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Performance and Emission Evaluation of Gasoline-Methanol Fuel Blend at Different Conditions in SI Engine

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Abstract

Evaluation of the effects of Gasoline-Methanol (GM) fuel blends on SI engine perfor-mance and emissions analysis was the aim of this research. Engine performance was ana-lyzed using M15 fuel blends at Wide Open Throttle (WOT) and various speed conditions between 1200 to 1800 rpm. A computerized 4s, 1cyl, VCR petrol engine test setup was used for the experimental work. The results found that the BSFC of M15 blends in-creased as much as regular gasoline for all engine speeds at full load. Exhaust emissions, including CO, HC, CO_2*, and NOx, are found to be minimized while engine torque and brake power (BP) is less than regular gasoline. This research recommends a methanol-gasoline blend can be an effective alternative for gasoline in transportation engines with-out requiring hardware modifications or causing major environmental harm. It found that the M15 fuel blend was appropriate for both increasing engine performance and reducing emissions.*

Keywords: *Blends, Emissions, Gasoline, Methanol, Performance, SI engine*

1.0 Introduction

The current research focuses on the exploration of renewable energy sources and their efficient use. Fossil fuels are a vital source of energy. Global warming is a significant environmental risk related to these fossil fuels, which is one of the main downsides. Alcohol-based fuels are one such substitute for pure gasoline. The physical characteristics of ethanol and methanol make them potential alternatives to gasoline in SI engines[1]. Renewable nature is one of the advantages of alcohol fuels. Biomass or fossil fuels can be used in the production of methanol. It was typically made of wood in the past. A recent development in methanol synthesis involves the use of renewable energy sources for mixing carbon dioxide with hydrogen produced by water electrolysis. By extracting CO_2 from the environment, this technique produces methanol using low- and zero-net-carbon processes. Thus, efforts to reduce global warming are directly affected by the increasing level of GHG emissions. Methanol has the potential to be used as an alternative fuel in automotive applications[2]. A practical solution to the worldwide fossil fuel problem is provided by biofuels. The key benefits of biofuels for the environment are the

