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PERFORMANCE STUDY OF METHANOL BLENDED PETROL IN SI ENGINE

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ABSTRACT: As single cylinder small engines have low compression ratio (CR), and they run with slightly rich mixture, their power are low and emission values are high. In this study, methanol was used to increase performance and decrease emissions of a single-cylinder engine. Initially, the engine whose CR was 7.5/1 was tested with gasoline and methanol at full load and various speeds. This method is used for increasing the fuel efficiency of a vehicle by adding different percentage of methanol to the petrol and to decrease the pollutants produced during combustion process. Due to the continuously increases in the cost of fossil fuels, demands for clean energy have also been increasing. Therefore, alternative fuels sources are sought to have alternate source for petrol without altering the existing engine or slight changes in the engine at low cost. In this paper the engines is tested without blending and with blending of methanol in various proportions with petrol and the measurements of CO and the corresponding readings were recorded.

Keywords: Carburetion and Blending

I. INTRODUCTION

Controlling operational parameters is considered to be practically attractive techniques for reducing the level of CO in spark ignition engine, because it would involve minimum additional cost and maintenance. A survey of the literature [1, 2] suggested that the fuel-air equivalence ratio is the important parameter which affects the level of CO emission in a spark ignition engine, while other studies [3-5] show that ignition timing has an appreciable influence on the level of CO emission and on the onset of knock. Today, usually fossil fuels are used for fuel production. The reserves of these fossil-based fuels are being rapidly depleted. Besides that, when these fuels are used in internal combustion engines, they produce air pollutants such as CO, HC, NOx and particulate matter. Alternative sources of energy are needed in order to replace the non renewable resources and also improve air quality. There are many investigations on increasing the engine performance and decreasing the concentration of toxic Components in combustion products by using non-petroleum, renewable, sustainable and non-polluting fuels. The high octane ratings and greater heat of evaporation values of alcohols such as ethanol, methanol and butanol make them appropriate fuels for high CR engines with high powers. High octane values can permit significant increases in CR. High heats of evaporation cool down the incoming fuel–air charge and make it denser to promote the power output. The fuels which have high the auto-ignition temperature are ignited at higher temperatures. The auto-ignition temperatures of alcohols are higher thanthose of gasoline, which make it safer for transportation and storage. The heat of evaporation of alcohol is 3–5 times higher than that of gasoline, which makes the temperature of the intake manifold lower, and increases the volumetric efficiency. The laminar flame speed of methanol is significantly higher than those of most of the hydrocarbon fuels. High laminar flame speed increases thermal efficiency by completing the combustion earlier which decreases heat losses from the cylinder. Methanol exhaust contains lower concentrations of particulate matters and nitrogen oxides than gasoline exhaust. The molecule of methanol has an oxygen atom that makes the gasoline-methanol blends more oxygenated. This leads to better combustion of the fuel and decreases carbon monoxide and hydrocarbon emissions. Methanol is an alternative fuel and can be produced from natural gas, biomass, and coal and also municipal solid wastes and sewage. Several studies have been conducted on the use of methanol and methanol-gasoline blends as fuel in the SI (Spark Ignition) engines. These results showed that there was an increase in engine thermal efficiency and decrease in CO emissions (fig 1) when pureethanol and pure methanol fuels were used and the effects of these fuels on engine performance and exhaust emissions.

