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Performance Analysis of Single Cylinder 4Stroke SI Engine Using Ethenol Blends With Gasoline

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ABSTRACT: Today transport system is depends upon the fossil fuels specially liquid fuel which are depleting much faster rate than production. Consumption of the fuel is increasing day by day which is affecting the economy of our country. It fuel research is completely based on finding alternative fuel. In This paper the investigation main purpose is to evaluate the performance of the engine and decrease fuel consumption by using alternative fuel on combustion in four stroke SI engine. For this experimental investigation has been conducted on four stroke spark ignition engine, fuelled with various bland of gasoline-ethanol. Experiment has been conducted ethanol-gasoline bland such as E0 (pure gasoline), E5(combination of gasoline 95% by volume, ethanol 5% by volume), E10(combination of gasoline 90% by volume, ethanol 10% by volume), E15(combination of gasoline 85% by volume, ethanol 15% by volume), E20(combination of gasoline 80% by volume, ethanol 20% by volume), E25(combination of gasoline 75% by volume, ethanol 25% by volume), E30(combination of gasoline 70% by volume, ethanol 30% by volume), E35(combination of gasoline 65% by volume, ethanol 35% by volume) and E40(combination of gasoline 90% by volume, ethanol 5% by volume), is used in the study and its effects on break power, specific fuel consumption, break thermal efficiency. In this research comprehensive review of various operating parameters use of ethanol-gasoline blends has been discussed. Result obtain from the experimental tests has been discussed too. This work investigated ethanol-gasoline blending on the performance, emission of four stroke single cylinder SI (spark ignition) engine, air cooled engine having compression ratio 2.5 is used. The advantages of using ethanol as SI engine fuel include its greenness, renewability, higher availability and usability in near future, higher octane number, and biodegradability. Ethanol can be produced biologically from sugarcane, crop residues, cellulose, agricultural biomass, municipal waste etc.

KEYWORDS: SI engine, Ethanol, alternate fuel, petrol blend, gasoline, Performance.

I. INTRODUCTION

World population increasing day by day, that increased demand of vehicles and industries, which consume fossil fuel. Fossil fuel reserves are limited in nature and they are going to be depleted in next some decayed, if these limited reserves used to fulfill the demand of industries and transportation. The cost of petroleum products have increased dramatically due to this increased demand of petroleum products. Increased demand and cost of petroleum products increases the attention of researchers in this field of alternative fuels in recent years. Ethanol is good alternative fuel for spark ignition engines and reduces the hazardous emission products from the engine as compared to the conventional fuel, which makes ethanol eco-friendly.

Ethanol is an alcohol made through the fermentation of plant sugars from agricultural crops and biomass resources. The most common agricultural crop utilized for ethanol production is corn. Only a portion of the feedstock is needed for ethanol production and the remainder can be used for animal feed, corn oil, or other products. Ethanol is a clear, colorless chemical compound made from the sugars found in crops such as corn, sugar beets and sugar cane. Ethanol is knows as most attractive alternative fuel because of its properties like high octane number and flame speed among all the alcohols. It can be produces from renewal energy resources like agriculture feedstock. Ethanol is good alternative fuel for spark ignition engines and reduces the hazardous emission products from the engine as compared to the conventional fuel, which makes ethanol eco-friendly.

Today the large amount of pollutants emitting out from the exhaust of the automotive vehicles run on fossil fuels are increasing and these pollutants are increasing as vehicles increasing day by day. In view of heavy consumption of

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gasoline due to transport, the search for alternative fuels has become compulsory. An important step in efforts to solve the problem is to replace fossil source energy with bio energy. In the transport sector this means blending bio fuel with petroleum based fuels for use with present vehicle fleets. Ethanol is considered to be one of the most promising alternative renewable fuels. The investigation main purpose is to evaluate the performance of the engine and decrease fuel consumption by using alternative fuel in four stroke SI engine. Ethanol blend has been introduced as a clean and green renewable alternative energy for SI engine. Ethanol has some advantages over gasoline, such as high octane number and flame speed, high latent heat of vaporization thereby higher volumetric efficiency. A varied mixture of ethanol and petrol are used depends of the country into Asian countries, such as Thailand (E10), Philippines (E5 and E10) and India (E5).

