IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
e-ISSN: 2278-1684, p-ISSN: 2320-334X
PP 33-37
www.iosrjournals.org

Experimental Investigation of four stroke spark ignition engine using alcohol petrol blends

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ABSTRACT: *Increasing global concern due to air pollution and to the limited oil reserves has generate much interest in the environmental friendly fuels alternative to petroleum based fuels, in particular for the transport sector in which the energy consumption depends almost exclusively on fossil fuels. Alcohols are an attractive alternate fuel because they can be obtained from number of sources, both natural and manufactured. Methanol and Ethanol are two kinds of alcohol can be obtained from many sources both fossil and renewable these include coal, petroleum, natural gas, biomass, wood and fills and even the ocean. In this work we prepared different alcohol petrol blends and find out optimum petrol blend for S.I. Engine. Then find different performance parameters like brake power, brake specific fuel consumption, torque, thermal efficiency for four stroke engine by using different blends. From that we find which is best possible blend that can be used in Four Stroke Spark Ignition Engine.*

Keywords: *Blends, Ethanol, Fuel consumption, Octane number, SI engine.*

I. INTRODUCTION

The recent shortage of refined Petroleum Products occasioned by the long queues of vehicles at Petrol retail outlets around the country has necessitated more importation of motor fuel gasoline.

The main reason is the increased prices, the very limited resources for such fossil fuels and increasing stringent environmental regulations. Growing concerns about greenhouse gas emissions will lead to an increase in bio-fuels and oxygenated fuels production. The application of bio-fuels and oxygenated fuels plays an important role in the alternative fuel for the internal combustion engines. The possible alternative fuels available in the market are diverse. Among the alternatives, Ethanol usually comes from biomass that includes crops rich in sugar, starch or cellulosic material. In India 5% Ethanol blending (E5) is mandatory which is proposed to be 10% (E10). Ethanol and gasoline have differences in some critical properties such as octane number, vapour pressure but their blends known as gasohol shows higher vapour pressure and octane compared to base components.

II. LITERATURE REVIEW

M.V. Mallikarjun (2009) explain Experimental Study of Exhaust Emissions & Performance Analysis of Multi Cylinder S.I.Engine When Methanol Used as an Additive [3].Simona Silvia Merola (2012) explain Experimental investigations of butanol-gasoline blends effects on the combustion process in a SI engine [4]. Maher A.R. Sadiq (2011) explain Effects of Ethanol-Gasoline Blends on Exhaust and Noise Emissions from 4-Stroke S.I.Engine [6]

III. PREPARATION OF BLENDS

3.1 Volumetric calculations

As E5 petrol is available in petrol outlets, therefore, other blends (E10, E15, E20, and E25) will be prepared by mixing ethanol in E5 petrol. Initially ethanol is added to 1000 ml of E5 petrol to get various blends. Therefore, amount of ethanol to be added is given in the “Table 3.1”

Table 3.1 Ethanol Content in Different Blends

S.No.	BLEND	PETROL (E5) VOLUME.	CALCULATED ETHANOL VALUE
1.	E5	1000 ml	0 ml
2.	E10	1000 ml	55.54 ml
3.	E15	1000 ml	111.08 ml
4.	E20	1000 ml	166.62 ml

5.	E25	1000 ml	222.16 ml

3.2 Properties of different blends[2]

The following “Table 3.2” shows properties of blends are tested in chemtech Laboratory pune,It is certified with ASTM (American society for testing material).

Table 3.2 Properties of different blends

SR NO.	SAMPLES	Sp.Gr @dec C IS	FLASH POINT (dec c)	ρ @15dec C (kg/m3)	μ@40 dec C (CST) ASTMD 445-06
1.	E10	745.3	<-4	747.8	0.4835
2.	E15	747.3	<-7	749.8	0.4975
3.	E20	750.3	<-5	752.5	0.5306
4.	E25	752.5	<-7	755	0.5483

IV. EXPERIMENTAL SETUP

The Experimental set up as shown in “ Fig 4.1” comprises of a 150 CC 4-S LML GRAPTOR engine, a Rope brake Dynamometer (Tongue Buckle for loading and unloading purpose), two spring balances (for measuring loads on tight and slack side), and two fuel tanks. A pulley is directly keyed to output shaft of engine on which load is applied. Load is applied by tightening and loosening of the Tongue Buckle. Rope Brake Dynamometer consists of a rope wire running over the pulley and connected to two spring balances.[5]