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tendency to reduce atmospheric emissions of CO_2, COx, SOx, and NOx. A global issue has emerged with the energy usage of the transportation sector. The issue of fossil fuel depletion is becoming increasingly crucial as global energy demands rise continuously. The issue prompted the development of new energy-management technologies and the stringent demand for a transition from conventional fossil fuels to biofuels to fulfill our energy needs and decrease CO_2 emissions[3]. A potential substitute for fossil fuels is methanol in internal combustion engines because it is widely available, does not interfere with food supply, and is produced at a lower cost than other alcohol groups. Methanol has several advantages when used as a fuel in IC engines. Some of these benefits include a low ignition temperature, a rapid flame speed that enhances output power, a high Hydrogen-To-Carbon (H/C) ratio that lowers harmful emissions, and the latent heat of vaporization that increases volumetric efficiency[4]. SI may run on alcohol since they possess a more Octane Number (ON) and more oxygen. With their physical and chemical properties to petrol and diesel, both methanol and ethanol make good substitute fuels[5]. Zhang *et al.*[6] found that while cars running on E7.5 or M7.5 emit less CO and HC than vehicles running on E10/M15, pure gasoline, NOx emissions increased by 7.5% to 25.8%. Li *et al.*[7] presented a comparative analysis of exhaust emissions, engine combustion, as well as performance, parameters of port fuel injection engines on various blends of alcohol (10% E - 60% E, 10% M- 60% M, 10% B-60% B) to gasoline fuel at varying loads, alcohol percentages, and equivalence ratio. Balki *et al.*[8] studied engine emissions as well as performance parameters for pure methanol and ethanol with gasoline fuel were evaluated at optimum operating conditions. For these reasons, the best engine performance values are obtained by using Analysis of Variance (ANOVA) and taguchi statistical methods to identify the optimum operating conditions. Elfasakhany[9] conducted at the same running conditions, minimum fuel blend ratios (3 to 10 percent vol. in gasoline fuel) during the engine speeds (2600 to 3400 rpm) at the half-valve opening position of the SI engine. They found an increase in BP, torque, and vol. efficiency but CO, and UHC decreased when EM fuel blends were used instead of other blended fuels. Among all blended fuels, EM fuel blends can give optimum performance as well as minimal emission levels (CO and UHC). Simeon Iliev[10] in this paper results showed that BP decreased while BSFC increased than unleaded gasoline by using fuel blends of gasoline-alcohol. Both carbon monoxide and hydrocarbon concentrations decrease as the amount of fuel blends increases while there is a considerable rise in nitrogen oxide emissions when increments in the quantity of blends of fuel go up to 30% (M30, E30). Elfasakhany[11] in this paper test results on Gasoline-Methanol (GM), Pure Gasoline (G), and Ethanol-Methanol (EM) blends were compared with low percentage ratios (3 to 10 percent volume) of dual alcohol blends in gasoline fuel. Among all the test fuels, Gasoline-Methanol (GM) blends were minimal carbon monoxide and unburned hydrocarbon exhaust emissions. Also, results found that Gasoline-Methanol (GM) blends present maximum torque and volumetric efficiency from a performance point of view. Qi *et al.*[12] investigated that when there is a rise in the amount of methanol fuel in the blends there is a decrease in peak engine power as well as torque while a significant rise in BSFC along with BTE remains equal. At low engine loads, M10 (10 vol.% methanol in gasoline) has less NOx, while the blends have less CO, and the HC concentration is slightly higher. Agarwal *et al.*[13] in this paper found that methanol blends have better brake thermal efficiency than gasoline. Blends of methanol and gasoline, or gasohol, produce less CO, NO, and smoke in comparison to regular gasoline. Balki *et al.*[14] results found that there is rise in Thermal Efficiency (THE), engine combustion efficiency, and BSFC by using alcohol fuels. Furthermore, cylinder gas pressure as well as heat release rate increased early, whereas carbon dioxide, NOx, CO, and HC pollutants were reduced. Altun *et al.*[15] Results in this paper showed that using 10% ethanol or methanol blended with unleaded gasoline fuel compatible with existing engines or vehicles and variables at various operating conditions minimized exhaust emissions of CO, BTE, and HC while enhancing BSFC. Canakci *et al.*[16] results indicated that emissions including CO, CO2, and NOx pollutants were minimized for all power output at a rate of 80 km/hr while engines were operating on alcohol-gasoline fuel blends. Evaluated values of engine emissions by using blends M10 (10% M + 90% G), E10 (10% E+90% G), E5 (5% E+ 95% G), and M5 (5% M+95% G) compared to unleaded gasoline fuel. Danaiah *et al.*[17] this paper presented methanol blends with better engine performance as well as emission parameters that demonstrate a substantial decrease in exhaust pollutants as compared to conventional gasoline fuel. Fuel blends between M10 (10% M + 90% G) and M15 (15% M + 85% G) lead to significant decreases in exhaust emissions and performance. Çelik *et al.*[18] revealed that boosting the methanol CR between 6:1-10:1 resulted in improvements in brake thermal efficiency and power output of up to 14% to 36%, respectively. Additionally, there was about 30%, 37%, and 22% reduction in carbon dioxide, carbon monoxide, as well as nitrogen oxides, respectively. Li *et al.*[19] studied that when compared to a non-optimized instance, the methanol engine's BSFC can be improved by over 10 percent across the full load range at 1600 revolutions per minute speed through the optimization of Ignition Timing (IT) as well as injection. The optimum Ignition Timings (IT) and injection give the best compromise between exhaust pollutants as well as Thermal Efficiency (THE). Eyidogan *et al.*[20] evaluated on 4 cyl, 4s MPFI SI engine employed in the fueled vehicle. While using ethanol or methanol-gasoline fuel blends BSFC improved, and cylinder gas pressure rose (CGP) more than the pure gasoline. Fan *et al*[21]. The results of the experiments indicate that the small quantity of Gasoline-Methanol (GM) blended fuels has minimal impact on energy consumption or power output. Methanol content in gasoline was directly proportional with increases in engine-out methanol and formaldehyde, two uncontrolled pollutants. However, adding methanol fuel produced negligible effect on ethanol fuel as well as acetaldehyde pollutants. Liu *et al.*[22] discussed engine torque and power have been marginally reduced by the methanol-gasoline fuel blend, while BTHE has increased. Spark Timing (STs) is required to be optimal for better performance. When methanol is added to gasoline, it significantly decreases emissions of carbon monoxide and hydrocarbons while improving the efficiency of SI engines on cold stars. Most of the researchers used different fuel blends with additives to analyze the overall performance as well as emissions of gasoline and diesel engines based on previous literature reviews. However, as far as the author's understanding, not much research has been done on gasoline-to-methanol blends using SI engines at various conditions or at their optimum value. The gasoline-methanol blend and its compatibility for use with existing vehicles or engines are the focus of the current research which fills this gap. Optimum gasoline and methanol blends from an emissions and performance perspective are the aim of this work. The experimental method is described in the next sections, and the paper ends with a discussion of results and a summary of conclusions.