Various properties of petrol and ethanol like density, ignition temperature are similar. Also the two liquids can be mixed easily without any external agent. The physical and chemical property of ethanol and petrol is shown below:

Table: 1 The physical and chemical property of ethanol and petrol

Sr. No.	Character	Ethanol	Petrol
1	Molecular weight	46.07	100-105 avg.
2	Composition by mass	w(C)=52% w(H)=13% w(O)=35%	w(C)=85% w(H)=15%
3	Sp. Gravity	0.794	0.7-0.78
4	Density Kg/m3	790	700-780
5	Boiling Temp.(^{0}C)	78	27-255
6	Freezing Point(^{0}C)	-114	-57
7	Ignition Temp (^{0}C)	423	390-420
8	Theoretical air fuel ratio (Kg/Kg of air)	9	14.7
9	Octane number	100	80-99
10	Cetane number	8	0-10

II. PREVIOUS WORK

Tiwari [1] studied experimental determination of suitable ethanol– gasoline blend rate at high compression ratio for gasoline engine. In this study, ethanol and gasoline blends ware used as fuel to improve performance in SI engine. **Sarkar at al. [2]** investigated the performance and emission characteristics of SI engine running on different ethanol gasoline blends. The purpose of this study is to experimentally analyse the performance and the pollutant emissions of a four-stroke SI engine operating on ethanol gasoline blends. **M. Al- Hasan [3]** investigated the effect of using unleaded gasoline–ethanol blends on SI engine performance and exhaust emission. **Lande and Tupkar [4]** did research on experimental investigation of using ethanol petrol blends in SI Engines. The experimental results revealed it is not only the price reduction by Ethanol blending that matters but also the millions of litres of petrol that we save for future. **Raman at al. [5]** study reveals the understanding of the engine performance characteristics and emissions production under ethanol gas petrol blending ratio and variant types of ethanol. **Ahmed [6]** study discusses the performance and exhaust emissions of a vehicle fueled with low content alcohol (methanol) blends and pure gasoline.

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III. EXPERIMENTAL WORK

A. ABOUT THE TEST RIG

1. **ENGINE-**The engine variable compression ratio, single cylinder four stroke petrol engine coupled with eddy current dynamometer.

Figure 1: Experimental setup or Test Rig

Figure 2: To making ethanol - gasoline blend

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Table 2: Engine Specifications

Sr. no.	Items	Specifications
1	Engine Make	GREAVES
2	Engine Sr. No.	G0H 6898076 SPT
3	Engine Variety	Vertical, Single Cylinder
4	Number Of Stroke	Four
5	Rated RPM	3000RPM
7	Compression Ratio	2.5:1 to10:1
8	Stroke	66.7mm
9	Bore	70mm
10	Specific Fuel Capacity	475 g/kwhr
13	Fuel Tank Capacity	5 litre
15	Starting	Hand starting
18	Lubricating Oil	SAE 20W40
19	Cooling System	Air cooling
20	Rated Power Output	2.5Kw

2. Rope Brake Dynamometer-A rope brake dynamometer is supplied with the engine coupled with the 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:

(a) 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.

(b) Temperature measurement: For heat balance analysis the PT-100 sensors are connected at exhaust gas calorimeter and engine cooling.

B MEASUREMENT METHODOLOGY

Measurement methodology includes the way and approach of taking observation during the experiment. In any experimental work there should be a proper methodology of experiment for getting proper data and results. So getting proper results the way of taking observation should be very accurate and systematically. In the particular experiment setup of four stroke SI engine measurement methodology is proceed in this way.

Testing and inspection of experiment setup

After settling all the instruments, observation is about to start but before starting any experiment on the setup it is very necessary to inspect all the places where care should be taken to avoid any danger during the observation process. The step of inspection of experiment setup is completed by checking all the important places of experiment setup in a regular time interval during whole process of taking observation. The way of inspection is described here.

a- Tightening all nuts on foundation structure coupled with engine frame.
b- Checking the level of oil in the tank to maintain proper level of oil on burette.
c- Checking the level of cooling water in water jacket.
d- Checking the leak points of oil in various gate valves where pipes are connected
e- Insure all switches kept off in electrical load panel before starting the engine.
f- Check and control speed of engine by adjusting the fuel supply before taking the observation.

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IV. RESULTS AND CALCULATIONS

