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Experimental investigation of ethanol blends with gasoline on SI engine

Gaurav tiwari, Dr. Nitin shrivastava
Department of Mechanical Engineering, R.G.P.V. BHOPAL

ABSTRACT –
Automobile have become a very important part of our modern life style. But the future of automobile based on internal combustion engines has been badly affected by two major problems. That is less availability of fuel and environmental degradation. So it is very important to found some new renewable non polluting alternative fuels to ensure the proper and safe survival of internal combustion engines. In present study we evaluate the performance of two stroke single cylinder spark ignition engine with ratio of 10% 20% and 30% of ethanol and gasoline by volume. Performance parameters (brake thermal efficiency, brake specific energy consumption and brake specific fuel consumption) were determined at various loads on engine with ethanol blended gasoline. The comparison was made on performance of conventional SI engine with pure gasoline operation.
As a result, brake thermal efficiency, brake specific fuel consumption and brake specific fuel consumption showed comparable performance when compared with pure gasoline performances.

I. INTRODUCTION

Day by day the large amount of pollutants emitting out from the exhaust of the automotive vehicles run on fossil fuels are increasing and these pollutants are proportional to number of vehicles. The civilization of any country is measured on the basis of number of vehicles. Hence the Government has to spend huge amount of money for importing crude petroleum to meet the fuel needs of the automotive vehicles, in the context of fast depletion of fossil fuels. In view of heavy consumption of gasoline due to individual transport, the search for alternative fuels has become compulsory. The alcohol as a alternative fuel has been suggested for automobiles. 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 ethanol as a Additives which is integral part of today's fuel. They are chemicals, which are added in small quantities either to enhance fuel performance or to correct a deficiency. They can have surprisingly large effects even when added in little amount.

Alcohol is a good substitute as alternative fuel for use in SI engine. It has good compatible property with gasoline fuels. Their octane rating is also more than 100.if alcohols are added in a small amount with gasoline in SI engine then there is no need to make any modification in engine. As we all know that modification in engine and change in composition of fuel are two methods by which we can improve the performance of an engine and can reduce the environmental pollution.

Here in this experiment we tried to change the composition of fuel by blending of ethanol with gasoline in a suitable amount to improve the performance of engine. 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, Saugirdas Pukalskas & Juozas Grabys [1] 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 M .Al-Hasan[2] 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.M .Abu-Zaid, O .Badran, and J .Yamin[3] 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.M.V .Mallikarjun and Venkata Ramesh Mamilla[4] Experimental study in four cylinders,S.I 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 D. Balaji[5]Introduced influence of isobutene 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 wecame to know the effect of ethanol – gasoline blend and methanol – gasoline blend and comparision between them. Christoph Baur et al [6] analyzed the performance of SI engine with ethyl tertiary butyl ether (ETBE) as a blending component in motor gasoline and compared with ethanol blend. Presence of oxygen within fuel make fuel to burn clearly with better performance and lower emission and also provide higher octane rating of fuel which allows us to use higher compression ratio, CO and UHC emission levels with ETBE was much lower compared to those with the base gasoline and the NOx emission levels were increased slightly with the oxygenated fuels and was increasing with the increase of the oxygen content in the blended fuels which is related to the greater availability of oxygen and the leaning effect of those oxygenated fuels provides complete combustion of fuel. Alvydas Pikuna [7] et al 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. Hakan Bayraktar [8] developed theoretical model, validating by its experimental results and mentioned the blends including ethanol up to 16.5% by volume can be used in SI engines without any modification to the engine design and fuel system theoretically. Higher octane rating of alcohol and its blending provides us to work with higher compression ratio; the effect of varying the compression ration with ethanol gasoline blend introduced by Hu¨seyin Serdar Yu¨cesu [9] et al used three compression ratios, with increasing compression ratio engine torque increased about 8%. At the higher compression ratios the torque output did not change noticeable, highest increment was obtained for fuels E40 and E60 as nearly 14%, considerable decrease of BSFC was about 15% with E40 fuel at 2000 rpm engine speed.

Tolga Topgu¨ l[10] et al also investigated the effect of varying compression ratio with hydra engine by varying the ignition timing, blending unleaded gasoline with ethanol increased the brake torque when the ignition timing was retarded . Effect of the mixture fuel of ethanol and gasoline on two stroke engine were studied by Ya O Li-hang[11] et al the effect of different ratio of mixed fuel on the characteristics of the engine was tested, when the ethanol content the gasoline was 10% maximum torque and power was obtained and with 20% gasoline minimum fuel consumption rate was obtained with reduced exhaust emission from the engine with alcohol blending. Ibrahim Thamer Nazzal [12] investigated the effects of alcohol blends on the performance of a typical spark ignition engine and compared the engine performance with using 12%ethanol–88%gasoline blended fuel and 12%methanol–88%gasoline blended fuel and 6% ethanol -6% methanol – 88% gasoline with gasoline fuel .The engine performance was measured at a variety of engine operating conditions.

