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Effect of Methanol Blends on performance of Two Stroke petrol Engine at varying load conditions

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Abstract— *Experiments were conducted to evaluate the performance evaluation of two stroke single cylinder, spark ignition (SI) engine, with methanol blended gasoline (40% gasoline, 20% methanol, & 10 % by volume). Performance parameters (brake horse power, specific energy consumption, thermal efficiency,) were determined at varying load condition it is observed that The experiments shows that 10% methanol blend with gasoline gives the best performance for the SI engine. The power output of the engine is almost near about the petrol on blend M10. It is recorded that the higher power output is 2. 85 KW with M10 blends at load 8 Kg as compare to petrol and the lowest power output is from the engine is 0. 82 KW with blend M40 at load 2 Kg. The specific fuel consumption decrease as load increase for petrol and methanol blends. The SFC of methanol (M10) is higher at low load condition and low at high load conditions as compare to other blends.*

Keywords— ***Gasoline, Methanol, specific fuel consumption. Brake horse power, Brake thermal efficiency, Engine.***

I. INTRODUCTION

In recent years, the automotive industry has been confronted with the urgent need to mitigate environmental pollution and reduce dependence on fossil fuels. This imperative has spurred research into alternative fuels and technologies that offer cleaner and more sustainable solutions. Among these alternatives, methanol has emerged as a promising candidate due to its renewable nature, lower carbon footprint, and potential to enhance engine performance when blended with conventional petrol.

A petrol engine (Known as a gasoline engine in America English) is an internal combustion engine with spark-ignition, designed to run on petrol (gasoline) and similar volatile fuels. Alcohols have been suggested as an engine fuel almost since automobile was invented. The alcohol used to change/modify the attitude toward the present fuel, i.e., gasoline and search for new alternatives. A major contributor to the greenhouse effect is the transport sector due to the heavy and increasing traffic level. In spite of ongoing activity to promote efficiency, the sector is still generating significant, especially in developing countries fairly drastic political decisions may have be taken to address this problem in the future. Furthermore, the dwindling supply of petroleum fuels will sooner or later become a limiting factor. An important step in efforts to solve the problem is to replace fossil source energy with Bio energy. In the transport sector this means either source energy with bio energy. In the transport sector this means either introducing bio fuels and using adapted vehicles, or blending bio fuels with petroleum – based fuels for use with present vehicle fleets.

The performance of an engine, characterized by parameters such as power output, fuel efficiency, and emissions, is influenced by numerous factors, including fuel composition, operating conditions, and engine design. Understanding how methanol blends affect these performance metrics under varying load conditions is crucial for optimizing engine operation and developing strategies for cleaner and more efficient combustion processes.

II. MATERILS AND METHODS

The tests were conducted on a two-stroke, single-cylinder, and spark-ignition gasoline engine at varying load, in AKS University Satna, Madhya Pradesh.

2.1 Engine setup

The engine is water-cooled, self governed and use forced lubrication system. To assess the performance, one should obtain the input (energy input through the fuel I. e. Petrol) and output (the energy available at the output shaft) relationship .To measure using the fuel controlling arrangement and stopwatch. The output measured using an absorption type dynamometer. The brake drum of the dynamometer is broken using a wire rope-wound around the drum-with one end connected to a spring balance between and the other end to a hanger and dead weights. The friction between the dram and rope can be varied by changing the net tension (difference between the weight and the spring balance reading), by tightening the spring balance end as well as adding more dead weight. The heat energy due to friction is to be remove by cooling the drum-I.e. By circulating cooling water through the groove inside the drum. In short, the load is varied rope through the fixture arrangement.