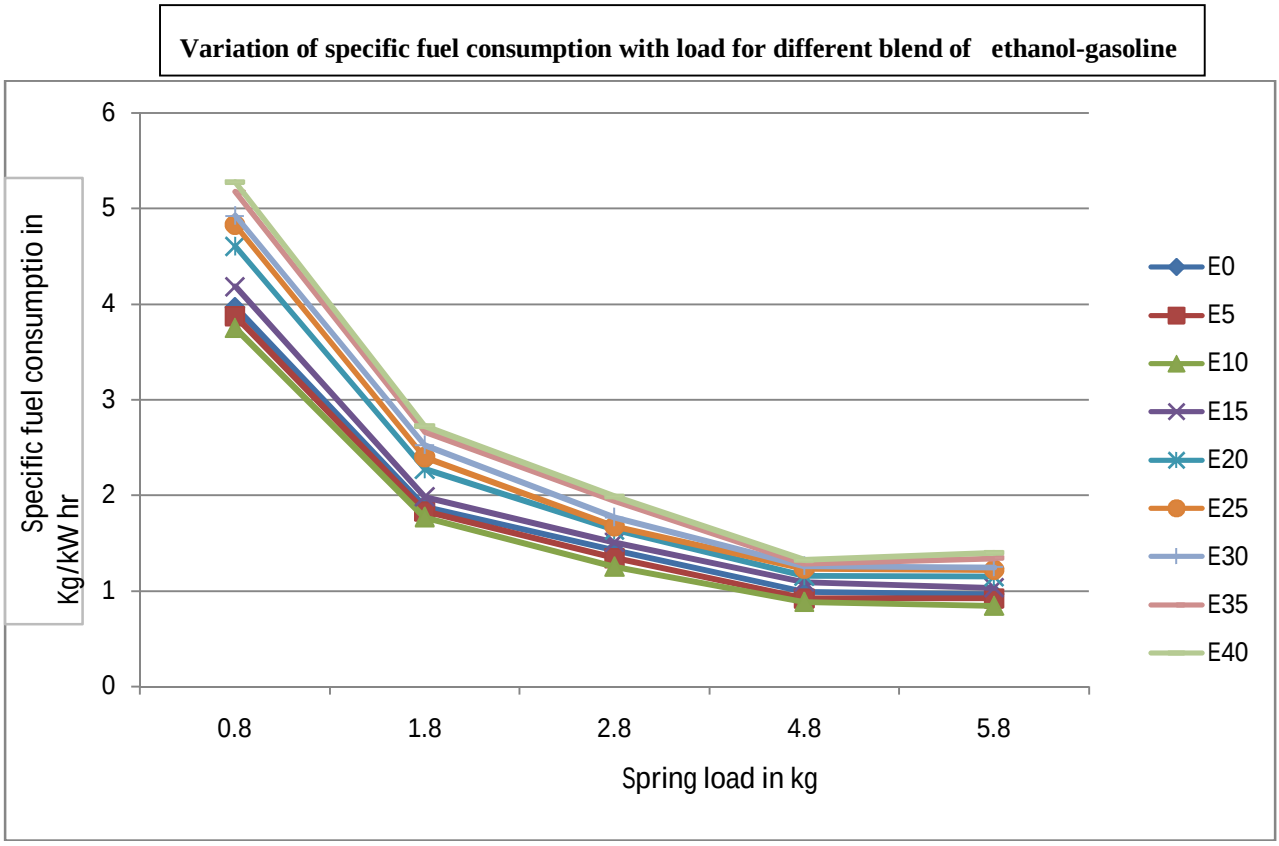

Figure 3: Variation of specific fuel consumption with spring load for different blend of ethanol-gasoline

Figure 3, Depicts variation in specific fuel consumption with load on different blends of ethanol gasoline. From the curve it is observed that the value of the specific fuel consumption decrease as the load increases. It is observed that the specific fuel consumption decreases from E0 to E10, after that as the blending ratio increases from E15 to E40, increase in the Brake specific fuel consumption. The minimum value of specific fuel consumption is found out at blend E10 and maximum value is find out at E40.

