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CONTROLL OF EXHAUST EMISSIONS BY USING BI METALLIC PISTON IN TWO STROKE SPARK IGNITION ENGINE

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Abstract: **The experimental study investigates to control the exhaust emissions from the two stroke single cylinder spark ignition engine using unleaded gasoline and alcohol additive blends on the SI engine (20% methanol, 80% gasoline and 20% ethanol, 80% gasoline by volume respectively) to control carbon mono oxide (CO) and UN burnt hydro carbons (UBHC). These pollutants are hazardous to the nature and cause of health problems to human beings but also impact on the environment. The aluminum and copper plates of 1.5mm thickness is fixed on the piston crown with the help of rivet arrangement. A microprocessor based analyzer is used for the measurement of CO and UBHC in the exhaust engine. The work done on the SI engine is fuelled with methanol and ethanol blends of proportions are 20% and compared with the conventional engine and bi metallic piston engine and to find the performance (break thermal efficiency, specific fuel consumption etc..,) and emission characteristics. The bi metallic piston with alcohol blended gasoline is considerably reduced emissions of CO and UBHC and increased in the engine performance characteristics when compared to the conventional engine (base piston).**

Key words: Bi metallic piston, Engine performance, Gasoline.

1. INTRODUCTION

The engines used for an alternative fuels are used modified engines which were originally designed for gasoline fuelling. Only when extensive research and developedin done over a period of years, maximum performance and efficiency can be realized from these engines. However the research and development is difficult to justify until the fuels are accepted as variable for large numbers of engine.

The engines areruns with the gasoline, the emissions of carbon mono-oxide (CO) and the UN burnt hydrocarbons (UBHC) are releasing from the exhaust manifold. These CO and UBHC are the major exhaust emissions formed due to the incomplete combustion of the fuel, which causes many dangerous human health disorders and also impact on the environment. The life period and maintenance of the engine are some of the reasons for the formation of the pollutants. Alcohols are preferred to IC engines because they are easily to store and have reasonably good calorific value.

Liquid fuels are the good alternative fuels and alcohols are suggested as an alternative fuels to the engine since the emissions are forming from the engine, when automobile was invented. The alcohol used to change/modify the attitude toward the present fuel. The aim of this paper is to reduce the emissions, improving the combustion characteristics of gasoline, which will be reflected in improving the engine performance characteristics (brake thermal efficiency, fuel consumption etc..,). Methyl alcohol (methanol) and Ethyl alcohol (ethanol) are two kinds of alcohol that seem most promising. When blending of the ethyl alcohol and methyl alcohol with the gasoline by volume respectively (20%).

It is the dream of engineers to increase the engine performance of the engine a very limited techniques are available are available with safety. Additives are integral part of the today's fuel. Together with carefully formulated base fuel consumption they contribute to efficiency and long life. They are chemicals, which are added in small quantities either to enhance fuel performance or to correct the deficiency.

They can have surprisingly large effects even when added in little amount. 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.

*1.1 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. To overcome these difficulties the methanol and ethanol are used as an additive with gasoline to increase the performance of engine and minimize the fuel consumption.

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*1.2 Objective of the study:*The objective of the study is to analyze the performance of the two stroke petrol engine using methanol and ethanol as an additive with the gasolineso as to overcome the above stated difficulties.

*1.3 Scope of the study:*To increase the performance of the two stroke petrol engine the methanol and ethanol been used as an additive with gasoline. The readings obtained from the conducted tests have been evaluated and the results and graphs are compared.