Fig 2.1. Experimental engine setup

Table 2.1 Specification of engine

PARAMETER	DETAILS
Engine company and model type	Make-bajaj Model-chetak Type-single cylinder,2 stroke petrol,
Cooling system	Air cooled
Cylinder Number	Single cylinder
No. of gear	4

RPM	5000rpm
Stroke	57mm
Bore	57mm
Capacity	144.45CC
Compression Ratio®	4:5:1
Max. Torque	1.1 kgfm @ 3500rpm
Weight of engine	103kg
Top Speed	85kmph
Rope Dia.	1.7 cm
Brake drum Dia.	35 cm
Fuel Tank capacity	6.50liters

2.2 Fuel Input measuring arrangement

These arrangements consist of a fuel tank of suitable capacity mounted on a stand. The fuel goes to the engine through a 50 ml burette. The burette facilitates the measurement of fuel consumption for a define period with the help of stop watch. The fuel I. e. petrol and ethanol, was measured using a calibrated burette (of capacity 50c. c) and a stopwatch.

Fig .3.2 Fuel input measuring arrangement

2.3 Parameter evaluated

The aim of study the performance evaluation of the engine with different blends of ethanol with Petrol-Methanol and plotting the characteristics such as

2.3.1 Specific fuel consumption (SFC)

2.3.2 Brake Horse Power (BHP)

2.3.3 Brake thermal efficiency (BTE)

2.3.1 Specific fuel consumption (SFC)

Specific fuel consumption is defined as the fuel flow rate per unit power output. It is a measure of the efficiency of the engine in using the fuel supplied to produce work. It is desirable to obtain a lower value of SFC meaning that the engine uses less fuel to produce the same amount of work. This is one of the most important parameter to compare variable fuel. It is expressed in kg/kW Hour

$$\mathbf{SFC} = \frac{\mathbf{Mf}}{\mathbf{BHP}}$$

Where,

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Mf = mass of fuel in kg/KW/hour

BHP = Brake horse power in kW

2.3.2 Brake Horse Power (BHP)

Brake horse power is one of the most important measurements is the test schedule of an engine. The net available at the shaft is known as brake power. It is define as rate of doing work is equal to the product of force liner velocity of the product of torque and angular velocity. Thus, the measurement of power involve the measurement of force(or torque) as well as speed. Un electrical loading dynamometer used for measuring brake power of engine. It is measured in kW.

$$\mathbf{BHP} = \frac{2 \times \pi \times N \times Te}{60 \text{ X } 1000}$$

N= Speed of the engine in rpm

Te= torque in Nm = w × R-(9. 81× Net mass applied in kg) x radius in m

2.3.3 Brake Thermal Efficiency (BTE)

A measure or overall efficiency of the engine is given by the brake thermal efficiency. BTE is the of energy in the brake power to the fuel energy

$$\mathbf{BTE} = \frac{BHP \times 3600}{Mf \times CV}$$

Where,

B. H. P = Brake horse power in kW.

Mf = Mass of fuel in kg/Hr.

CV = Calorific value in kJ/kg.

2.4 Engine Speed (rpm)

Speed is a rate variable defined as the time rate of motion. It may be linear, I. e., along the axis of moment or angular I. e., around the axis. The angular speed is measured by tachometer. Tachometer is an instrument used to measure angular velocity of the shaft either by registering the number of rotation during the period of contain or by indicating directly the number of rotation per minute. It indicated the value of rotary speed display a reading of an average speed. An Emerson make digital panel tachometer was used for measurement of engine rpm. It has a measuring range of 1 to 2000 rpm.

Fig. 2.3 Measurement of engine rpm

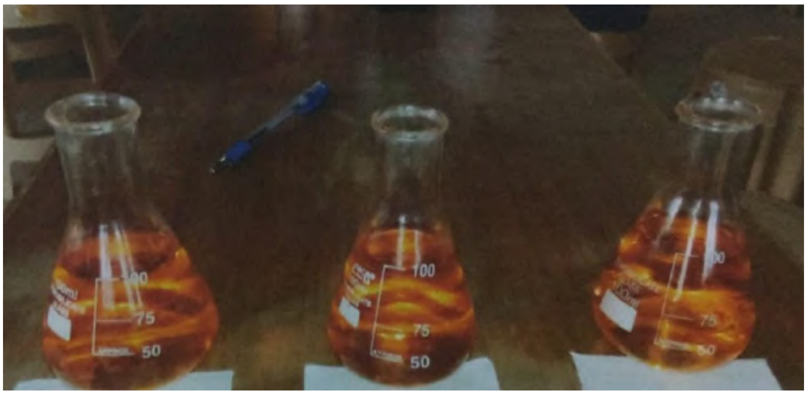

Fig 2.4 Petrol blends with different proportion of methanol

III. RESULT AND DISCUSSION

The experiment were conducted using petrol and methanol blends M10, M 20, M 40 and performance of the engine was evaluated using several parameter such as brake power, specific fuel consumption and thermal efficiency.