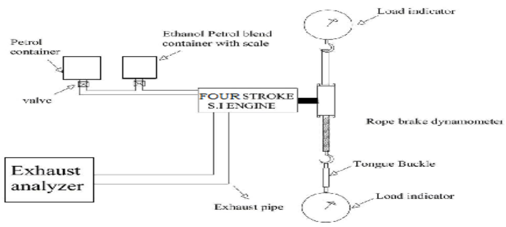

Fig. 4.1 Experimental Set up

V. OBSERVATION TABLE

The following “Table 5.1” shows reading for E5

Table 5.1 E5 Loading Observations

Sr. No.	LOAD (Tight) (kg)	WOOD (Slack) (Kg)	STARTING Volume (ml)	END Volume (ml)	Consumption (ml)	RPM	TIME (sec)
1.	-	-	280	240	40	2609	258.32
2.	20	13	300	270	30	2742	182.20
3.	30	17	250	220	30	2616	134.70
4.	35	22	150	130	20	3028	91.80
5.	40	26	250	230	20	2318	98.30
6.	50	31	220	190	30	2598	124.60
7.	60	36	150	130	20	2952	64.30
8.	70	41	160	150	10	2008	36.89

The following “Table 5.2” shows reading for E10

Table 5.2 E10 Loading Observations

Sr.No.	LOAD (Tight) (kg)	WOOD (Slack) (Kg)	STARTING Volume (ml)	END Volume (ml)	Consumption (ml)	RPM	TIME (sec)
1.	-	-	280	260	20	3520	110.49
2.	20	12	240	220	20	3062	114.32
3.	30	19	180	160	20	2564	108.00
4.	40	26	290	270	20	3084	82.42
5.	45	29	240	220	20	3016	78.10
6.	50	35	230	210	20	3028	75.90
7.	60	42	180	160	20	2904	69.23
8.	70	48	140	130	10	2262	35.22

The following “Table 5.3” shows reading for E15

Table 5.3 E15 Loading Observations

Sr.No.	LOAD (Tight) (kg)	WOOD (Slack) (Kg)	STARTING Volume (ml)	END Volume (ml)	Consumption (ml)	RPM	TIME (sec)
1.	-	-	280	260	20	3757	118.44
2.	20	12	210	190	20	3574	120.32
3.	30	16	240	220	20	3509	116.43
4.	40	23	180	160	20	3060	100.82
5.	50	30	140	120	20	3282	89.42
6.	60	34	260	220	20	2462	80.76
7.	70	37	210	200	10	2946	32.23

VI. CALCULATION TABLES

The following “Table 8.1”shows calculation of E5

Table 8.1 E5 Loading Calculation

Sr.No.	TORQUE (N.m)	POWER (W)	RATE (Ml/sec)	RATE (Kg/Sec)	RATE (gm/Hr)	BSFC (gm/kw-hr)	Thermal Efficency (%)
1.	0	0	0.15484	0.00011	412.44	-	-
2.	4.4978	1291.50	0.16465	0.00012	438.62	339.62	24.31
3.	8.3532	2288.33	0.22271	0.00016	593.29	259.27	32.31
4.	8.3532	2648.72	0.21786	0.00016	580.37	219.11	37.40
5.	8.9957	2183.61	0.20395	0.00015	541.99	248.20	32.88
6.	12.2085	3321.46	0.24077	0.00017	641.41	193.11	44.14
7.	15.4213	4767.22	0.31109	0.00023	828.61	68.93	46.83
8.	18.6340	3918.30	0.27107	0.00020	722.13	184.29	44.27

The following “Table 8.2”shows calculation of E10

Table 8.2 E10 Loading Calculation

Sr no	TORQUE (N.m)	POWER (W)	RATE (Ml/sec)	RATE (Kg/Sec)	RATE (gm/Hr)	BSFC (gm/kw-hr)	Thermal Efficency (%)
1.	0	0	0.1810	0.00013	482.18	-	-
2.	5.1404	1648.27	0.1749	0.00013	465.93	282.67	29.14
3.	7.0681	1897.79	0.1851	0.00014	493.10	259.82	31.14
4.	8.9957	2905.21	0.2426	0.00021	646.28	222.47	37.10
5.	10.2808	3247.03	0.2560	0.00022	681.98	210.03	39.28
6.	9.6383	3056.22	0.2635	0.00024	706.75	231.26	33.45
7.	11.5659	3517.26	0.2888	0.00024	769.36	218.75	35.15
8.	14.1362	3348.52	0.2839	0.00024	756.30	225.89	32.06