2. LITRATURE SURVEY

In recent years several researches have been carried out to the influence of the ethanol and the methanol on the performance of the spark ignition engines on the piston coatings.T.O. Wagner, D.S. Gray, B.Y. Zarah, and A.A. Kozinski[1]:Alcohols have been suggested as an engine fuel almost since automobile was invented. The alcohol used to change/modify the attitude towards the present fuel, i.e., gasoline and Search for new alternatives. 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. This paper investigates the performance parameters like brake thermal efficiency, volumetric efficiency, brake specific fuel consumption and emission characteristics like NOX, UBHC, CO etc.M .Al-Hasan[2]: Effect of ethanol–unleaded gasoline blends on engine performance and exhaust emission was studied by M .Al-Hasan. A four stroke, four cylinder SI engine (type TOYOTA, TERCEL-3A) Experimental Study of Gasoline –Alcohol Blends on Performance of Internal Combustion Engine 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. Balaji [3]: Introduced influence of ethanol and methanol blend in spark ignition engine performance operated with gasoline and ethanol .A four strokes, 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 20%, methanol and 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. The emission results showed that while blending unleaded petrol, the HC content is lowest for petrol-87.5%+ ethanol 10% + isobutene 2.5%.The addition of blends didn't decrease the performance of the engine.Murthy, P.V.K., Narasimha KumarS., Murali Krishna, M.V.S., Seshagiri Rao, V.V.R. and .Reddy, DN[4**]:** The present paper reported the control of emissions of CO, UBHC, and aldehydes from the exhaust of two-stroke SI engine with alcohol blended gasoline in different configurations of the engine with catalytic converter with different catalysts such as sponge iron (S) and manganese ore (M) and compared with pure gasoline operation on CE. The performance of the catalyst was compared with one over the other. M .Abu-Zaid, O .Badran, and J.Yamin[5]: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.

Bi metallic piston is the new concept which has taken from the reference of piston coatings with alcohol additives in the gasoline by volume respectively.

3.EXPERIMENTAL SETUP AND PROCEDURE

The engine is Suzuki max 100, of 100CC engine, single cylinder, air cooled spark ignition engine, with electrically loaded dynamometer. The engine specifications are listed below. The systematic layout experimental setup as shown in the below figure. The bi metallic piston and arrangement of the bi metallic piston in to the engine cylinder is shown in below. The fuel consumption was measured by using calibrated burette and stop watch with an accuracy of 20CC fuel consumption.

Preparation of bi metallic piston:

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Fig: 1 Bi metallic piston

From the figure 1, the piston is fixed to the lathe machine, for removing the material from the piston crown up to the required thickness. The aluminum plates and copper platescutin to piston diameter, and then plates are placed on the piston. The holes are drilled for the fixing with the help of rivet joints.

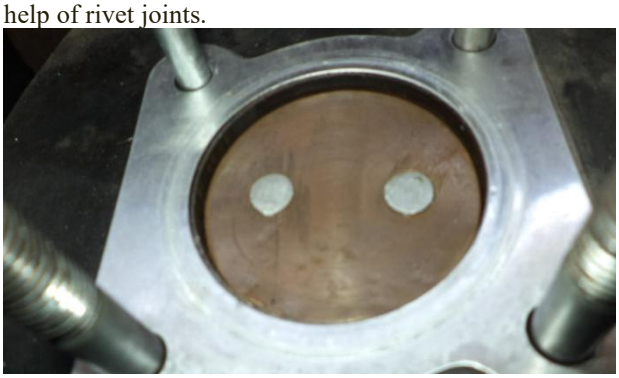

Fig: 2 Bi metallic piston arrangements

TABLE1

TEST ENGINE SPECIFICATIONS

ITEM	SPECIFICATIONS
Engine	Single cylinder 2-stroke S.I engine
Cylinder bore	50.5mm
Stroke length	50.5mm
Engine speed	5000 rpm
Compression ratio	6.7:1
Type of cooling system	Air cooling

3.1 Specifications of other devises and fluid used in experiment:

Density of petrol: 720 kg/m^3

Density of water: 1000 kg/m^3

Calorific value of petrol: 48000 KJ/kg

Calorific value of methanol: 22700 KJ/kg

Calorific value of ethanol: 29700 KJ/kg

BLENDS	CALORIFIC VALUE (KJ/kg)	DENSITY (kg/m^3)
M20	38781.72	852.25
E20	43062.88	849.25

Fig: 3 Experimental setup

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.

The test procedure will be followed on basic piston and bi metallic piston

- The engine was started and allowed to warm up for a period of 15-20 min.
- The first test will be conduct on the pure gasoline at different loads.
- The fuel consumption was constant at 20CC for each performance.
- The next test will be conduct on the ethanol blended gasoline of proportions 20% and collect the 20cc fuel consumption, current, voltage, and emissions test will be conduct at different loads of the blended gasoline (ethanol gasoline) proportions 20%.
- The next test will be conduct on the methanol blended gasoline of proportions 20% and collect the 20cc fuel consumption, current, voltage and emission test will be conduct at different loads of the blended gasoline (methanol gasoline) proportion of 20%.
- For each experiment, four runs were performed to obtain an average value of the experimental data.

