ISSN: 2277-9655
Impact Factor: 1.852

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

Performance Analysis of Two Stroke SI Engine with Methanol Blending

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Abstract

Use of automobiles are increasing day by day. Alternative fuels for IC engines are also becoming important because of diminishing gasoline reserves and increasing air pollution. Methanol and Ethanol are good commodities as alternative fuels since they are in liquid form and have several physical and chemical properties similar to those of gasoline and diesel fuels. The method of Four Spark ignition is a new concept. In this study conventional two stroke SI engine with single spark plug and alcohol blending is compared with four spark plug SI engine

Keywords: Internal Combustion Engine, gasoline, octane number, alternative fuels, spark plug, methanol

Introduction

` The internal combustion engine is an engine in which the combustion of a fuel (normally fossil fuel) occurs with an oxidizer (usually air) in a combustion chamber. In an internal combustion engine, the expansion of the high-temperature and high-pressure gases produced by combustion apply direct force to some component of the engine. This force is applied typically to pistons, turbine blades, or a nozzle. This force moves the component over a distance, transforming chemical energy into useful mechanical energy. The first functioning internal combustion engine was created by Étienne Lenoir.

The term internal combustion engine usually refers to an engine in which combustion is intermittent, such as the more familiar four stroke and two stroke engines, along with variants, such as the six stroke piston engine and the Wankel rotary engine. A second class of internal combustion engines use continuous combustion: gas turbines, jet engines and most rocket engine, each of which are internal combustion engines on the same principle as previously described.

The internal combustion engine (or ICE) is quite different from external combustion engine, such as steam or sterling engine, in which the energy is delivered to a working fluid not consisting of, mixed with, or contaminated by combustion products. Working fluids can be air, hot water, pressurized water or even liquid sodium, heated in some kind of boiler. A large number of different designs for ICEs have been developed and built, with a variety of different strengths and weaknesses. Powered by an energy-dense fuel (which is very frequently gasoline, a liquid derived from fossil fuels). While there have been and still are many stationary applications, the real strength of internal combustion engines is in mobile applications and they dominate as a power supply for cars, aircraft, and boats. The importance of the world's environmental pollution and the strict governmental regulations on exhaust emissions has led us to seek alternative fuels for automotive. For these purposes a number of studies on the blends of gasoline fuel and alternative fuels have been performed.

Methanol and Ethanol are an important alcohol-based alternative fuel used to reduce air pollution level and consuming petroleum fuels. To reduce the dependency of petroleum fuels methanol and ethanol has been received much attention in recent years by many countries. Moreover, methanol and ethanol are recognized as an environmentally friendly alternative fuel because previous studies have shown that there is a substantial reduction of CO, unburned hydrocarbons and particulate matter emission in methanol and ethanol compared to conventional gasoline engines. [3,4]

Methanol or methyl alcohol (CH3OH), is the simplest aliphatic alcohol and the first member of the homologous series. It is a colorless liquid and is completely miscible with water and organic solvents [1]. The primary feed stocks for methanol production are natural gas, lignite coal, and renewable resources such as wood, agricultural biomass materials, waste biomass and municipal wastes [2]. As a liquid, the storage, transportation, distribution, and application of methanol are similar to those of traditional gasoline and diesel fuels; therefore, methanol is considered to be one of the most favorable fuels for engines of the future. Methanol has many desirable combustion and emission characteristics, such as high

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Impact Factor: 1.852

octane number indicating excellent antiknock performance; high latent heat of vaporization allowing a denser fuel– air charge; and excellent lean-burn properties. These properties make methanol a good fuel for spark-ignition Otto-cycle engines [5].

Methodology

1. Test engine is two stroke, single cylinder used in scooter .It is coupled to an Electrical dynamometer and mounted on a strong base. It is complete with air, fuel, temperature, load and speed measurement system. Testing is restricted only to load test as engine cooling rate cannot be evaluated. As alternator rated for 3000 rpm, engine is made to run at 3000 rpm with the help of accelerator assembly.