2.0 Experimental Methodology

Gaining a better understanding of engine performance as well as emission characteristics by using a gasoline-methanol blend is the main goal of the research presented in this section. In this study, Gasoline-Methanol (GM) fuel blends effects on emissions and engine performance are compared to those of pure gasoline. Comparing Gasoline-Methanol (GM) blends to unleaded gasoline through experimentation at different speed conditions from 1200 to 1800 rpm. In the next section, details of the engine setup and the experimental methodology are discussed.

2.1 Fuel Blends Preparation

The experiment used a Gasoline-Methanol (GM) fuel blend. In the research lab of Apex Innovations Pvt. Ltd, Sangali, a gasoline-methanol blend was prepared. UN 1230 flammable liquid placard-methanol procured from impression chemicals enterprises, Sangali (Maharashtra). The gasoline used in this work was purchased at a commercial petrol pump operated by Hindustan Petroleum Corporation Limited (HPCL). Gasoline and methanol are used in different quantities to prepare fuel blends. Initially add 5-10 ml of water to regular gasoline to start the process of separating ethanol from gasoline. Make sure the fuel blend is well-prepared and homogeneous before beginning the experiment. That blend is kept for 5 to 10 minutes and then the phase takes place while adequate contaminates of water and ethanol blended with gasoline causes ethanol fuel to attach itself with liquid particles going to the bottom and leaving two

Table 1. Fuel properties[9]

Properties	Methanol	Gasoline
Composition (C, H, O) (mass%)	37.5,12.5,50	86,14,0
Chemical formula	CH_3OH	C_8H_{15}
Boiling point (^{0}C)	64.5	25–215
Heat of evaporation (kJ/kg)	920.7	223.2
Density (kg/m3)	796	760
Oxygen content, mass%	49.9	0.0
Stoichiometric A/F ratio	6.4	14.6
Saturation pressure at 38 ^{0}C (kPa)	31.69	31
Lower heating value (MJ/kg)	20.1	43.5
Solubility in water (ml/100 ml H_2O)	Fully miscible	<0.1
Flash point (^{0}C)	11.1	-45 to -38
Vapor toxicity	Toxic in only large doses	Moderate Irritant
Auto-ignition temperature (^{0}C)	470	420

different layers in the fuel storage tank and only gasoline phase on the upper side and ethanol-water mixture at the lower side. 85% gasoline blended with 15% methanol to obtain mixtures called M15. In this experimental work fuel properties are shown in Table 1. To get optimal results for the trials, the engine was running at 1800 rpm. The engine will be run on a Gasoline-Methanol (GM) blend during 1200-1800 rpm, with a CR of 10:1 at full throttle. Results from experimental work to be graphically compared. AVL DIGAS 444 gas analyzer is used for exhaust gas emissions analysis as well as checking in all tests including AFR, CR, STs, and Methanol-Gasoline (GM).

2.2 Engine Test Rig and Procedure

The engine configuration consists of a 4 cylinder, 1 cyl, Kirloskar, 4.5 kW (TV1), Variable Compression Ratio (VCR) petrol engine (Figure 1). Table 2 shows the specifications of the engine. The instruments used for the defined work include an electronic control unit (ECU), digital manometer, burette and stopwatch, Exhaust Gas Analyzer (EGA), gasoline engine test rig, and chrome aluminum (K-Type). The internal combustion engine

Table 2. Specifications of engine

Components	Details
Manufacturer	M/S Kirloskar Oil Engines Ltd.
Model	TV 1
Ignition	Spark Ignition
Cycle	4 Strokes
Rated Power	4.5kW @ 1800 rpm
Compression ratio	10:1
Connecting rod	234mm
Injection timing	359^0 BTDC
Injection pressure	3 bars
No. of Cylinders	1 Cylinder
Bore/Stroke	87.5 /110 mm
Cubic Capacity	661 cm^3
Type of Cooling	Water Cooled

Table 3. Gas analyzer details[8]

Model	AVL DIGAS 444 Gas Analyzer
Measuring principle	NDIR
Weight	4.5kg
Measuring range	
O_2	0-22 (vol.%)
CO_2	0-20 (vol.%)
NO	0-4000 (ppm)
CO	0-15 (vol.%)
HC	0-20000 (ppm)
Engine Speed	400- 6000 (rpm)
Lambda (λ)	0 - 9.999
Oil Temperature	- 30 -125 0C

was coupled to an eddy current dynamometer at different engine loads. The test engine's CR was set to be 10:1. Vital instruments for measuring cylinder pressure as well as crank angle were set up in the engine set. Data loggers and computer systems were interfaced with signals for both P-V as well as P- θ diagrams. Engine load measurements, Temperatures (T), fuel flow, and airflow were linked with the computer. A panel box that included a U-tube manometer, an air box, fuel tanks for the blend test, and a gasoline measuring system.

