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Study Of Performance Parameters Of Single Cylinder Four Stroke Spark Ignition Engine Using Gasoline - Ethanol Blends

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Abstract: The transport systems are dependent on the fossil fuels especially liquid fuels and these fuels are depleting at much faster rate than production. The consumption of fossil fuels is very unstable and directly affects the economy of our country as we are importing it from other nations so this factor has urged us to find other alternatives to prolong the usage of petroleum. Thus, by using bio-fuel as alternative, the problem could be tackled. For this an experimental investigation has been conducted on air cooled 5 HP single cylinder spark ignition engine, fuelled with the various blends of gasoline-ethanol. Engine performance is also evaluated using gasoline fuel without any modification in a present engine. As far as the ethanol is concerned, India is the second largest producer of sugar cane, from which ethanol is produced. Experiments were conducted using different blends of gasoline-ethanol such as E0, E20, E40, E60, E80 and E100 and its effect on brake power, specific fuel consumption, break thermal efficiency and brake mean effective pressure with respect to the engine speed (rpm) were reported. The results of experimental investigation were compared with that of gasoline fuel. Results show that alcohol like ethanol in pure form or if blended with gasoline increases the thermal efficiency.

Keywords: SI engine, gasoline–ethanol blends, performance parameters

I. INTRODUCTION:

Energy is the most important requirement for any of the activity. For this energy, some fuels are required but these fuels are not available in abundance. Basically these fuels play a very important role in the modern development and rapid industrialization. The important fossil fuels are Coal, Petroleum and Natural Gas. The automobiles are the most important sector for the social development; it has enhanced the life standards of the human beings. But these are causing a lot of pollution. Decreasing emissions from automobiles and increasing engine efficiency are necessary steps towards improving air quality and reducing green house effect. Transportation vehicles are the largest consumer of imported oil and a major source of pollution that affects the air quality. It is well known that alcohol addition to SI Engines can reduce the exhaust emissions and increase its efficiency. With the addition of alcohol to the gasoline, SI Engines can run on lean air fuel ratios and this lean operation of SI Engines can reduce NOx emissions by a significant amount relative to NOx emissions at stoichiometric conditions.

II. PRESENT WORK

A. EXPERIMENTAL SETUP & TECHNIQUES

The engine selected for the performance test is very much popular in small two wheelers such as motorbike and scooters and small gen-sets. This is basically a single cylinder four stroke air cooled spark ignition petrol engine. The Experimental set-up consist of spark ignition engine along with dynamometer, load cell, fuel input measuring system, air intake measuring system, digital panel board, thermocouples for temperature measurement, digital tachometer. The specification of the engine used for experimentation is given in Table I. The set-up enables the study of engine brake power, fuel consumption, air consumption, heat balance, thermal efficiency, volumetric efficiency etc. The performance tests were carried out on the spark ignition engine using various blends of ethanol-gasoline fuels and also on pure gasoline. The tests were conducted by varying the loads at fixed throttle position and two positions of throttle were fixed i.e. ¼ throttle and ½ throttle. The experimental data generated was documented and presented here using the ethanol-gasoline mixture for 1 hr engine test operation. In each experiment, engine performance parameters such as brake power, brake specific fuel consumption, brake thermal efficiency and brake mean effective pressure were measured.

TABLE I
Engine specifications

1	Honda; SI Engine	5 BHP @ 3600 rpm
2	Bore	76 mm
3	Stroke	60 mm
4	Cubic capacity	272 cc
5	Rated speed	3600 rpm
6	Maximum speed	3600 rpm
7	Minimum speed	800 rpm
8	Compression ratio	6.5 : 1

Following test fuels are used for the present investigations along with pure gasoline. Different fuels are designated as follows.

TABLE II
Test fuels

1	E 0	Ethanol 0% and Gasoline 100%
2	E 20	Ethanol 20% and Gasoline 80%
3	E 40	Ethanol 40% and Gasoline 60%
4	E 60	Ethanol 60% and Gasoline 40%
5	E 80	Ethanol 80% and Gasoline 20%
6	E 100	Ethanol 100% and Gasoline 0%

TABLE III
Fuel properties of blends

S.No	Blends	Calorific Value, KJ/Kg	Specific Gravity
1	E 0	44000	0.740
2	E 20	40580	0.749
3	E 40	37160	0.758
4	E 60	33740	0.767
5	E 80	30320	0.776
6	E 100	26900	0.785

III. RESULTS AND DISCUSSION

A. Brake Power

The brake power for different blends of gasoline-ethanol and that of conventional gasoline at ¼ throttle position was reported in figure 1. The test was conducted for pure gasoline fuel which was base line fuel and then for different blends of gasoline-ethanol such as E20, E40, E60, E80, E100 samples. In general as the speed increases, the brake power first increases, then reaches to maximum value and then decreases as shown in figure 1. Further, with the increase of ethanol percentage in the blended fuel, the brake power decreases. This is due to the lower calorific value of the higher blend as a result the brake power decreases at fixed throttle position.

