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Experimental Investigation of SI Engine Characteristics with Methanol Blended Petrol

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Abstract- Today many countries in the world are facing a serious issue of pollution as well as increased global consumption of fossil fuels. A petrol engine is an internal combustion engine with spark ignition, designed to run on petrol and similar volatile fuels. This current work present the scenario of petrol engines characteristics when used with alcohol fuels like methanol in blended form with petrol. Experiments are carried out for analyzing various parameters such as break thermal efficiency, specific fuel consumption, and emissions of CO, HC, and NO_X gases in exhaust for different fuel blends at different engine conditions. All these characteristics which are found by experimenting methanol blended petrol fuel are compared with characteristics obtained by pure petrol. The experimental results revealed the considerable improvement in reduction of exhaust emissions with little compromise in performance.

Keywords- SI Engine, petrol, methanol, performance and emissions

1. INTRODUCTION

The world's fossil fuel reserves are limited and there has been intensive research to find out alternatives to fossil fuels. Hence, there is a progressive interest related to using non-fossil sources in vehicle. The alcohols are major renewable energy sources to supplement declining fossil fuel reserves. This work presents comparative as well as experimental studies of the SI engine using methanol blends with petrol. There are many alternatives for petrol, among them methanol to be most useful one because of higher octane value and more volatility in nature for effective vaporization during carburation process.

In recent years several researches have been carried out to the influence of methanol on the performance of spark ignition engines. Among the alcohols, methanol has the lowest combustion energy. However, it also has the lowest stoichiometric or chemically correct air-fuel ratio. Therefore, an engine burning methanol would produce the maximum power. A lot of research has been done on the prospect of methanol as an alternative fuel. Methanol, CH3OH, is the simplest of alcohol and originally produced by the destructive distillation of wood. However, methanol can be produced from many fossil and renewable sources which include coal, petroleum, natural gas, biomass, wood landfills and even the ocean [1]. Saugirdas Pukalskas & Juozas Grabys [2] studied the influence of gasoline -ethanol blends on parameters of engines. Their results showed that when ethanol is added, the heating value of the blended fuel decreases, while the octane number of the blended fuel increases. Also the engine power and specific fuel consumption of the engine slightly increase with blends. M.V.Mallikarjun and Venkata Ramesh Mamilla [3] carried out study on four cylinders, S.I engine by adding methanol in various proportions in gasoline under different load conditions of the engine. For blends(0-15) pertaining to performance of engine it is observed that there is an increase of octane rating of gasoline along with increase in brake thermal efficiency, indicated thermal efficiency. A. Kowalewicz [4] investigated the use of methanol as a fuel for spark ignition engines. He concluded that a neat methanol engine has 30% more efficiency than a regular engine, not only due to high compression ratio but also due to methanol's higher heat of vaporization that cools the air in the engine to a larger extent, thus increasing the density and allowing more air in. This results in a leaner fuel mixture, possibly lowering emission of CO due to more complete combustion. Turkcan et al.[5] reported the effect of methanol/diesel and ethanol/diesel fuel blends on the combustion characteristic of an IDI diesel engine at different injection timings by using five different fuel blends (diesel, M5, M10, E5 and E10). The tests were conducted at three different start of injection. Liu Shenghua et al. [6] worked on a three-cylinder SI engine with different ratios of methanol (10%, 15%,20%, 25% and 30%) in gasoline under the full load condition. Their results showed that the engine power and torque decreased, while the brake thermal efficiency improved with the methanol quantity increase in the fuel blend. Yanju et al. [7] investigated three typical methanol–gasoline fuel blends M10, M20, and M85 in an SI engine. They stated that with the increase of fraction methanol in gasoline, the CO emission decreases and the reduction is 25% for M85, and the low methanol ratio fuel blends have no significant effect on reducing the NOx emission while M85 gives an 80% reduction.

2. EXPERIMENTAL FACILITIES

2.1 Engine

The engine used for the current experimental study is 4 Stroke single cylinder stationery petrol engine. The detailed specifications of the test engine are given in table 1 and experimental setup is shown in figure 1.

Table 1: Test Engine Specifications

Engine	Birla Power
Bore/ Stroke	61.9mm/60mm
Starting	Rope & Pulley Starting
Method of Ignition	Spark Ignition
Power	2.5kw
Speed	3000rpm

Fig.1 Experimental Test Setup

2.2 Exhaust gas analyser

The exhaust gas analyser used for the present study is Indus made five gas analyser. The detailed technical specifications of exhaust gas analyser are given in below table 2 and its photograph is shown in figure 2.