Such different choices of outcome measures raise the question of what outcome measures should be considered as standard for evaluating intervention effectiveness or appropriate in what circumstances.

The arrangement comprised transmitters employed to monitor air and fuel flow. Water flow was measured with calorimeters and cooling water rotameters. Experimental methanol-gasoline blends were evaluated at a constant 1800 rpm during a range of load conditions, from 0 to 24 kg. The trials evaluated engine performance based on different parameters including BP, BT, FP, BMEP, FMEP, BTHE, IP, mechanical efficiency, BSFC, and heat balance. Engine exhaust gases including NOx, HC, CO_2, CO, and O_2 are measured with the AVL DIGAS 444 Exhaust Gas Analyzer (EGA). Gas analyzer details are shown in Table 3. The "engine soft" software programme package, which is based on LabVIEW, is used for online engine performance evaluation. A test engine was equipped with a piezoelectric dynamic pressure sensor (BERU PSG) to obtain in-cylinder pressure data. Using a national instruments data acquisition system for each crank angle between -3600 to +3600 CA, cylinder pressure readings were recorded. Temperatures of exhaust gases are measured using the thermocouples of type K.

Figure 1. Computerized 4s, 1cyl, VCR Petrol engine test rig Source: Apex Innovations. (IC engine research lab).

The test rig runs on Gasoline-Methanol (GM) fuel mixtures driven by a computerized 1cyl, 4s VCR Kirloskar 4.5 kW (TV1) SI engine without any engine modifications as shown in Figure 1.

In this research work the engine speed with 20^0 Spark Timings (STs) is kept between 1200 to1800 rpm for a CR of 10:1, and the A/F ratio is maintained at 0.9 for all operating conditions. For all performance and emission parameters, each reading is obtained four times. Pure gasoline (G) and Gasoline-Methanol (GM) fuel blends are used in a SI engine to perform the following experiments. Take care that the safety procedures in the laboratory are adhered to, starting from the point when the engine is started for the check and continuing until the readings are finished. The electrical supply should be turned on immediately when the engines are not underload to measure speed and load accurately. prior to running the engine, fill the fuel tank with the tested fuel-pure gasoline or a Gasoline-Methanol (GM) blend. When an engine is operating at its rated 1800 rpm, steady-state conditions

