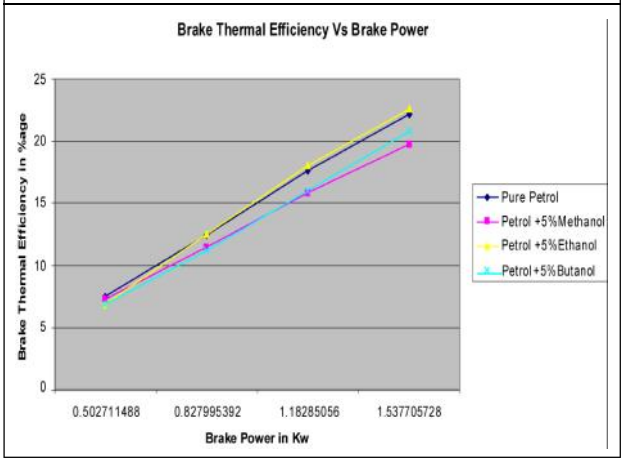


attributed to the Lower Heating Value (LHV) per unit mass of the alcohol fuel, which is distinctly lower than that of the unleaded gasoline fuel. Therefore the amount of fuel introduced in to the engine cylinder for a given desired fuel energy input has to be greater with the alcohol fuel

Brake Thermal Efficiency

Figure 3 presents the effect of methanol, ethanol and n-butanol-unleaded gasoline blends on brake thermal efficiency. As shown in the figure break thermal efficiency increases as the engine torque increases. The maximum brake thermal efficiency is recorded with 5% ethanol in the fuel blend at constant engine speed.

Figure 3: Brake Thermal Efficiency vs Brake Power at Various Loads



Specific Fuel Consumption

The effect of using methanol, ethanol and n-butanol-unleaded gasoline blends on Brake Specific Fuel Consumption (BSFC) is shown in Figure 4. As shown in the figure SFC decreases as the engine torque increases. This is normal consequence of the behavior of the engine brake thermal efficiency.

Mechanical Efficiency

The effect of using methanol, ethanol and n-butanol -unleaded gasoline blends on Mechanical

Figure 4: Specific Fuel Consumption (BSFC) vs Brake Power at Various Loads

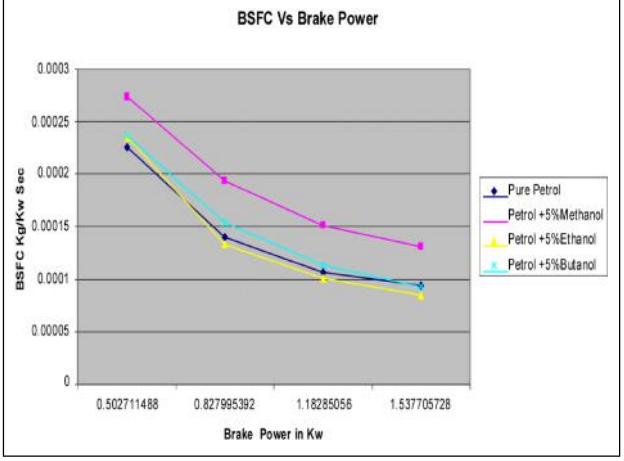
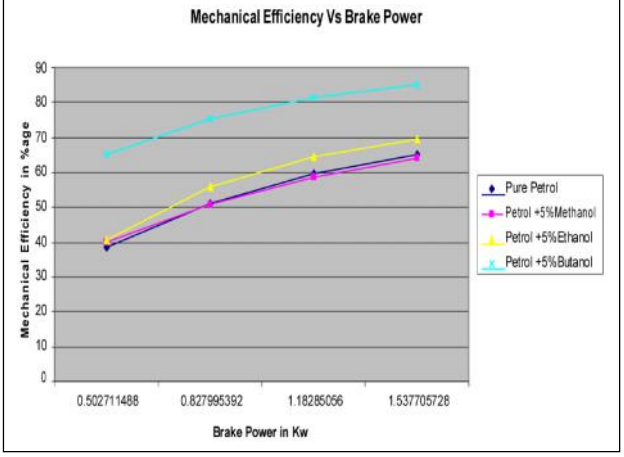


Figure 5: Mechanical Efficiency vs Brake Power at Various Loads

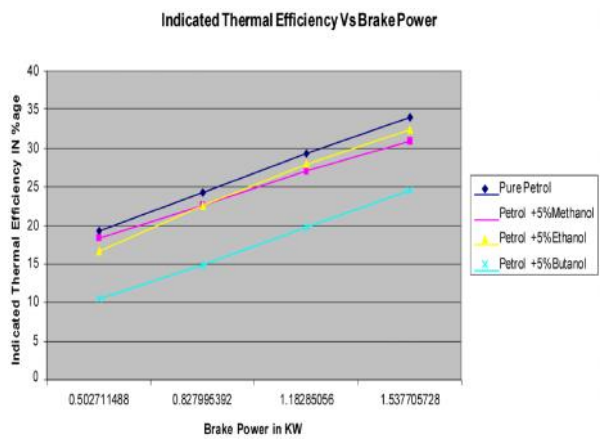


efficiency is shown in Figure 5. As shown in the figure efficiency increases as the engine torque increases. The comparison of efficiency after adding the additive is given below. As the percentage of additives increases in the gasoline, the performance of the engine increases.

Indicated Thermal Efficiency

Figure 6 presents the effect of methanol, ethanol and n-butanol -unleaded gasoline blends on indicated thermal efficiency. As shown in the figure indicated thermal efficiency increases as the engine torque increases. The minimum brake

Figure 6: Indicated Thermal Efficiency vs Brake Power at Various Loads



thermal efficiency is recorded with 5% n-butanol in the fuel blend at engine speed.

CONCLUSION

From the results of the study, the following conclusions can be deduced:

1. Using methanol, ethanol and n-butanol as a fuel additive to unleaded gasoline causes an improvement in engine performance.
2. Methanol, ethanol and n-butanol addition to gasoline results in an increase in brake power, brake thermal efficiency, volumetric efficiency, and fuel consumption respectively.
3. The addition of 5% methanol, 5% ethanol and 5% n-butanol to the unleaded gasoline is achieved in our experiments without any problems during engine operation.

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Hyderabad, INDIA. Ph: +91-09441351700, 09059645577
E-mail: editorijlerst@gmail.com or editor@ijerst.com
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