The following “Table 8.3”shows calculation of E15

Table 8.3 E15 Loading Calculation

Sr no	TORQUE (N.m)	POWER (W)	RATE (Ml/sec)	RATE (Kg/Sec)	RATE (gm/Hr)	BSFC (gm/kw-hr)	THERMAL EFFICENCY (%)
1.	0	0	0.1688	0.00012	444.35	-	-
2.	5.1404	1923.88	0. 1662	0.00012	442.75	230.13	37.48
3.	8.9957	3305.57	0.1717	0.00012	457.40	138.37	55.22
4.	10.9234	3500.32	0.1983	0.00014	528.27	150.92	58.47
5.	12.8511	4416.79	0.2236	0.00016	595.67	134.86	64.56
6.	16.7064	4307.24	0.2476	0.00018	659.60	153.13	55.97
7.	21.2043	6541.61	0.3102	0.00022	826.37	126.32	69.54

VII. RESULTS AND DISCUSSION

9.1 BSFC

The "Fig 9.1" shows the representation of BSFC variation with respect to load applied. It is seen that BSFC for any fuel decreases with increasing load. This implies that ratio of fuel consumption and brake power decreases with increasing load. Thus, it is clear that at higher load fuel consumption for same brake power decreases.

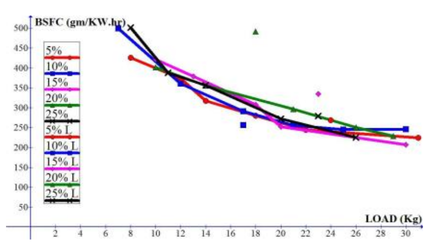

Fig 9.1 BSFC vs. Load

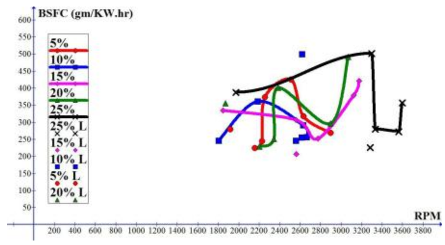

Fig 9.2 BSFC vs Rpm

The "Fig 9.2" shows representation of BSFC variation with respect to rpm. On overall basis (considering curves for different blends) increase in ethanol percentage resulted in decreased fuel consumption (neglecting E25 as points obtained are insufficient). Thus, it is clear that at different rpm fuel consumption with respect to power decreases for increasing ethanol percentage.

9.2 Thermal efficiency

Thermal efficiency is a measure of transformation capacity (heat energy to mechanical work). Thus higher thermal efficiency means high transformation ratio. The "Fig 9.3" shows this variation with respect to load applied. It is clear that for a blend sample thermal efficiency increases for higher loads. Also trend lines for curves of different blends show better thermal efficiency for blends with higher ethanol percentage.

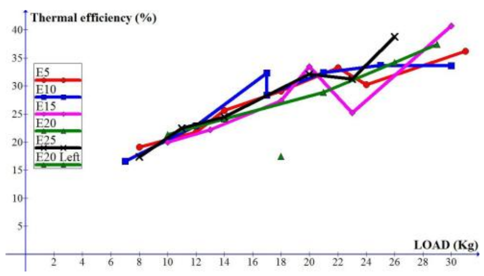

Fig 9.3 Thermal Efficiency vs Load

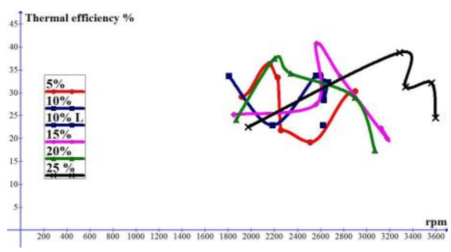

Fig 9.4 Thermal Efficiency vs RPM

The "Fig 9.4" Shows representation of Thermal efficiency variation with respect to changing rpm. Overall trend of the curves show that increase in ethanol percent in blend increases the thermal efficiency (neglecting E25 as points obtained are insufficient). This may be attributed to the fact that ethanol is an oxygen containing fuel. It has capability of self – supplying oxygen which enhances combustion process and improves energy conversion efficiency. Higher latent heat of ethanol with respect to that of petrol helps it to absorb some heat of combustion. This decreases the overall temperature of the mixture, increasing the inflation factor.