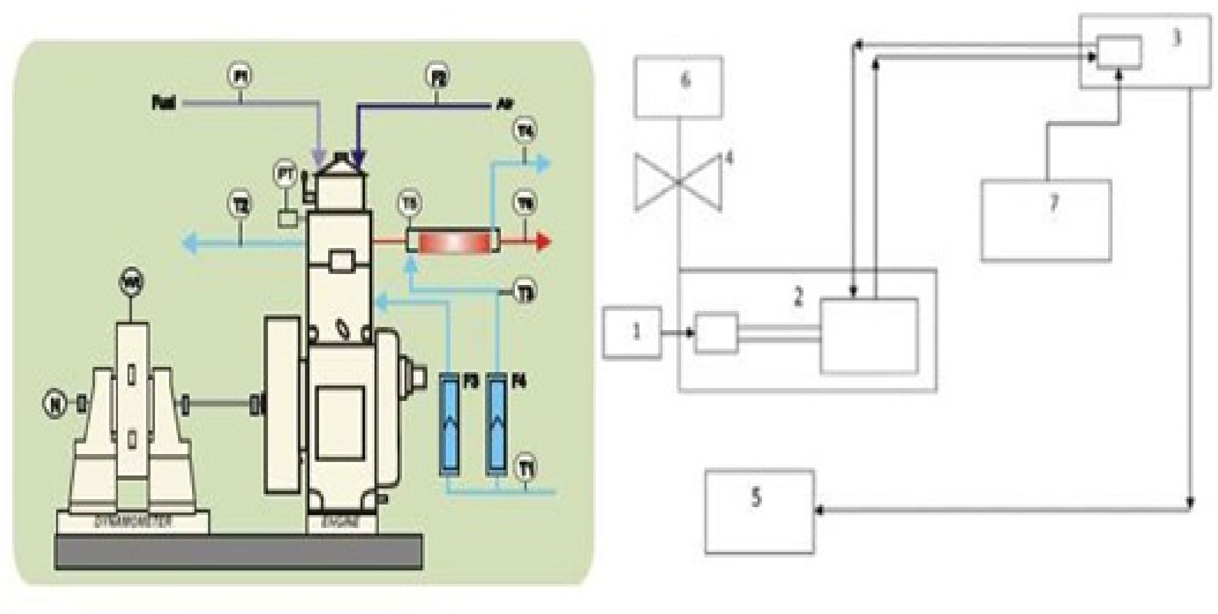

Figure 2. Schematic layout of engine test rig, **(a)** Diagram **(b)** Line diagram.
1. Eddy Current Dynamometer (ECD) loading, 2. 1 cyl, 4s petrol engines and Alternators, 3. Exhaust Gas Recirculation (EGR) Systems, 4. control valves or flow controllers 5. exhaust gas analyzers and opacity meters, 6. fuel storage tank, 7. air drum or air receiver but,
T1 stands for jacket cooling water inlet temperature.
T2 stands for jacket cooling water outlet temperature.
T3 stands for calorimeter cooling water inlet temperature.
T4 stands for calorimeter cooling water outlet temperature.
T5 stands for the Exhaust Gas Temperature (EGT) before the calorimeter.
T6 stands for the Exhaust Gas Temperature (EGT), after the calorimeter.
F1 stands for flow rate of fuel.
F2 stands for flow rate of air.
F3 stands for cooling water engine jacket flow rate.
F4 stands for cooling water calorimeter flow rate.
W stands for load cell reading

are reached. Using an eddy current dynamometer, the engine is loaded by varying the positions of the knobs on the control panel. A gas analyzer called AVL DIGAS 444 is used to measure exhaust emissions gases. Measurement of exhaust emissions gases is done with an AVL DIGAS 444 gas analyzer. To analyze the overall performance as well as combustion data for various load conditions, connect the engine to the computer operating the Lab View software (Engine Soft). The above experimental procedure was repeated for different loads of pure gasoline along with gasoline-methanol blends.

3.0 Result and Discussions

For performance as well as emissions evaluation a 1-cylinder, 4-stroke, variable compression ratio gasoline engine with Gasoline-Methanol (GM) blend is used. In this experimental work, pure gasoline plus gasoline-methanol fuel blends with varying speeds of 1200-1800 rpm on an SI engine. Engine performance, as well as emissions evaluation by using Gasoline-Methanol (GM) blends and regular gasoline at various operating conditions with constant compression ratio 10:1 A/F ratio = 0.9 and STs = 20^0. The following section represents the effect of gasoline-blended methanol in percentages varying between 0% to 15% for engine performance characteristics like BSFC, BT, and BP comparing to speed in rpm and the exhaust emissions gases like CO, CO_2, HC, and NO_x.

3.1 Engine Performance Characteristics

3.1.1 Brake Torque

Figure 3 indicates the variation of BT versus engine speed in M0 and M15 blends as speed increases. In comparison to M0, torque was reduced for M15. The findings explicitly show that the torque obtained by pure gasoline and methanol-fueled gasoline was equal.

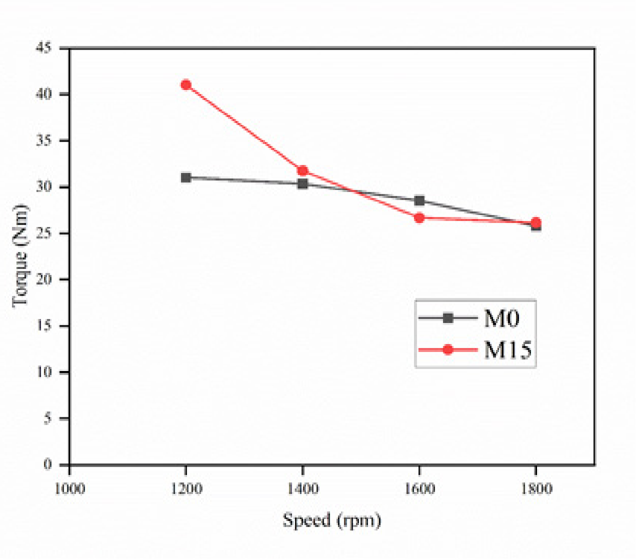

Figure 3. Variation of torque with speed.

3.1.2 Brake Power

Figure 4 indicates the variation of BP vs speed for M0 and M15 blends. Because methanol fuel has a much lower Calorific Value (CV) than M0, using M15 blends at higher speeds will produce more BP than M0, as shown by the trends in the graph.

3.1.3 Brake Specific Fuel Cosumption

Figure 5 shows a graph plotted for BSFC vs engine speed by using M15 blends and M0. All test fuels have low SFC values at minimum rate, whereas the BSFC rises with speed. The blend's anti-knock qualities improved as the amount of alcohol increased. However, lowering the power and improving BSFC. These graph trends clearly show that using an M15 blend will result in higher BSFC at higher speeds than pure gasoline.