2. Here, the timing of ignition of spark for single and four plugs is not altered. It remains at the same time which was originally designed for the two stroke scooter engine. The modification carried in cylinder head by providing four spark plugs on it, removal of magneto, as originally available with the engine and replaced by four ignition coils (one for each spark plug). The contact breaker of the original magneto system was used for ignition. Electrical supply was provided by 12 volts parallel connected battery. The ignition circuit with four numbers of simultaneous sparks is shown in figure **3.** Simultaneous four sparks is provided by discharging capacitor through sparkplug where high voltage is generated at tip of the plug which provides spark in the combustion chamber.

4. We fit the spark plug at four different locations in test engine. Then we compare the result of one spark plug, two spark plug three spark plug and four spark plug.

Results

Location-1

At location 1, minimum fuel consumption is 0.38 kg/h at brake power 0.43kW in G95M5 fuel blend and maximum thermal efficiency is 19.9% at 1.43kW in G95M5 and corresponding value for gasoline is0.45kg/h and 19.2% which is shown in fig.1.1 & 1.2

G100M0			
Sr.No	BP(kW)	FC(kg/h)	η_{bth}
1	0.473	0.45	9.2
2	0.897	0.52	15.1
3	1.263	0.66	16.8
4	1.42	0.7	17.8
5	1.58	0.76	18.2
G95M5			
Sr.No	BP(kW)	FC(kg/h)	η_{bth}
1	0.43	0.38	12.2
2	082	0.44	16.3
3	1.26	0.57	19.45
4	1.43	0.63	19.9
5	1.6	0.74	19
G100M0			
Sr.No	BP(kW)	FC(kg/h)	η_{bth}
1	0.47	0.45	9.1
2	0.89	0.5	15.6
3	1.27	0.6	18.5
4	1.44	0.66	19.1
5	1.57	0.72	19.2

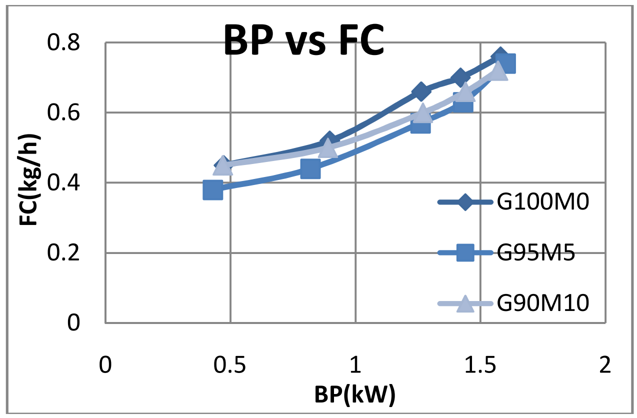

Fig. 1.1: Brake power v/s FC (Location-1)

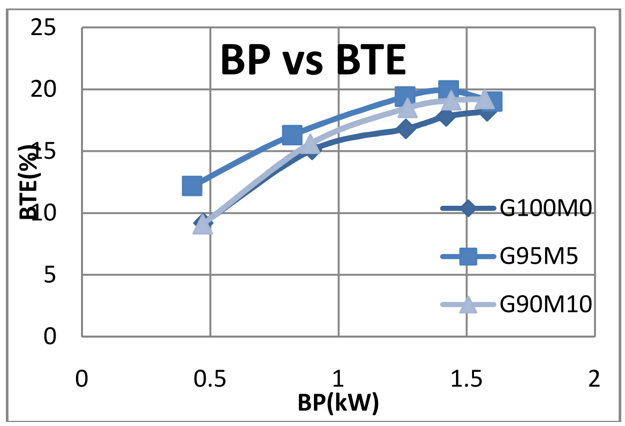

Fig. 1.2: Brake power v/s BTE (Location-1)

Location-1-2 (fig.3.1)

At location 1-2, minimum fuel consumption is 0.505 kg/h at brake Power 1.25kW inG95M5 fuel blend And maximum thermal efficiency is 19.5% at 1.4896 kW in G90M10and Corresponding value for gasoline is 0.654kg/h and 19.2% which is shown in fig.1.3 & 1.4