With keeping in mind the financial and environmental considerations an attempt has been made to increase the thermal efficiency and performance of the engine by using ethanol as additive with gasoline in engine. The performance analysis at varying load and constant speed. Satisfactory results were obtained and the work carried out is presented.

II. EXPERIMENTAL EQUIPMENTS AND PROCEDURE

The test rig comprises of air cooled petrol engine in which temperature is measured by digital temperature indicator the specification of engine is given as following

S.No.	Description	Data
1	Type of engine	Two stroke petrol engine
2	No. of cylinder	Single cylinder
3	Max B.P.	5.93 k.w
4	Max. speed	5000 rpm
5	Direction of rotation	Clockwise
6	Bore diameter	57 mm
7	Stroke length	57 mm
8	Cubic capacity	150 cc

Gasoline available in market is blended with ethanol in different blends. These are E-10 (10% ethanol + 90% gasoline) E-20 (20% ethanol + 80% gasoline) E-30(30% ethanol + 70% gasoline). Initially density of gasoline is known from which density of different blends were calculated. Same is done for finding the calorific value of all the blends.

BLEND	DENSITY	CV
E-10	741.30	43.5
E-20	746.71	42
E-30	752.22	40.8

THE PHYSICAL AND CHEMICAL PROPERTY OF ETHANOL AND PETROL

S.No.	Character	Ethanol	Gasoline
1	Molecular weight	46.07	100-105
2	Composition	(c) = 52% (H) = 13% (O) = 35%	(c) = 85% (H) = 15%
3	Sp. Gravity	0.794	0.7-0.8
4	Density	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	Air fuel ratio	9.0	14.7
9	Octane number	100	80-99
10	Cetane number	8	0-10

Ethanol is similar in nature with gasoline with high octane number. Both are liquid in nature thus storage and transportation are much similar. Both can be mixed easily and burnt. Ethanol has small molecular weight, large oxygen content and high H/C ratio. Octane number for ethanol is 100. Ethanol is oxygenated fuel with small molecules; it can burn fast and fully with oxygen inside. These characters can help to improve thermal efficiency as well as to achieve the cleanliness inside the engine and to reduce exhaust. With low boiling point ethanol is easy to burn and form the mixture gas which is conducive for gasoline to burn completely. Latent heat of vaporization of ethanol is three times bigger than that of petrol. So when ethanol is vaporizing, it absorbs a large amount of heat, meanwhile, the temperature of the mixed gas is lowered down. Although calorific value of ethanol is low, the heat, which the mixed gas of ethanol and gasoline produces under theoretical air fuel ratio, is roughly the same as that of petrol.

Figure.1. Experimental setup for the effect of ethanol- gasoline blends

TEST METHOD: At very first all different blends were prepared in laboratory and lubricating oil is added in sufficient ratio with gasoline The engine was started and allowed to warm up for a time period of 10 – 15 min. test were performed at constant speed and varying loads for each individual blends. Before testing with new blend the engine was allowed to run for sufficient time to consume the whole remaining fuel from previous blending.

For getting an average value of result from each blending the test were performed four times for each mixture. The fuel consumption is measured via metred measuring jar. The consumption is measured for certain interval of time so that we can found the fuel consumption with respect to time. The same process is repeated for blends of E-10, E-20, and E-30 and for pure gasoline.

The main focus of this study was to increase the performance and minimize the fuel consumption of two stroke petrol engine by using ethanol and methanol as additive with gasoline. The readings obtained from the conducted test have been evaluated and the result and graphs are compared.

EXPERIMENTALN DATA:

BTE IN % AT VARIOUS LOADS (W)				
	500	**1000**	**1500**	**2000**
GASOLINE	10	16	19	21
E-10	9	15	19	20
E-20	8	15	19	19.5
E-30	8	14	18	18

BSFC IN KG/W-HR AT VARIOUS LOADS (W)				
	500	**1000**	**1500**	**2000**
GASOLINE	0.9	0.5	0.4	0.2
E-10	1	0.6	0.4	0.3
E-20	1.1	0.7	0.6	0.5
E-30	1.1	0.9	0.8	0.7

III. RESULT AND DISCUSSION

part 1-Comparative study of gasoline and ethanol

Brake thermal efficiency:

Brake thermal efficiency is an indication of output gain from given input energy.the input energy is in the form of heat. More heat input gives better result, higher calorific value of fuel and better performance. Here as shown in graph and table for ethanol blending shows higher thermal efficiency for E10 and E30.