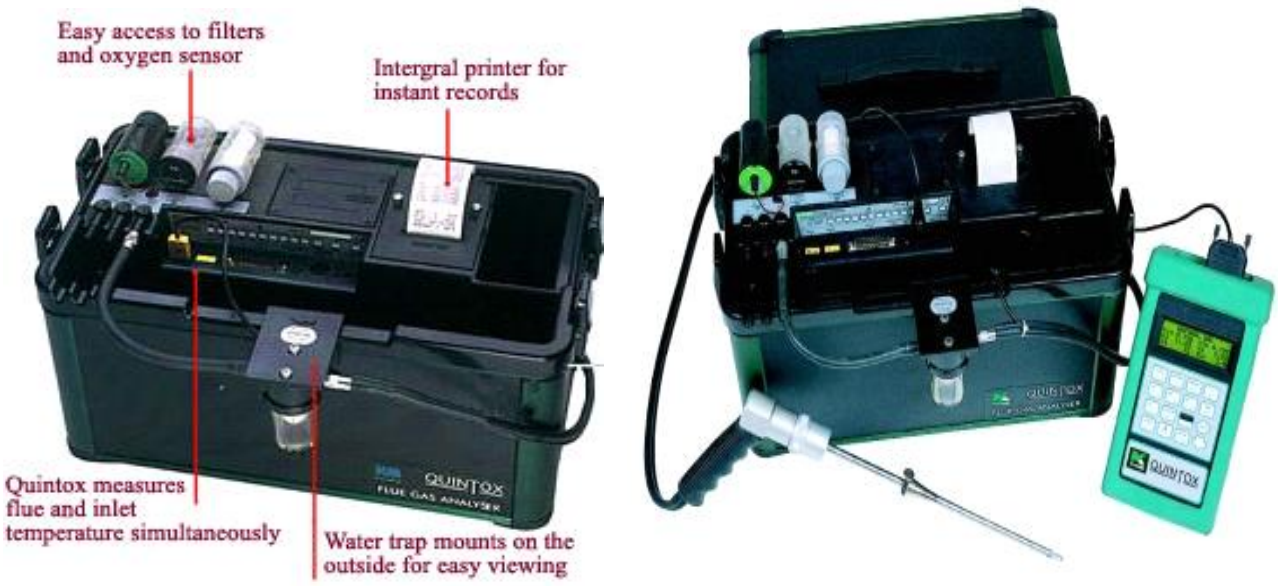

Fig 1: Instruments used to measure CO

1.1 Scope and Objective of Present Work:

In the present work, our objective is to increase the performance of the 350 cc Bullet engine to achieve better power and emission characteristics with the latter. Due to the continuously increases in the cost of fossil fuels, demands for clean energy have also been increasing. Therefore, alternative fuels sources are sought to have alternate source for petrol without altering the existing engine or slight changes in the engine at low cost.

II. EXPERIMENTAL SETUP

1. The experimental setup consists of a 350cc four stroke single cylinder petrol engine (fig 2)
2. A hydraulic dynamometer for loading and to measure the brake power of the engine for different loads.
3. A mileage tank is connected to measure the fuel consumption of the engine.
4. The performance test on the engine is carried out by the following ways:

a). Using conventional carburettor.