3. Performance evaluation of gasoline engine using petrol and methanol blends at varying load

3.1 Brake Power (KW) at varying load with different blends of petrol – methanol

The test was conducted for pure gasoline fuel which was blend base line fuel and then for different blends of gasoline – methanol such as M10, M20 and M40 samples. Fig 4.1 shows the variation in engine break power at varying load with petrol and methanol blends M10, M20 and M40. The power output of the engine is almost near about the petrol on blend M10. It is recorded that the higher power output is 2.85 KW with the blend M 10 at load 8 kg as compare to petrol and the lowest power output is from engine is 0.82 KW with blend M40 at load 2 kg. it was concluded that the blends the blend with 10 % have no more effect on power output. It also shows that the percentage of blends increase with petrol the brake power decrease if increase in load. Table 4.1 shows the M10 blends give higher brake power at all loads as compare to other blend M20, M40. It is recorded that M10 out power is 0.92 KW,1 .72Kw, 2.25 KW and 2.85 KW respectively at varying load 2 to 8 Kg.

Table 3.1 Break power at varying load with different blends of petrol-Methanol.

Load, kg	Petrol	M 10	M 20	M 40
	Break Power, KW			
2	0.98	0.92	0.89	0.82
4	1.82	1.72	1.59	1.43
6	2.3	2.25	2.1	1.91
8	2.96	2.85	2.4	2.25