As shown above in table the brake thermal efficiency is slightly increasing with increasing of load and the brake specific fuel consumption is decreasing for same load. Graph shows the comparison of three blends of ethanol with gasoline that thermal efficiency of E10 blend is highest but further blends of ethanol shows lower performance even at higher oxygen content and at higher load. The calorific value of ethanol is greater than methanol thus it shows better performance then methanol. The performance of E20 and E30 is lower than E10.

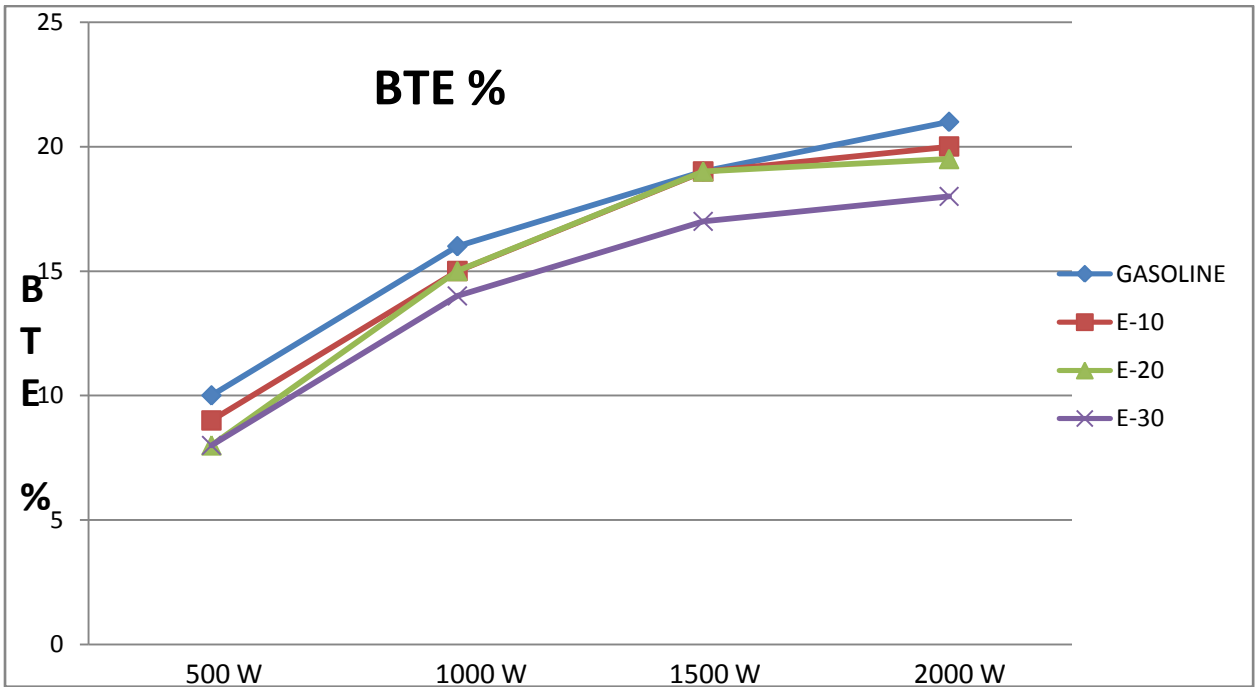

Fig.2 Brake thermal efficiency of ethanol blends

Brake specific fuel consumption:

Brake specific fuel consumption is define as the fuel consumed for one kilowatt power generation in one hour. Brake specific fuel consumption is decreases when load is increases. Brake specific fuel consumption is always least for full load condition. Fuel consumption is increases with load but brake specific fuel consumption decreases because it is function of fuel consumption and brake power. Graph plotted for ethanol blends showing brake specific fuel consumption at various loading condition. It shows that least fuel consumption of fuel for gasoline but at full loading condition the brake specific fuel consumption for E10 is least and for E30 it is highest.

As we already discussed that the brake thermal efficiency is better for E10 and thus it shows least brake specific fuel consumption. The lower the calorific value of fuel the higher will be fuel consumption.