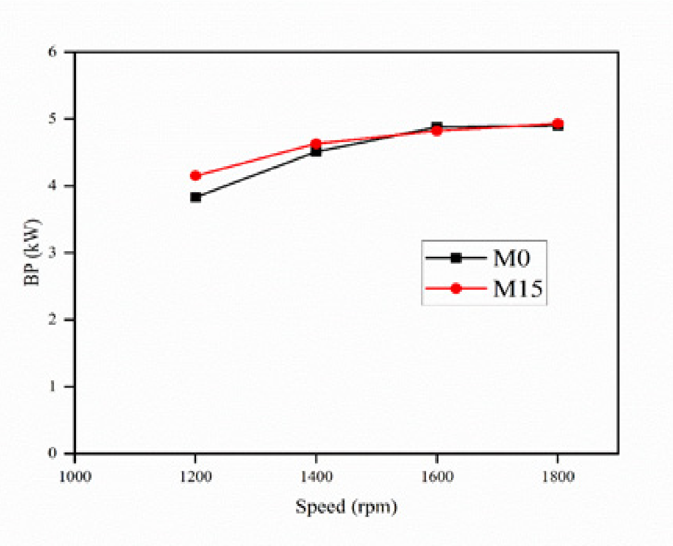

Figure 4. Variation of brake power with speed.

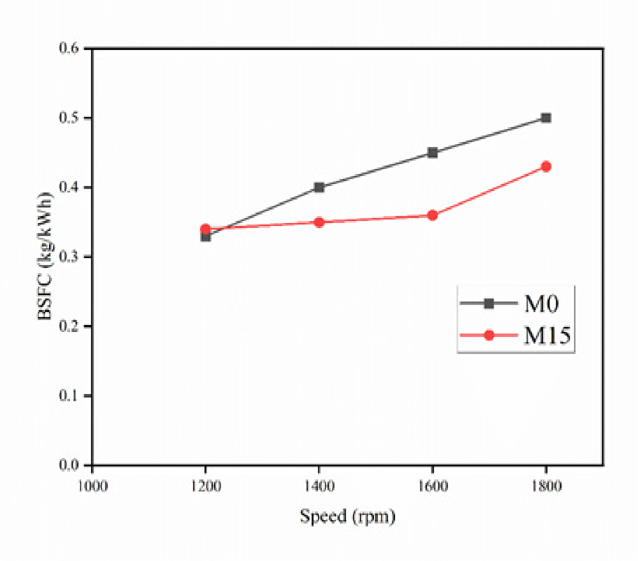

Figure 5. Variation in brake specific fuel consumption with speed.

3.2. Emission Characteristics

3.2.1 Carbon Monoxide

Figure 6 indicates the variation of CO versus engine speed. As speed increases, the percentage of CO for M15 decreases, while M0 declines. A drop in CO concentrations due to a rise in methanol content. Depending on engine conditions and A/F ratio, the M15 blend gives minimal CO emissions. Due to incomplete combustion, CO will be formed in some rich areas inside the cylinders. CO emissions decrease significantly at all engine speeds as the amount of methanol in the gasoline blend rises.

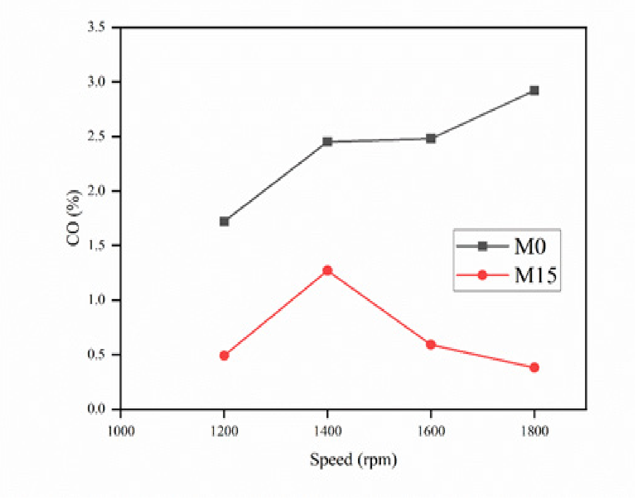

Figure 6. Variation in carbon monoxide with speed.

3.2.2 Hydrocarbon

Figure 7 represents the variation of HC versus speed. These pollutants were marginally lower in M15 blends compared to M0. It has been determined that increasing the methanol content reduces the concentration of hydrocarbon exhaust gases compared to basic gasoline M0. As the methanol percentage increases, improved combustion occurs, which results in minimized levels of hydrocarbon emissions.