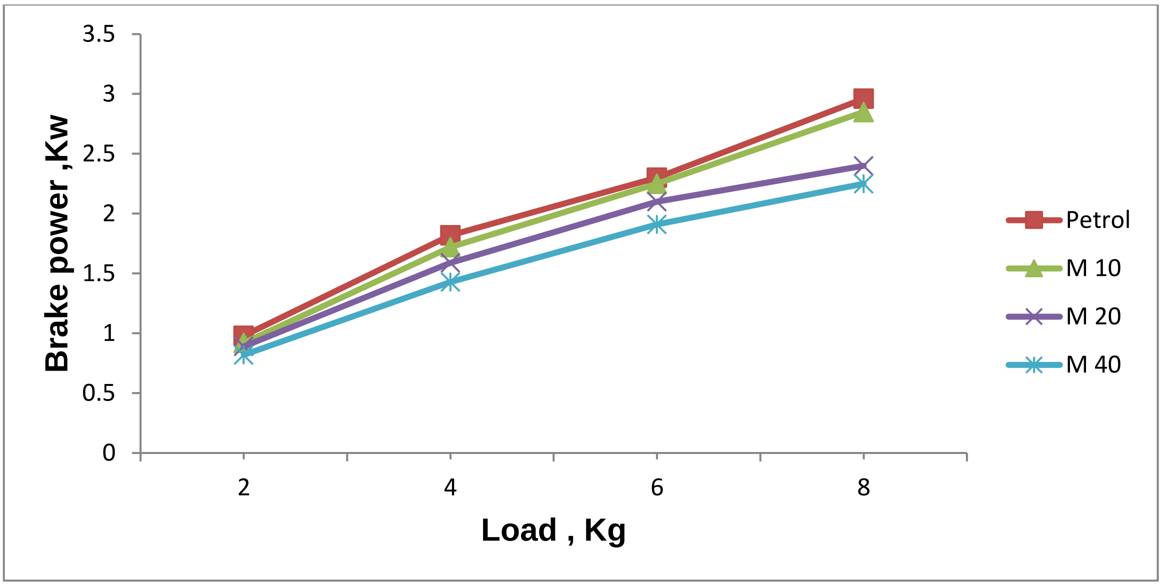

Fig .3.1 Break power at varying load with different blends of Petrol- Methanol

3.2 Specific Fuel consumption at varying load with different blends of Petrol methanol.

The test was conducted for pure gasoline fuel which was base line fuel and then for different blends of gasoline-Methanol such as M10, M20, and M40 samples. Fig 4. 2 and table 4. 2 represent the effect of methanol blend with petrol on specific fuel consumption at different load condition. It shows the specific fuel consumption decrease as load increase for petrol and methanol blends. The SFC of Methanol (M10) is higher at low load condition and low at high load conditions as compare to other blends. The specific fuel consumption of Methanol blend (M10) is nearly about petrol at lower load condition this is due to the inherent oxygen contents of Methanol. Fig 4.2 show the specific fuel consumption of methanol blend (M10) is higher at lower load 2 kg is 0. 74 kg/kW/h and the lower SFC of methanol blend (M10) is 0. 49 kg/kW/h.

Table 4. 2 Show the specific fuel consumption of ethanol (M 10) is lower at all load condition as compare to other blends. It is 0. 74 kg/kW/h, 0. 64 kg/kW/h, 0. 61 kg/kW/h and 0. 49 kg/kW/h respectively at load between 2 to 8 kg.

Table 3.2 Specific Fuel Consumption at varying load with different blends of petrol-Methanol.

Load , kg	**Petrol**	**M 10**	**M 20**	**M 40**
	Specific Fuel Consumption			
2	0.72	0.74	0.76	0.79
4	0.61	0.64	0.59	0.72
6	0.58	0.61	0.63	0.65
8	0.43	0.49	0.54	0.59

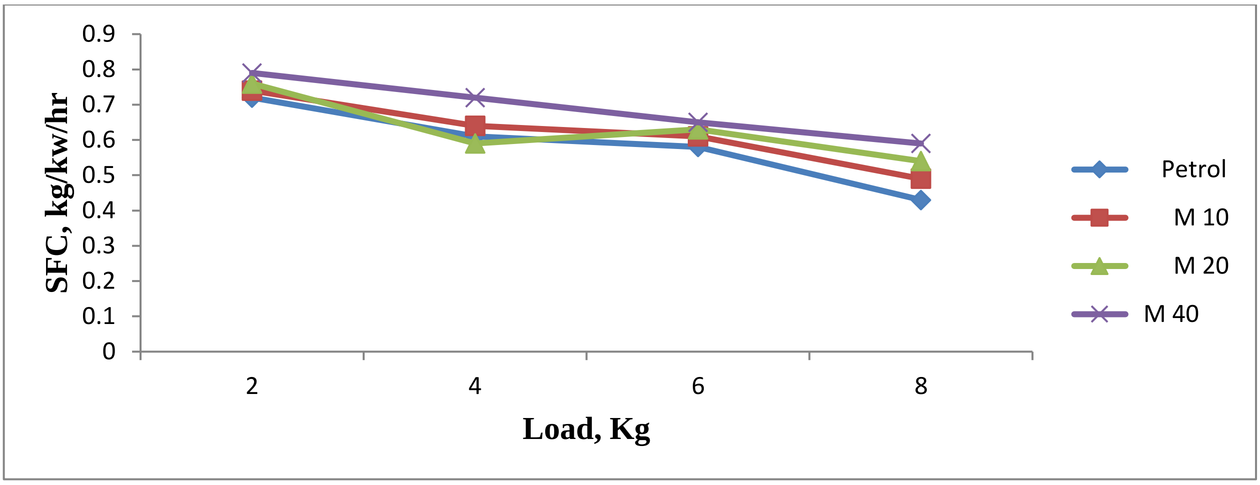

Fig. 3.2 Specific fuel Consumption at varying load different blends of Petrol-Methanol

3.3 Break thermal efficiency at varying with different blends of Petrol-Methanol

The test was conducted for pure gasoline fuel which was based line fuel and then for different blends of gasoline-methanol such as M 10, M 20, and M 40 samples .Fig 4.3 present the effect of using Methanol-petrol blends on break thermal efficiency. As shown in the figure, thermal efficiency increases as the percentage the effect of methanol increases, the maximum thermal efficiency is recorded with blend of 40% methanol in the petrol at all loads as compare to other blends the thermal efficiency increases because of better combustion due to higher octane no as compared to petrol. The maximum thermal efficiency is recorded 22.8% with the blends of M 40 at 8 kg load and the minimum thermal efficiency with recorded 10.7 with M10 at load 2 kg. Table 4.3 represent the thermal efficiency with different blends at all varying load the thermal efficiency is recorded maximum in M 40 it is 12% , 16.2% , 21.5% and 22.8 % at load between 2 to 8 kg .