b). by blending the petrol with methanol

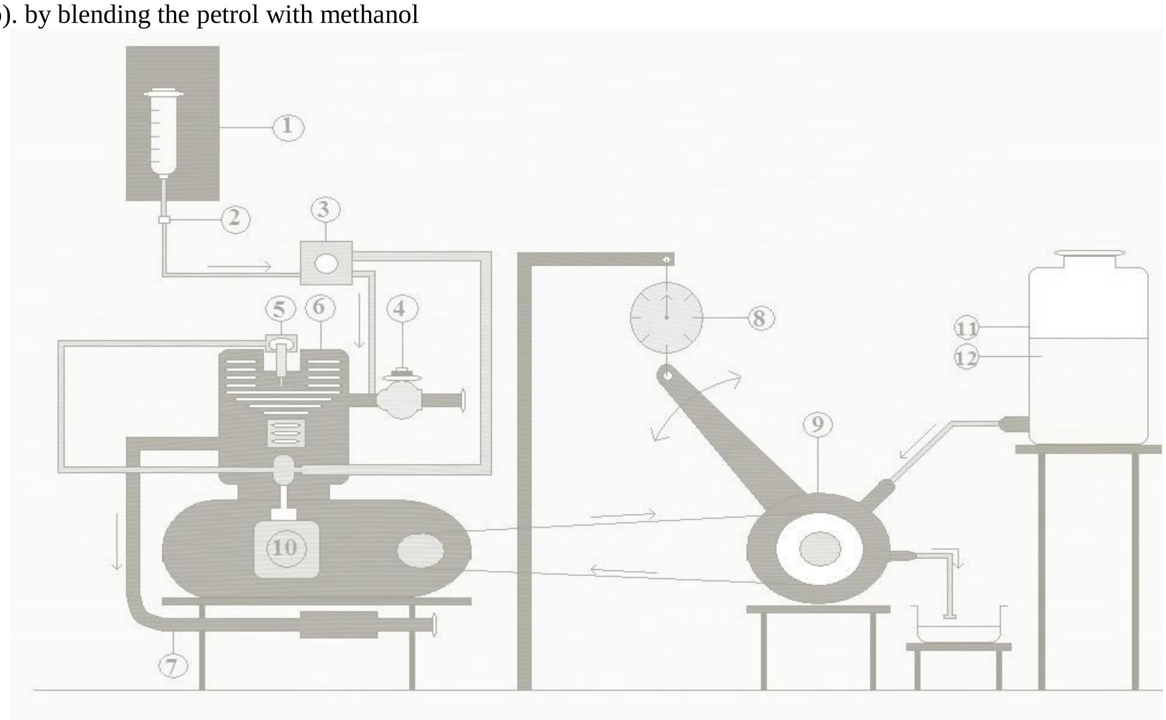

Fig 2. Engine Set Up

1. Fuel tank with measuring scale 2. Control valve 3. Three way valve 4.Carburetor 5. Injector 6.Engine 7.Silencer 8.Spring balance 9. Dynamometer10. Fuel pump 11.Water 12. Water tank

2.1 Gas Analyzer:

It is very essential to determine the emission characteristics of the engine. This gas analyzer provides the, HC, CO and other emission characteristics of the engine.

III. EXPERIMENTAL PROCEDURE

Initially the engine is tested using conventional carburettor without blending the petrol. The procedure is as given below.

1. The engine is started and run for few minutes to reach a steady state condition.
2. The engine once it reaches a steady state condition the engine rpm is set and the time taken for consuming a known volume of fuel is measured. This measurement is done under two conditions at constant speed of the engine,

At no load

Under load.

3. Methanol is blended with petrol & the blend contains 5%, 10%, 15%, 20%, 25% methanol and 95%, 90%, 85%, 80%, 75% petrol respectively (called M5, M10, M15, M20, M25)
4. The power developed by the engine is measured.

3.1 Basic Measurements:

Engines are power producing systems. In order to determine their capacities and suitability for applications, it is necessary to measure their levels of performance in meeting various requirements. The important parameters considered for the measurement of performance of the engine are:

3.1.1. Measurement of Speed:

An electrical tachometer or a digital tachometer can be used to measure the speed of the shaft. The digital tachometer reading is a linear function of speed of the shaft and is directly indicated in the display.

3.1.2. Measurement of Fuel Consumption:

In this the time taken for a known volume of fuel consumption is measured and the fuel consumption rate can be calculated. The fuel consumption rate can be calculated as, Fuel consumption

Kg/hr = Xcc*specific gravity of fuel / 1000*t

3.1.3. Measurement of Brake Power:

It involves the determination of torque and power developed at the engine output shaft. The torque is measured by the hydraulic dynamometer. The hydraulic dynamometer is run by the chain sprocket arrangement provided between the engine output shaft and dynamometer's sprocket. The brake power can be calculated using,

Brake power =2πNT / 60000 kw

It **3.1.4. Specific Fuel Consumption:**

is the amount of fuel consumed per unit of power developed per hour. It is a clear indication of the efficiency with which the engine develops power from the fuel.

SFC = (fuel consumed in kg/kW.hr) / (power developed)

3.1.5. Brake Thermal Efficiency:

Brake thermal efficiency = brake power / (heat supplied/sec)

The readings and results obtained are listed in the table and respective graphs are plotted.

TABLE 1

a. by Using Carburettor (without Blending)

Sl. no	Load (n)	Speed (rpm)	Fuel consumption (CC)	Time (sec)	BP (KW)	SFC (kg/kw-hr)	TFC (kg/hr)	η_{bth} (%)
1	0	1330	50	193	-	-	0.70	-
2	19.62	1330	50	176	1.912	0.397	0.76	20.49
3	39.24	1330	50	96	3.825	0.368	1.41	22.19
4	58.86	1330	50	69	5.738	0.341	1.96	23.91
5	78.48	1330	50	55	7.651	0.324	2.48	25.23

Emission obtained CO = 3.19%

b. By Using Carburettor (Blending 5%)

Sl. no	Load (n)	Speed (rpm)	Fuel consumption (CC)	Time (sec)	BP (KW)	SFC (kg/kw-hr)	TFC (kg/hr)	η_{bth} (%)
1	0	1330	50	207	-	-	0.65	-
2	19.62	1330	50	194	1.912	0.360	0.69	23.18
3	39.24	1330	50	103	3.825	0.345	1.32	24.29
4	58.86	1330	50	72	5.738	0.329	1.89	25.51
5	78.48	1330	50	56	7.651	0.316	2.42	26.33