3.2.3 Nitrogen Oxides

Figure 8 shows the trends of emission of NO_x versus speed. Decrease in NO_x emission for all types of fuel as an increase in engine speed. As we go from pure gasoline to blended fuel, emissions of nitrogen oxides decrease drastically.

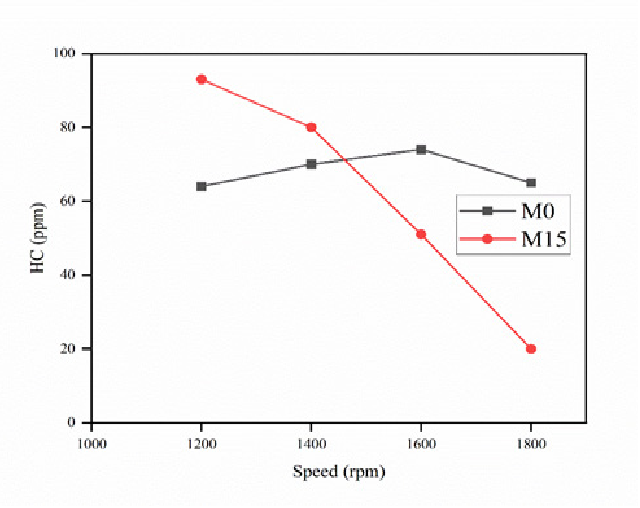

Figure 7. Variation in hydrocarbon with speed.

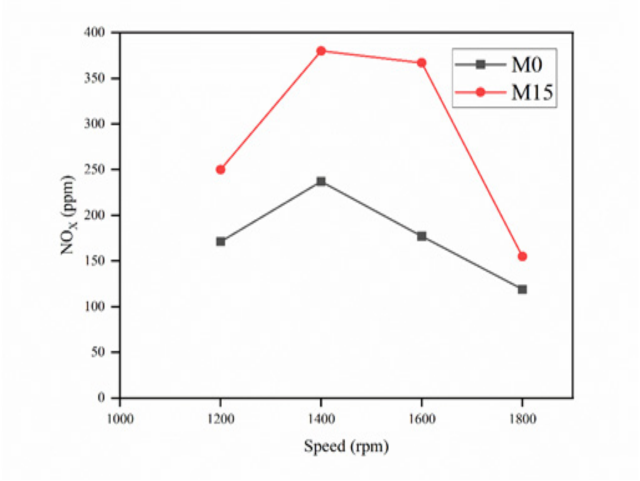

Figure 8. Variation in nitrogen oxide with speed.

Emissions of nitrogen oxides may vary depending on the blend's methanol percentage and operating conditions. The fuel mixture has less NO_x because there is a larger proportion of methanol in it.

For all engine loads, M15 emits less NO_x than gasoline. The decreased temperature induced by higher latent heat of methanol vaporization is the cause.

3.2.4 Carbon dioxide

Figure 9 shows that CO_2 emissions are decreasing for M15 blends as compared to regular gasoline fuel. Methanol-gasoline blends reduce CO_2 emissions since methanol

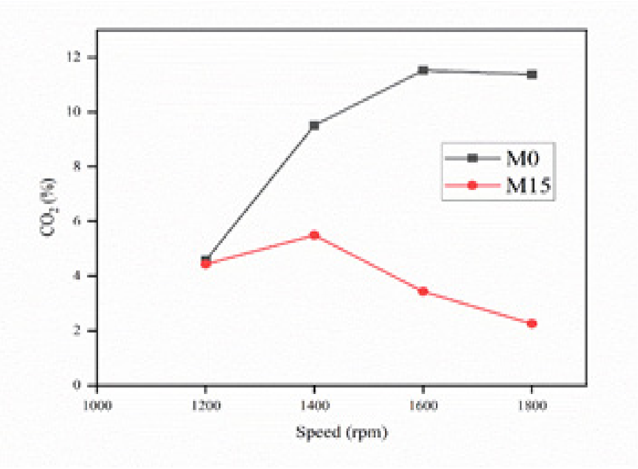

Figure 9. Variation in carbon dioxide with speed.

(M) contains oxygen atoms. In addition to removing toxic aromatic compounds (like benzene), a methanol fuel blend was used to lower the sulfur concentration. Methanol produces less carbon dioxide because it has less carbon atoms than gasoline. The CO_2 exhaust emission value for gasoline fuel is about 11.37%, whereas the CO_2 value for M15 fuel at 1800 rpm speed is around 2.5%. It is considered that the amount of carbon dioxide produced is equal to the amount of fuel consumed.