Fig.2 Exhaust Gas Analyser

Table:2 Specifications of Exhaust Gas Analyser: INDUS make and PEA 205

Type of Emission	**Range**	**Resolution**
NO X (ppm)	0-5000	1
HC (ppm)	0-15000	1
CO (%)	0-15.0	0.01
O_2 (%)	0-20.0	0.01
CO_2 (%)	0-20.0	0.01

3. RESULTS AND DISCUSSION

Various tests on 4-S single cylinder SI engine at different loading conditions with pure M0 (pure petrol), M5 (5%methanol and 95% petrol), M10 (10%methanol and 90% petrol), M15 (15%methanol and 85% petrol), and M20 (20%methanol and 80% petrol) are conducted and the results in terms of performance and emissions obtained are discussed as follows

3.1 Mass of Fuel Consumed

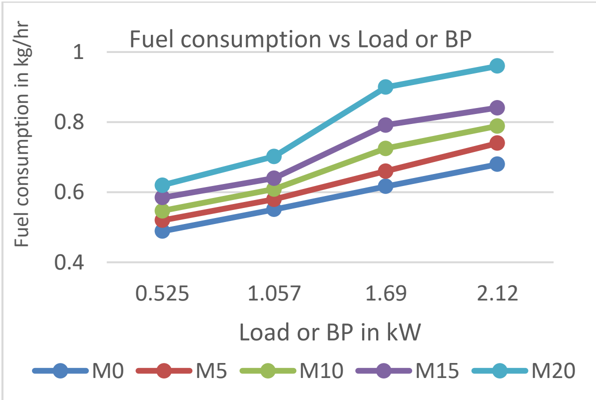

Fig.3 Variation of Fuel consumption with Engine Load

The variation of Fuel consumption of M0, M5, M10, M15, M20, fuels with variation in Brake power is described in the above Figure 3. From the Figure it can be observed that the Mfc increases with increase of concentration of Methanol in Petrol at all loads. At starting loads there is slight variation in fuel consumption for different blends, but as the load increases the variation is very much observed.

3.2 Brake Specific Fuel Consumption (BSFC)

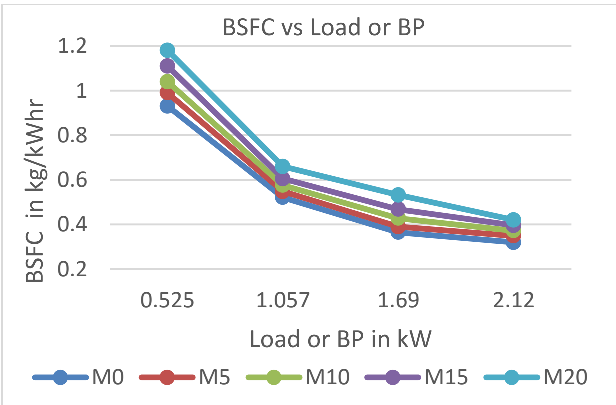

Fig.4 Variation of Brake Specific Fuel consumption with Engine Load

The variation of Brake Specific Fuel consumption of M0, M5, M10, M15, M20 fuels with variation in Brake power is described in the Figure 4. From the Figure it can be observed that the BSFC decreases as the load increases but increases with increase of concentration of Methanol in Petrol at all loads. At starting loads there is much variation in BSFC, but as the load increases the variation is observed to be less.

3.3 Brake Thermal Efficiency (BTE) (%)

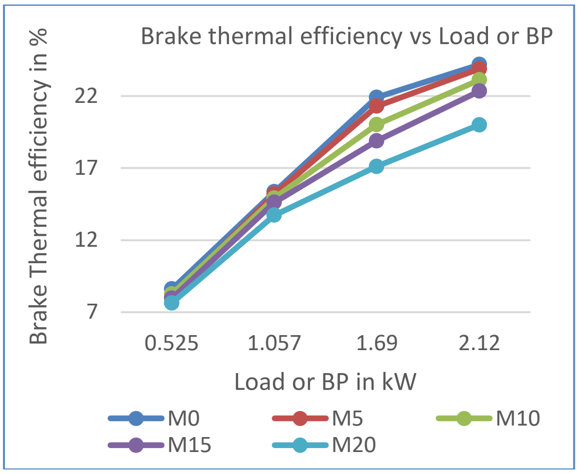

Fig.5 Variation of Brake Thermal Efficiency with Engine Load

The variation of Brake Thermal Efficiency of M0, M5, M10, M15, M20 fuels with variation in Brake power is described in the Figure 5. From the Figure it can be observed that the BTE decreases with increase of concentration of Methanol in Petrol at all loads. The BTE is also observed to be increasing as the load increases.

4.4 CO Emissions (%)

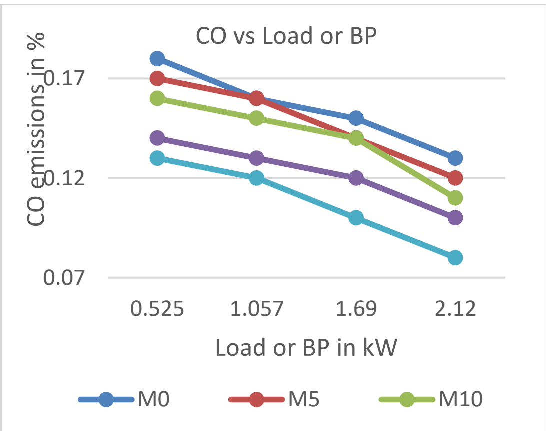

Fig.6 Variation of CO Emission with Engine Load

The variation of CO Emissions of M0, M5, M10, M15, M20 fuels with variation in Brake power is described in the Figure 6. From the Figure it can be observed that the CO Emissions decrease with increase in concentration of Methanol in Petrol at all loads. It is also observed that the emissions are being reduced as the load is getting increased.