The above test procedure will be followed for the both base piston and bi metallic piston [10].

4RESULTS AND DISSCUSSION

1) We are using the copper plate on the piston crown as a bi metallic piston because copper or its alloys are acted as a catalyst in combustion chamber, where by facilitated effective combustion of fuel leading to formation of CO_2 instead of CO and copper is also a ductile metal with very high thermal conductivity and electrical conductivity [6].
2) The function of rivets in a joint is to make a connection that has strength and tightness. The strength is necessary to prevent failure of the joint. The tightness is necessary in order to continue to strength. When two

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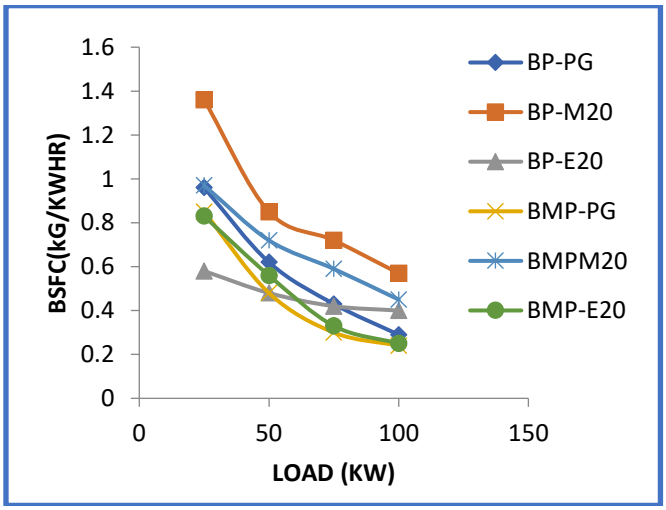
plates are to be fastened together by a rivet the holes in the plates are punched and reamed or drilled [7] .

3) Methanol dissociates in the combustion chamber of the engine forming hydrogen, which helps the fuel-air mixture to burn quickly and thusincreases combustion velocity, which brings about complete combustion of carbon present in the fuel to $CO_2$and also CO to CO_2 thus makes leaner mixture more combustible, causing reduction of CO emissions [8].
4) When ethanol mixes with the gasoline during the combustion ethanol reactswith oxygen toproduce carbon dioxide, water and heat [9].
$C_2H_5OH+3O_2 \rightarrow 2CO_2+3H_2O+Heat.$

Results:

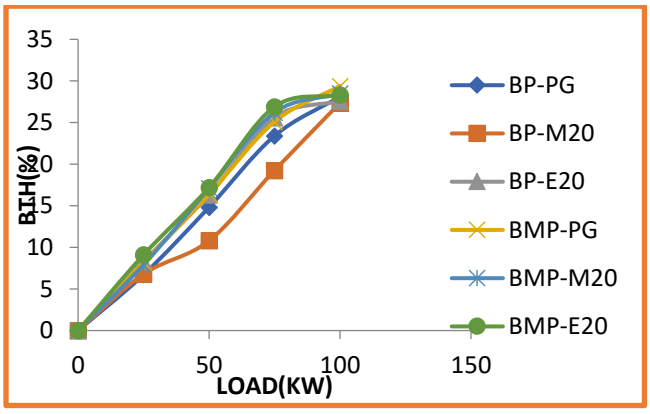
Load Vs BSFC



*Specific fuel consumption:*The effect of using methanol and ethanol unleaded gasoline blends on brake specific fuel consumption (BSFC) is shown in the load vs. BSFC graphs. From the graphs SFC decreases as the engine torque increases.

From the graphs by using ethanol and methanol on base piston and bi metallic piston with the proportions of 20% and pure gasoline , the gradual decreasing of the specific fuel consumption when comparing to the base piston and bi metallic pistonthe overall fuel consumption is decreased by 10- 12% to the bimetallic piston than the base piston.