Load , kg	**Petrol**	**M 10**	**M 20**	**M 40**
	Break Thermal Efficiency			
2	10.2	10.7	11.1	12
4	13.8	14.3	15	16.2
6	16.9	18.3	19.1	21.5
8	18.6	19	20.9	22.8

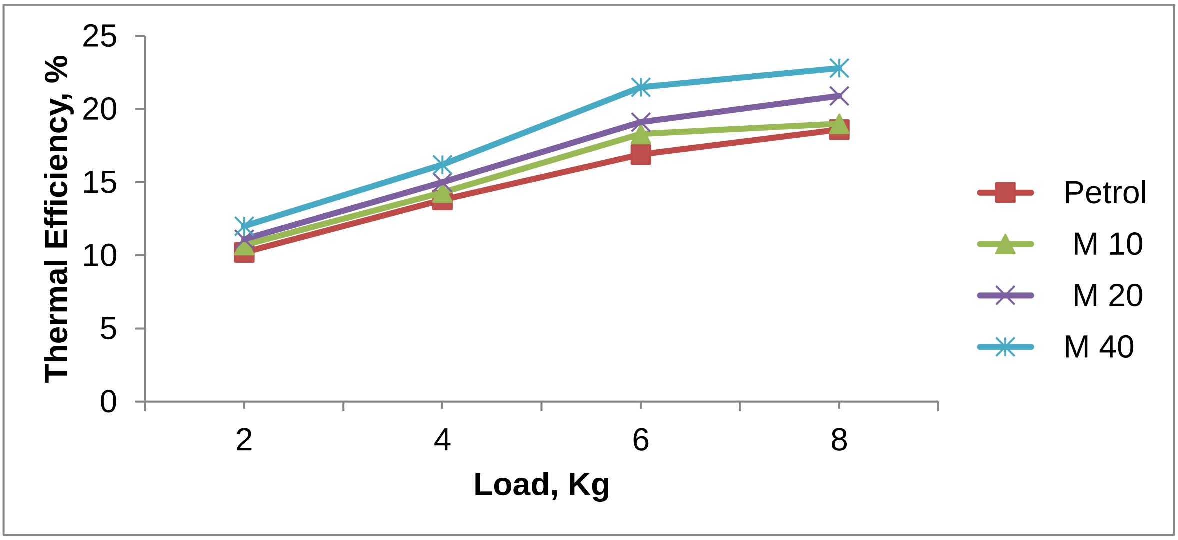

Fig 3.3 Break thermal efficiency at varying load with different blends of Petrol –Methanol

IV. CONCLUSION

The experimental performance on Sl engine with different ethanol blends with gasoline was investigated. The main outcomes of this analysis are as:

The experimental performance on Sl engine with different ethanol blends with gasoline was investigated. The main outcomes of this analysis are as:

- The experiments shows that 10% methanol blend with gasoline gives the best performance for the SI engine.
- Methanol blended with gasoline always improves the performance of SI engine and reduced the exhaust emissions also.
- It is concluded that the percentage of blends increase with petrol the brake horse power decrease at all varying load. The power output of the engine is almost near about the petrol on blend M10. It is recorded that the higher power output is 2. 85 KW with M10 blends at load 8 Kg as compare to petrol and the lowest power output is from the engine is 0.82 KW with blend M40 at load 2 Kg.
- The specific fuel consumption decrease as load increase for petrol and methanol blends. The SFC of methanol (M10) is higher at low load condition and low at high load conditions as compare to other blends.
- Thermal efficiency increases as the percentage of methanol increases. The maximum thermal efficiency is recorded with blend of 40% methanol in the petrol at all loads as compare to other blends which is observed that 22.8%.

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