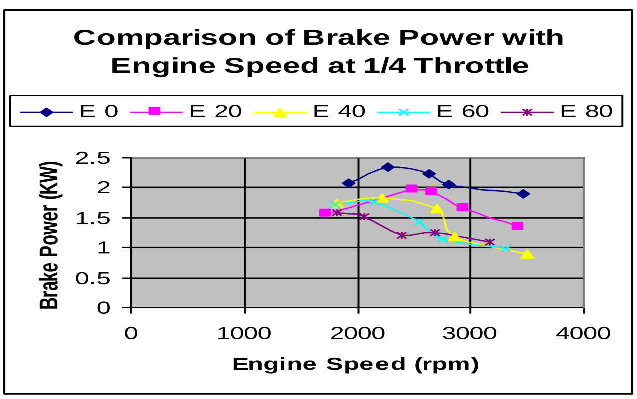

Fig.1 *Comparison of Brake Power at ¼ throttle (gasoline-ethanol blend)*

B. Break Mean Effective Pressure

The brake mean effective pressure for different blends of gasoline-ethanol and that of conventional gasoline at ¼ throttle position was reported in figure 2. The test was conducted for pure gasoline fuel which was base line fuel and then for different blends of gasoline-ethanol such as E20, E40, E60, E80, E100 samples. In general as the speed increases, the brake power first increases, then reaches to maximum value and then decreases continuously. Further, with the increase of ethanol percentage in the blended fuel, the brake mean effective pressure decreases as shown in figure 2. This is due to the lower calorific value of the higher blend as a result for same quantity of fuel burnt brake mean effective pressure decreases.

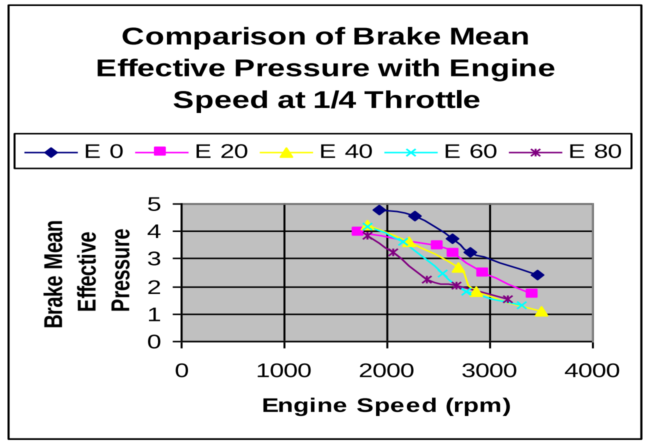

Fig.2 *Comparison of BMEP at ¼ throttle (gasoline-ethanol blend)*

C. Brake Specific Fuel consumption

The brake specific fuel consumption for different blends of gasoline-ethanol and that of conventional gasoline at ¼ throttle position was reported in figure 3. The test was conducted for pure gasoline fuel which was base line fuel and then for different blends of gasoline-ethanol such as E20, E40, E60, E80, E100 samples. In general as the speed increases, the brake specific fuel consumption first decreases, then reaches to minimum value and then increases. Further, with the increase of ethanol percentage in the blended fuel, the brake specific fuel consumption increases because as percentage of ethanol in blend increases, the calorific value decreases as a result break power decreases for same throttle position and hence break specific fuel consumption increases as break specific fuel consumption is inversely proportional to break power.

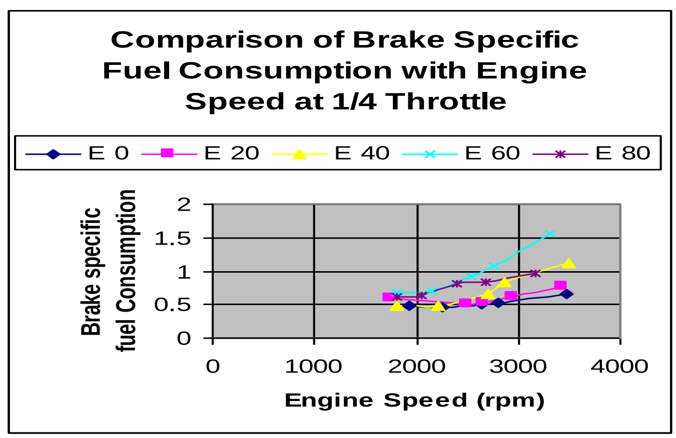

Fig. 3 *Comparison of BSFC at ¼ throttle (gasoline-ethanol blend)*

D. Comparison of Break Thermal Efficiency

The brake specific fuel consumption for different blends of gasoline-ethanol and that of conventional gasoline at ¼ throttle position was reported in figure 4. The test was conducted for pure gasoline fuel which was base line fuel and then for different blends of gasoline-ethanol such as E20, E40, E60, E80, E100 samples. In general as the speed increases, the brake thermal efficiency first

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increases, then reaches to maximum value and then decreases. Further, with the increase of ethanol percentage in the blended fuel, the brake thermal efficiency increases because of better combustion due to higher octane no as compared to gasoline fuel.

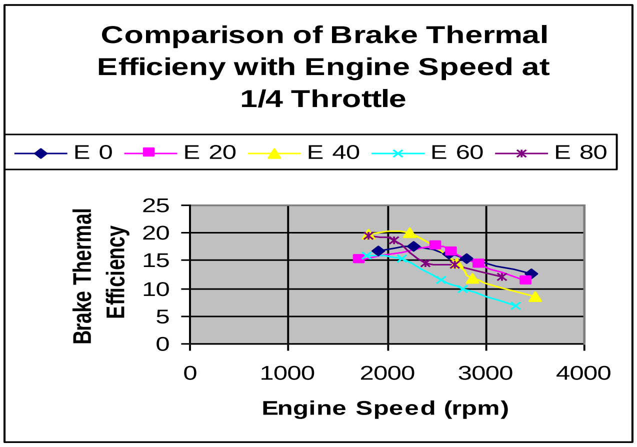

Fig. 4 *Comparison of BTE at ¼ throttle* (Gasoline-ethanol blend)

IV. CONCLUSIONS

Experimental investigations were carried out using single cylinder spark ignition engine. The results and conclusions obtained from the present investigations are as follows:

1. Blending mechanism works effectively and hence improved engine combustion performance and emission reduction using ethanol blends with gasoline.
2. There is a fuel saving of 40 to 50 %, while using gasoline – ethanol fuel blends.
3. There is also an improvement in thermal efficiency by 20 to 30 % using gasoline – ethanol blends.

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