3.5 HC Emissions (ppm)

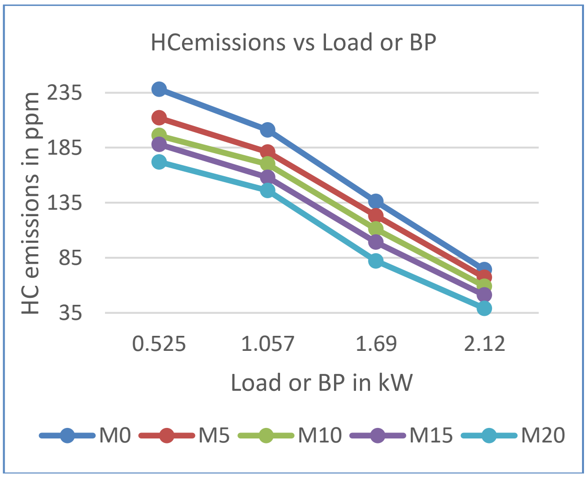

Fig.7 Variation of HC Emission with Engine Load

The variation of HC Emissions of M0, M5, M10, M15, M20, fuels with variation in Brake power is described in the Figure 7. From the Figure it can be observed that the HC Emissions decreases with increase in concentration of Methanol in Petrol at all loads. It is also observed that the emissions are being reduced as the load is getting increased.

3.6 CO_2 Emissions (%)

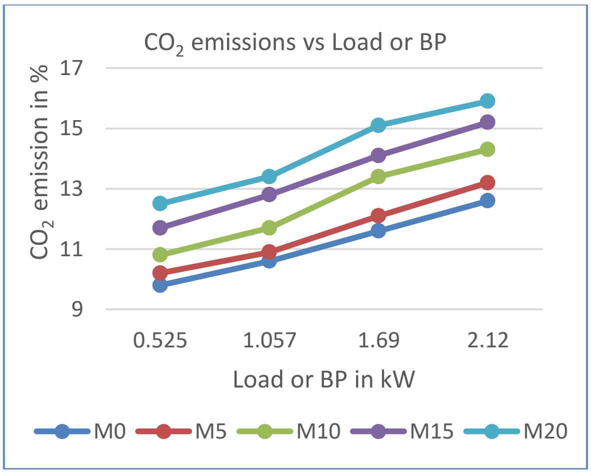

Fig.8 Variation of CO_2 Emission with Engine Load

The variation of CO_2 Emissions of M0, M5, M10, M15, M20, fuels with variation in Brake power is described in the Figure 8. From the Figure it can be observed that the CO_2 Emissions increase with increase in concentration of Methanol in Petrol at all loads. It is also observed that the emissions are being increased as the load is getting increased.

3.7 NO_X Emissions (ppm)

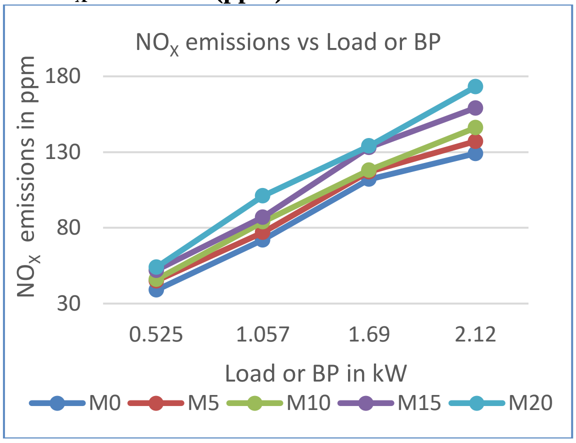

Fig.9 Variation of NOx Emission with Engine Load

The variation of NOx Emissions of M0, M5, M10, M15, M20, fuels with variation in Brake power is described in the Figure 9. From the Figure it can be observed that the NO_X Emissions increase with increase in concentration of Methanol in Petrol at all loads. It is also observed that the emissions are being increased as the load is getting increased.

4. CONCLUSIONS

The performance and emission characteristics of Methanol fuel has been analyzed and compared with Petrol fuel. Yet the result did not prove to be more efficient, the study shows that the emissions are greatly reduced using the blended fuel which raises the hope of reducing the environmental pollution and global warming effects.

Performance Characteristics

As the Load or Brake Power increases and percentage of methanol in the blend increases

- The Mass of Fuel Consumed increases.
- The Break Specific Fuel Consumption decreases.
- The Brake Thermal Efficiency decreases with methanol blend and increases with load.

Emission Characteristics

As the percentage of methanol in the blend increases

- The CO Emissions are reduced.
- The HC Emissions are reduced.
- The CO_2 Emissions are increased
- The NO_X Emissions are increased.

Hence the Petrol fuel blended with Methanol can be used in existing Petrol engines to reduce the emissions without compromising much in performance to ultimately reduce the dependency on petroleum diesel fuels.

5. ACKNOWLEDGEMENTS

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