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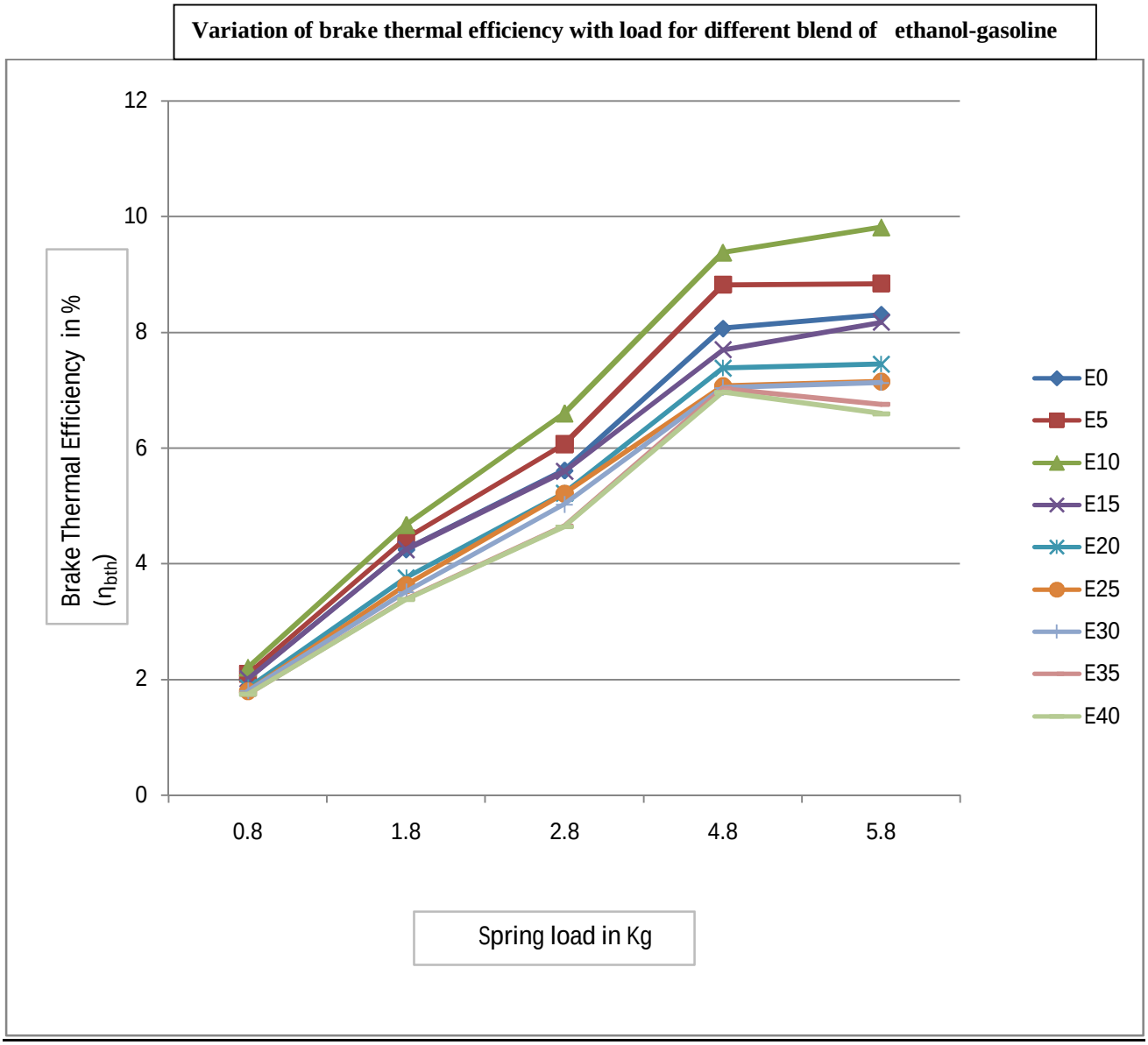

Figure 4: Variation of brake thermal efficiency with load for different blend of ethanol-gasoline

Figure 4, Depicts the effect of variation of load on brake thermal efficiency for different blends of ethanol gasoline. From the curve it is observed that the value of the in brake thermal efficiency increase as the load increases. It is observed that the Brake thermal efficiency increases from E0 to E10, after that as blending ratio increases, decrease in the brake thermal efficiency. Brake thermal efficiency is increasing for a particular percentage of blending of ethanol. After a particular fixed percentage of blending the efficiency decreases. The blending of ethanol in gasoline provides good combustion property. If we add ethanol after a particular percentage than it is incapable in proper combustion of fuel which results in lowering the brake thermal efficiency. The maximum value of in brake thermal efficiency is found out at blend E40 and minimum value at E40.

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PERFORMANCE ANALYSIS

Table 3: Calorific values of ethanol and gasoline blends-

Ethanol blend	Calorific Value (MJ/kg)
Petrol	45
E5	44.25
E10	43.5
E15	42.75
E20	42
E25	41.25
E30	40.5
E35	39.75
E40	39

V. CONCLUSION

By conducting the experiment on 4 stroke single cylinder SI engine in I.C Engine Lab of SRCEM Banmore, following Conclusions have been drawn:-

- Brake specific fuel consumption decreases from blending E0 to E10, further increase in blend ratio, the BSFC increases. The minimum BSFC achieved at E10.
- Brake thermal efficiency increases from blending E0 to E10, further increase in blend ratio, the BTE decreases. The maximum BTE achieved at E10.

From the results, it can be concluded that ethanol blends are quite successful in replacing pure gasoline in four stroke spark ignition engine. Results clearly show that Brake thermal efficiency is increasing for a particular percentage of blending of alcohol. After a particular fixed percentage of blending the performance of SI engine decreases. The blending of ethanol in gasoline provides good combustion property. If we add alcohols after a particular percentage than it is incapable in proper combustion of fuel which results in lowering thermal efficiency. Performance of E10 shows better result within group of various blends of ethanol with gasoline. It shows least brake specific fuel consumption and better engine performance. So from the result it is seen that E10 ethanol blended Gasoline is the best choice for use in the existing Spark Ignition Engines without any modification to increase Efficiency.

FUTURE SCOPE

- Analysis of composition of exhaust emission can be done.
- SI engine efficiency can be increase without any modification by using ethanol blended Gasoline.
- Combustion Analysis can also be done.
- It is not only the price reduction by ethanol blending that matters but also the millions of litres of petrol that we save for future.
- The values of the exhaust gas temperature decrease so environment temperature can be reduced.

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