Load Vs break thermal efficiency

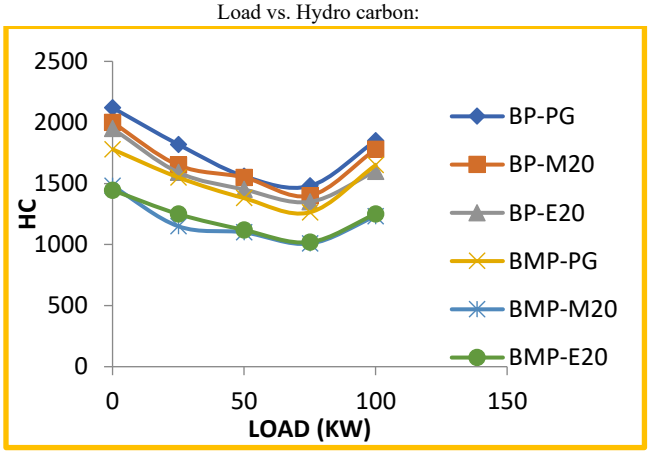


Brake thermal efficiency:

The effect of using the ethanol and methanol on gasoline blends on brake thermal efficiency is shown in the load vs. brake thermal efficiency. As shown from the graphs the brake thermal efficiency increases by using the ethanol and methanol.

The overall brake thermal efficiency is increased by 1.02% when comparing the base piston to bimetallic piston with the blends of ethanol and methanol of 20% and pure gasoline.

Load vs. Hydro carbon:



*UN burnt hydrocarbon emissions:*The measured unburned hydro carbon emissions for base piston and bi metallic piston are shown in the figures load vs. HC emissions. By using the blends of ethanol and methanol of proportions 20% the decrease of the UBHC emissions of bi metallic piston when compared to basepiston. Because at high temperature, Engine will have sufficient amount of oxygen, which mixes with HC emissions. As a result HC will split in to H and C which mixes with O_2 thereby reducing the HC emissions.

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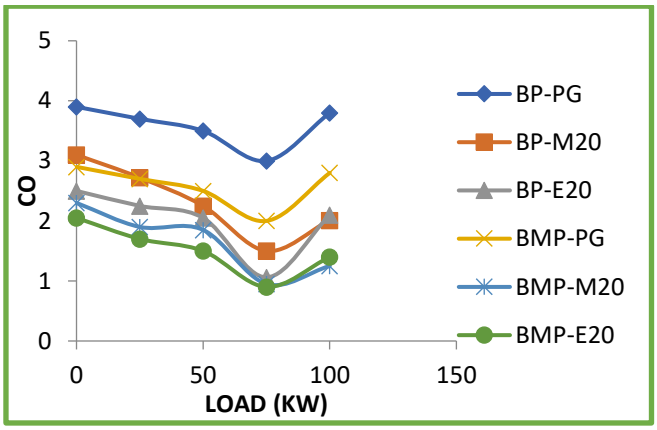

*Carbon mono oxide emissions:*The emissions of CO for various loads, it is found that the CO emissions are decreased in bi metallic piston when comparing to the base piston due to complete combustion. At high temperature C easily combines with O2 and reduces CO emission. This range of difference is maintained up to 60% of the load then the CO emissions are increased in the base piston.

5.CONCLUSIONS

Experiment is conducted on two-stroke spark ignition engine by using bimetallic piston run with methanol blended gasoline and ethanol blended gasoline (methanol blended and ethanol blended with gasoline by volume respectively). The carbon mono oxide (CO) emissions, un-burnt hydrocarbons (UBHC) emissions are controlled. Hence control of these pollutants call for immediate attention. Aluminium and copper plates of some thickness fixed on piston crown with help ofrivetarrangedBi metallic piston in two stroke single cylinder spark ignition engine.
The following are the conclusions can be drawn from the experiment

- Brake specific fuel consumption is reduced about 10-12% of bi metallic piston engine fuelled with ethanol and methanol blends when compared to normal engine.
- Brake thermal efficiency of bi metallic piston engine increased by 1.1% tested with ethanol and methanol blends when compared to normal engine.
- There is linear variation in the mechanical efficiency of bi metallic piston engine and normal
- By using the blends of ethanol and methanol of proportions there decrease of the UBHC emissions of bi metallic piston when compared to base piston.
- The emissions of CO for various loads, it is found that the CO emissions are decreased in bi metallic piston when comparing to the base piston due to complete combustion.

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