Emission obtained CO =2.95%

c. by Using Carburettor (Blending 10%)

Sl. no	Load (n)	Speed (rpm)	Fuel consumption (CC)	Time (sec)	BP (KW)	SFC (kg/kW-hr)	TFC (kg/hr)	η_{bth} (%)
1	0	1330	50	210	-	-	0.64	-
2	19.62	1330	50	193	1.912	0.366	0.70	23.18
3	39.24	1330	50	101	3.825	0.350	1.34	24.29
4	58.86	1330	50	71	5.738	0.332	1.91	25.51
5	78.48	1330	50	55	7.651	0.321	2.46	26.41

Emission obtained CO =2.65%

d. by Using Carburettor (Blending 15%)

Sl. no	Load (n)	Speed (rpm)	Fuel consumption (CC)	Time (sec)	BP (KW)	SFC (kg/kw-hr)	TFC (kg/hr)	η_{bth} (%)
1	0	1330	50	236	-	-	0.57	-
2	19.62	1330	50	191	1.912	0.371	0.71	23.3
3	39.24	1330	50	102	3.825	0.347	1.33	24.81
4	58.86	1330	50	72	5.738	0.329	1.89	26.29
5	78.48	1330	50	57	7.651	0.313	2.40	27.63

Emission obtained CO =2.39%

e. by Using Carburettor (Blending 20%)

Sl. no	Load (n)	Speed (rpm)	Fuel consumption (CC)	Time (sec)	BP (KW)	SFC (kg/kw-hr)	TFC (kg/hr)	η_{bth} (%)
1	0	1330	50	215	-	-	0.63	-
2	19.62	1330	50	195	1.912	0.360	0.69	24.33
3	39.24	1330	50	100	3.825	0.352	1.35	25.09
4	58.86	1330	50	68	5.738	0.348	2.00	25.42
5	78.48	1330	50	52	7.651	0.342	2.62	25.81

Emission obtained CO =2.44%

f. by Using Carburettor (Blending 25%)

Sl. no	Load (n)	Speed (rpm)	Fuel consumption (CC)	Time (sec)	BP (KW)	SFC (kg/kw-hr)	TFC (kg/hr)	η_{bth} (%)
1	0	1330	50	213	-	-	0.638	-
2	19.62	1330	50	180	1.912	0.394	0.755	22.91
3	39.24	1330	50	95	3.825	0.374	1.434	24.15
4	58.86	1330	50	66	5.738	0.360	2.067	25.13
5	78.48	1330	50	51	7.651	0.351	2.689	25.75