The optimum torque value for analyzing Brake Torque (BT) curves is 10% higher than regular Gasoline (G). Because methanol possesses a more substantial heating value compared to regular Gasoline (G), less energy is generated during combustion and fewer efforts is required for the expansion stroke. The engine reduced the energy in the cylinder as it used an equal amount of fuel blend during the inflow stroke. At higher engine speed conditions, the BP is 4.93 kW when an M15 methanol-gasoline blend is used, which is approximately 0.03% more than pure gasoline. Due to the decreased percentage, higher blend preparation phases are not necessary for the latent heat of methanol, even if they might increase engine power and volumetric efficiency. The findings show that power reaches its maximum at 1800 rpm, after which it begins to decline because of higher friction powers and decreasing volumetric efficiency. The graph shows that at 1400, 1600, and 1800 rpm, adding 15% methanol to the baseline fuel increases BSFC by 35%, 36%, and 43% in comparison to pure gasoline. BSFC is usually related to a fuel's heating value. When methane gasoline combustibles are used without modification, their reduced energy content increases the engine's BSFC. Methanol fuel has a heating value that is nearly 54.85% less than that of regular gasoline. A result of the different energy density needed to generate an equal amount of power at the same working conditions when using mixtures of fossil fuels. Hence, BSFC is increasing. At CR 10:1, M15 reduced CO concentrations by 2.54% compared to gasoline. It means that as the engine speed increases, gasoline produces more incomplete combustion than methanol blend. At 1800 rpm, CO emissions were 2.92% for gasoline and 0.38% for M15, respectively. However, adding 15% methanol into blended fuels reduces CO emissions by 2.54% as compared to gasoline at optimum engine conditions. The main reason for the reduction is that methanol contains less carbon than regular gasoline. Fuels produced less CO emissions at 1800 rpm. The graph shows that when the compression ratio and the proportion of methanol in gasoline increase, the HC emissions decrease. Using M15 at a 10:1 compression ratio, the HC concentration was 45% less than that of gasoline. Due to methanol burning more slowly than gasoline and releasing less carbon into the atmosphere, it significantly reduces HC emissions. For all engine speeds, using a methanol-unleaded gasoline fuel blend reduces exhaust emissions by about 61% of the mean average HC emission levels. NO_x emissions are low at about 1800 rpm, but high around 1400 rpm. NO_x concentration produced the least quantity of M15 blend. For all speeds and all types of mixed fuel, there was an overall 2.88% reduction in nitrogen oxide pollution. Since methanol fuels lower the combustion temperature, they have a larger latent heat of vaporization than gasoline. Combining methanol with gasoline would also result in a lower combustion temperature than that of pure gasoline. Combining methanol and gasoline together may have a greater effect. As the rate of methanol content addition rises, NO_x emissions drop. When Methanol (M) content increases, CO_2 level decreases. The proportional air-fuel ratio influences CO_2 emissions. Furthermore, CO_2 percentage is enhanced by the quantity of methanol added. The resulting graphs make it clear that the quantity of carbon dioxide will decline in proportion to the decrease in methanol content in the blend.

4.0 Conclusions

Experimental test results show that, compared with standard gasoline (M0), the M15 blend requires more fuel consumption because of its lower calorific value. While using M15 blend, brake power obtained was 4.90 KW, which is less than regular gasoline. At speed 1800 rpm, BP will drop as the percentage of GM blends increases. The BSFC obtained 0.43 Kg/kWh when using the M15 blend which is lower than regular gasoline at constant engine speed. The Brake Torque (BT) of 26.15 Nm is obtained by using an M15 fuel blend, which is more than regular gasoline (M0) at constant engine speed conditions. According to the results of the exhaust gas analysis, CO emissions are 0.4% lower when using an M15 fuel blend than regular gasoline at full load conditions. In comparison to regular gasoline, HC emissions are 20 ppm when the M15 blend is used at constant engine speed while NOx emissions are 36% higher. We choose a constant CR 10:1 and an A/F ratio 0.9 at 20^0 STs to decrease emissions. As a result, spark timing is optimal. A BS4 engine is used. Because of its low volatility, methanol has a lesser energy content than gasoline, which might damage rubber and plastic fuel system components. Methanol has an elevated level of formaldehyde emissions; however, it is safer than gasoline. Pure methanol engines with low volatility may be difficult to start and operate inefficiently until they warm up in wintry conditions. Material changes for blends more than 15% as well as additives or inhibitors. To work on higher blends of more than 15%, such as flex-fuel, M85, and M100, as well as to develop additives to increase vehicle compression ratios. To do tests on diverse types of vehicle models as well as to work with the engine model BS6.

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