G100M0			
Sr.No	BP(kW)	FC(kg/h)	η_{bth}

ISSN: 2277-9655
Impact Factor: 1.852

1	1.2347	0.6547	16.55
2	1.5042	0.75	19
3	1.556	0.7892	19.2
G95M5			
Sr.No	BP(kW)	FC(kg/h)	η_{bth}
1	1.25	0.505	17.76
2	1.4896	0.656	19.5
3	1.5497	0.723	21.3
G100M10			
Sr.No	BP(kW)	FC(kg/h)	η_{bth}
1	1.24	0.63	17.28
2	1.4896	0.7411	18
3	1.6101	0.8129	18.5

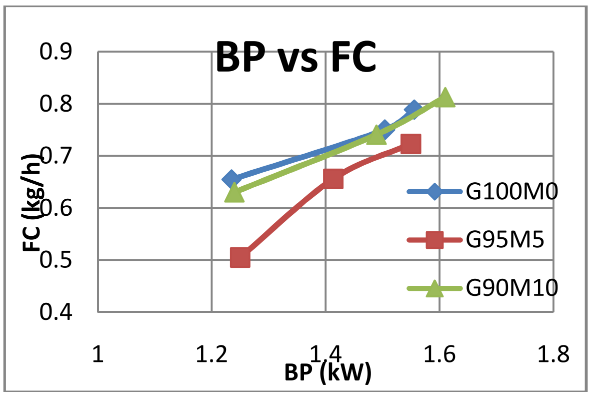

Fig. 1.3: Brake power v/s FC (Location-1-2)

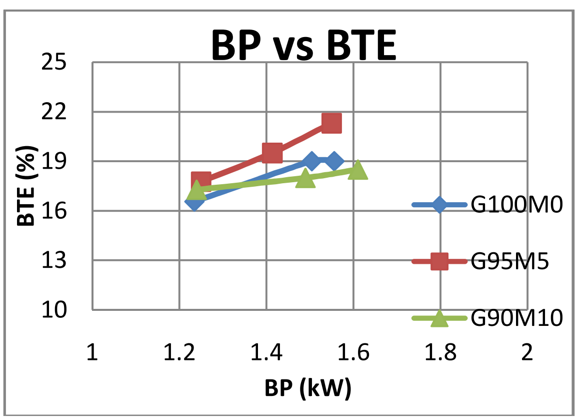

Fig. 1.4: Brake power v/s BTE (Location-1-2)

Location-123

t location 123, minimum fuel consumption is 0.62 kg/h at brake power 1.194kW in G100M0 fuel blend and maximum thermal efficiency is 22.24% at 1.68kW in G95M5 and corresponding value for gasoline is 0.62kg/h and 18.36% which is shown in fig.1.5 & 1.6

G100M0			
Sr.No	BP(kW)	FC(kg/h)	η_{bth}
1	1.194	0.62	17.47
2	1.509	0.723	18.30
3	1.7	0.812	18.36
G95M5			
Sr.No	BP(kW)	FC(kg/h)	η_{bth}
1	1.278	0.63	18.02
2	1.563	0.652	21.04
3	1.68	0.663	22.24
G100M0			
Sr.No	BP(kW)	FC(kg/h)	η_{bth}
1	1.268	0.614	18.11
2	1.528	0.663	20.23
3	1.63	0.681	21.00

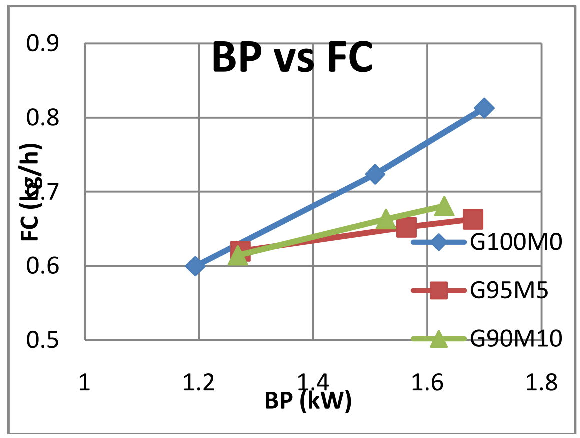

Fig. 1.5: Brake power v/s FC (Location-123)