9.3 Co emission

Carbon monoxide emission characteristics of different blends have been shown in "Fig 9.5" These characteristics have been measured at no load and initial throttle position. Carbon monoxide percentage in emission from burnt fuel shows a declining trend with increase in ethanol percentage in fuel. Thus ethanol addition to petrol helps to reduce green house gases in atmosphere.

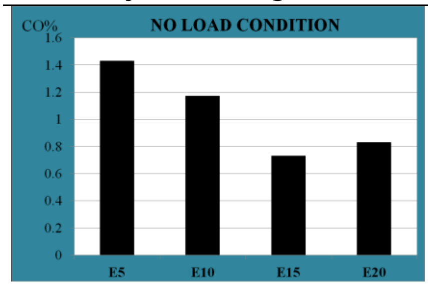

Fig 9.5 CO Emission

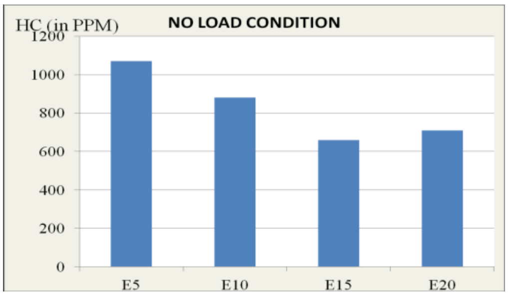

Fig 9.6 HC Emission

9.4 HC EMISSION

Hydrocarbon emission at no load is shown in "Fig 9.6" shows Hydrocarbon emission (measured in ppm) also Shows a declining trend with increasing ethanol percentage in petrol. Thus, ethanol addition to petrol advocates less hydrocarbon emissions (least for E15).

VIII. CONCULSION

Experimental results indicated that using ethanol -gasoline blended fuels, the power output, fuel consumption, thermal and volumetric efficiency of the engine increase.CO and HC emissions decrease dramatically as a result of the leaning effect caused by the ethanol addition; and CO2 emission increases because of the improvement of combustion. It shows that ethanol can be used as a supplementary fuel to gasoline in modern spark ignition engines without major changes, and it can help to save our environment from toxic pollutants and to save a considerable part of the available oil. We can say by experimentation that E15 (Ethanol-15%, Gasoline-85%) is best possible blend that can be used in Four Stroke Spark Ignition Engine.

REFERENCES

[1] Ambarish Datta, Achin Kumar Chowdhuri, Bijan Kumar Mandal,,Experimental Study on the Performances of Spark Ignition Engine with Alcohol-Gasoline Blends as Fuel, *Vol. 2 No. 1, 2012*

[2] Ibrahim Thamer Nazzal ,Experimental Study of Gasoline –Alcohol Blends on Performance of Internal Combustion Engine,, *European Journal of Scientific Research ,Vol.52 No.1 , 2011,.16-22*

[3] M.V. Mallikarjun and Venkata Ramesh Mamilla , Experimental Study of Exhaust Emissions & Performance Analysis of Multi Cylinder S.I.Engine when Methanol Used as an Additive,.*International Journal of Electronic Engineering Research Volume 1 Number 3 ,2009. 201–212*

[4] Simona Silvia Merola,Cinzia Tornatore, Luca Marchitto, Gerardo Valentino and Felice Esposito Corcione Merola, Experimental investigations of butanol-gasoline blends effects on the combustion process in a SI engine by et al. *International Journal of Energy and Environmental Engineering 2012*

[5] D.Balaji, Dr.P.Govindarajan, J.Venkatesan , Experimental investigation on varying engine torque of SI engine working under gasoline blended with oxygenated organic compounds

[6} A.R. Sadiq,Yassar K. Ali & Aimen Rashad Noor, Effects of Ethanol-Gasoline Blends on Exhaust and Noise Emissions from 4-Stroke S.I.Engine , *Engineering. & Technology Journal, Vol. 29, No. 7, 2011*