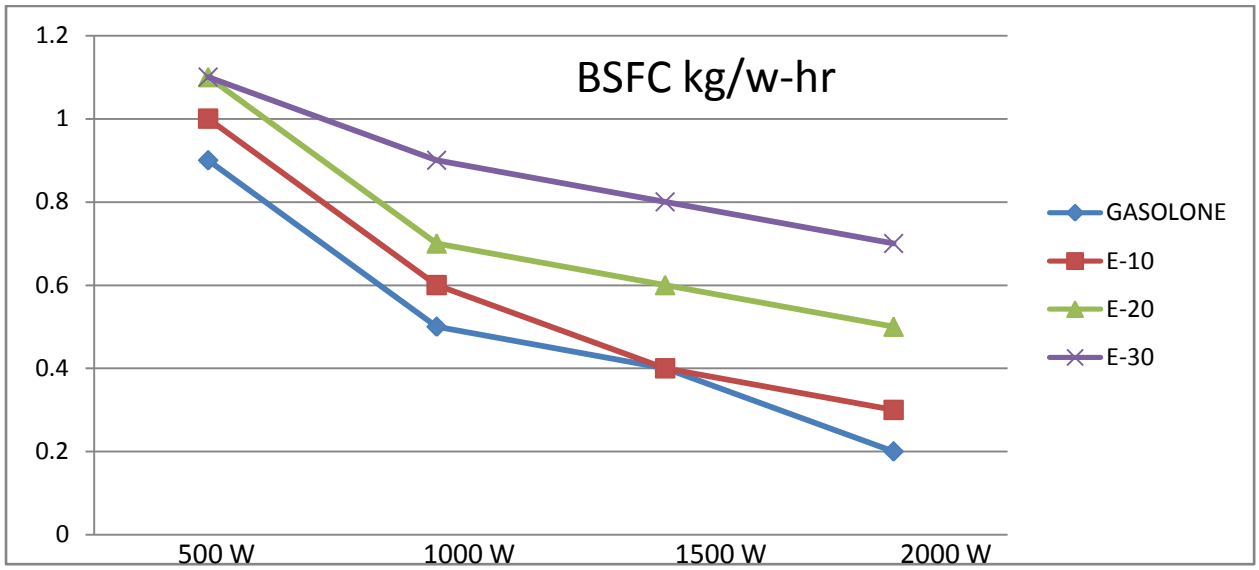

Fig.3.Brake specific fuel consumption for ethanol blends

Brake specific energy consumption:

The function of BSEC is to provide a quantitative image about the amount of thermal energy consumed to generate one unit of work. BSEC is inversely proportional to the brake thermal efficiency. Figure shows the variation of brake specific energy consumption with various loading for various blends of ethanol with gasoline.

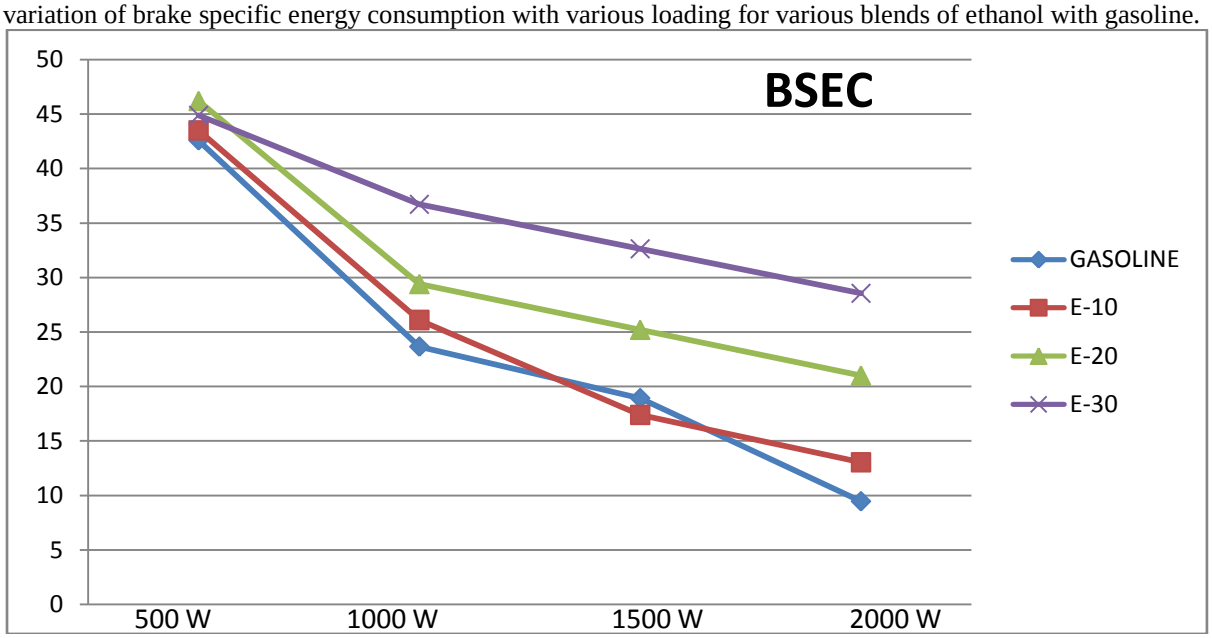

Fig.4.Brake specific energy consumption for ethanol blends

IV. CONCLUSION

Brake thermal efficiency is increasing for a particular percentage of blending of alcohol. And the percentage is different for different alcohols. After a particular fixed percentage of blending the performance of alcohol blending decreases. The blending of ethanol in gasoline provide good combustion property. If we add alcohols after a particular percentage than it is incapable in proper combustioning 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.

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