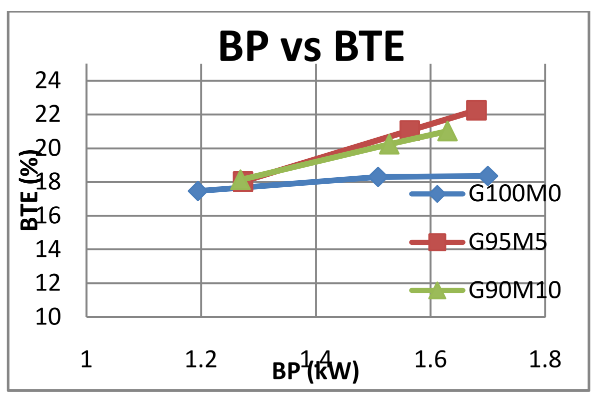

Fig. 1.6: Brake power v/s BTE (Location-123)

Location-1234

At location 1234, minimum fuel consumption is 0.586 kg/h at brake power 1.428kW in G95M5 fuel blend and maximum thermal efficiency is 26.92% at 2.217kW in G90M10 and corresponding value for gasoline is 0.681kg/h and 20.57% which is shown in fig.1.7 & 1.8

G100M0			
Sr.No	BP(kW)	FC(kg/h)	η_{bth}
1	1.449	0.6810	18.67
2	1.58	0.7636	19.5
3	1.846	0.7875	20.57
G95M5			
Sr.No	BP(kW)	FC(kg/h)	η_{bth}
1	1.428	0.586	21.39
2	1.568	0.61	22.48
3	1.92	0.663	25.42
G100M0			
Sr.No	BP(kW)	FC(kg/h)	η_{bth}
1	1.532	0.6	22.42
2	1.659	0.63	23.12
3	2.217	0.7231	26.92

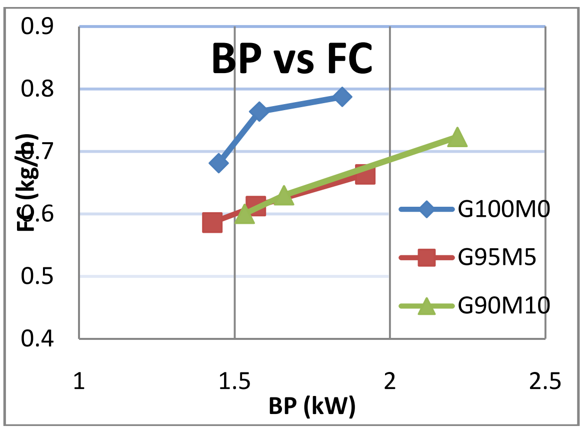

Fig. 1.7: Brake power v/s FC (Location-1234)

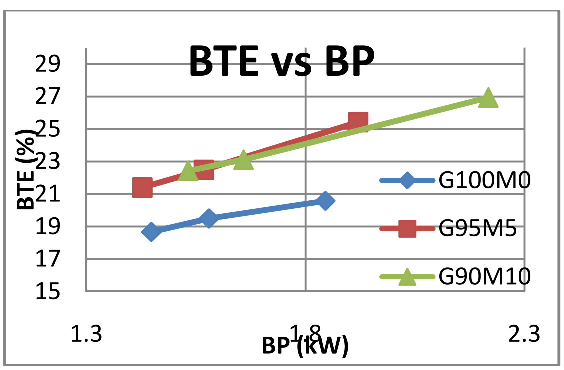

Fig. 1.8: Brake power v/s BTE (Location-1234)

Conclusion

From this study, it can be concluded that low fraction methanol/gasoline blend can be used in SI engines with multi spark plugs in single cylinder engine. The fuel blend has slightly lowered the engine power and torque, while increases engine brake thermal efficiency. For better operation, spark timing will be optimized. Methanol gasoline blended fuel may lower HC and CO emissions. However, the increase of methanol increases the formaldehyde emissions and methanol emission increases with the increase of engine load under different speeds. The most interesting thing is that methanol addition to gasoline improves the SI engine cold start and lower CO and HC emissions significantly. From the result we conclude that fuel consumption and brake thermal efficiency of 5% methanol is very good

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