Emission obtained CO =2.53%

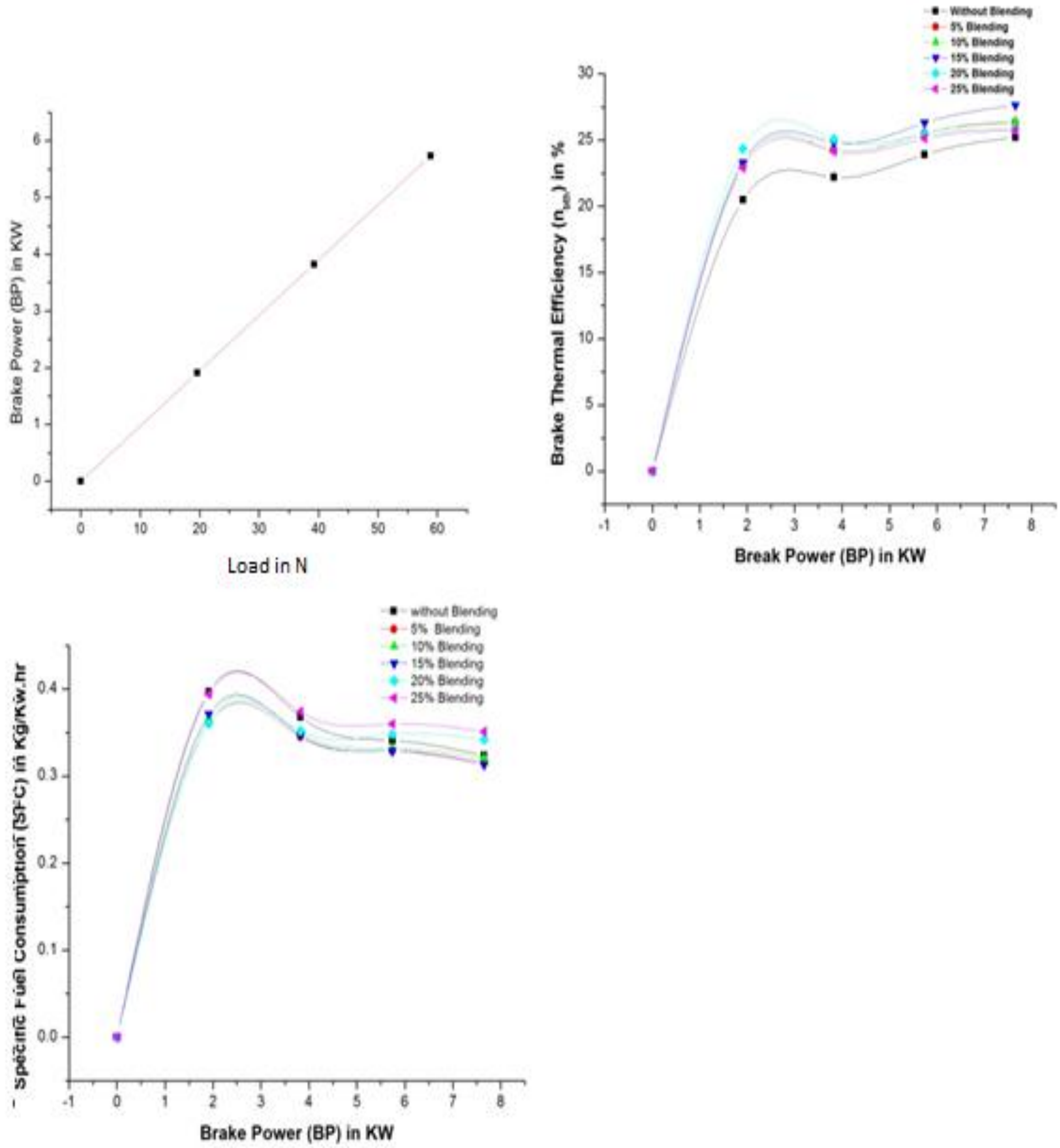

Fig 3. a.Brake power vs Load
b. Brake thermal efficiency vsbrake power
c. SFC vs Brake Power

IV. RESULTS AND DISCUSSION

According to the results, as the fraction of methanol in the blend increased, the specific fuel consumption increased, and CO, HC emissions decreased. When pure methanol was used.compared the performance and emissions characteristics of the alternative fuels and gasoline in an SI engine. Their results showed that the engine power and CO emissions decreased, fuel consumption increased when methanol was used instead of gasoline. We used five types of typical methanol-gasoline blends of M5, M10, M15, M20 and M25 to investigate the effects of different methanol/gasoline ratios on engine power, thermal efficiency and emissions. The addition of methanol significantly improved the brake thermal efficiency. CO x emissions decreased with the increase of the methanol/gasoline ratio in the blend. The performance tests were carried out at and Constant speed and variable conditions over the range of 1330rpm, using various blends of methanol-gasoline fuel.

V. CONCLUSION

The concept of blending of methanol with petrol for a SI engine has been implemented successfully to a 350 cc 4 stroke SI engine. After the experimental set up the engine was tested under al the following conditions 0% methanol blended petrol With methanol blended petrol. The test have been conducted under no load and at different loads maintaining the speed of the hydraulic dynamometer at a constant value of 240-260 rpm throughout the test and the engine produced a maximum power of 7.65kW, at an engine speed of 1330 rpm. Since the engine is old, the power output is very low as compared to its rated power of 13 kW at 5600 rpm.Testing this engine for higher speed has resulted in uncontrollable vibrations. Therefore loading has been done to generate a maximum power of 7.65 kW and speed being 1330 rpm.The comparative test result has obtained from figures indicate a slight improvement in performance when engine is working with methanol Blended Petrol

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ExperimentalsetupPhoto:

The photo shows Experiment conducted in a laboratory