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Effect of Pertalite – Methanol Blends on Performance and Exhaust Emission of a Four-stroke 125 CC Motorcycle Engine

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Abstract

The paper showed the effect of using Pertalite – methanol blend fuel on performances and exhaust emission of a four-stroke 125 cc single cylinder engine. Two different blends of fuels, 100% Pertalite – 0% methanol (M0) and 70% Pertalite – 30% methanol (M30), were experimentally tested. The experiments were conducted with different engine speeds ranging from 5000 to 8500 rpm. Power, torque, brake specific fuel consumption (BSCF) and exhaust emissions were measured during the test. It was concluded that M30 blend generated the largest power, 5.28 kW, at 7500 RPM. The M30 fuel also produced the highest torque, 7.1Nm, at 5500 RPM. For the specific fuel consumption, the best value of M30 fuel was 0.39 kg/kW.h, at 7500 RPM, while the M0 fuel has the best value at 7500 RPM that was 0.21 kg/kW.h. The M30 blend fuel decreased the emissions of carbon monoxide (CO), carbon dioxide (CO2), and hydrocarbon (HC).

Keywords: Pertalite, methanol, power, torque, exhaust emission

1. Introduction

Fossil fuels are non-renewable fuels. Utilization of fossil fuels is very beneficial for human life such as for industrial activities, transportation and households. But the existence of fossil fuels is not always able to meet human needs. For this reason, it needs to add additives to decrease the fuels usage. Additive also improves the quality of fuels. One of the most important additive is methanol.

In some countries such as the United States and Brazil, M10 fuel (10% Methanol and 90% Gasoline) is sold as a substitute for pure gasoline. By using this fuel can reduce HC (Hydrocarbon) and CO (Carbon monoxide) emissions. Another advantage is reduce the gasoline usage by 10%. Methanol is also used in some dual-fuel diesel engines.

Research on blend Premium gasoline - methanol fuel has been done to determine the performances of 4-stroke gasoline motors, according [8]. In this study, researchers used a mixture of Premium gasoline and methanol with the composition of M0, M5, M10, M15, M20, M25, and M30. The results of the study stated that the M15 fuel produced the highest engine output power. The power produced is 6.68 hp / 7000 rpm, an increase of 12.7% compared to pure Premium fuel.

Other research on the effect of using a mixture of Premium gasoline and methanol on 4 stroke gasoline motor exhaust emissions, based on [4]. In this article, the fuel composition specimens used are M20, M40 and M60. Based on the test results, the M60 fuel shows the best exhaust emissions.

From these results on the mixture of gasoline and methanol on 4-stroke gasoline motor that already exists, it can be concluded that methanol has an effect on engine performances and exhaust emissions. However, the type of gasoline used is the Premium type. In this study, researchers used another type of gasoline, Pertalite. This study will look for engine performances and exhaust emissions.

2. Method and Equipment

Experiments were conducted on single cylinder, four stroke engines (Honda Vario Techno 125 cc). Testing is done by placing a motorcycle on a Computerized Dynamometer tool, and then the engine is turned on and tested in several engine rotation variants 5000, 5500, 6000, 6500, 7000, 7500, 8000 and 8500 rpm at constant load. Before data is taken, engine allowed running at idling speed for about 10 minutes. The test results listed on the test equipment monitor. This test is done repeatedly with two different blends of Pertalite fuel and methanol, M0 and M30. The exhaust emission gas is recorded by exhaust gas analyzer KEG-500.

2.1. Experimental set-up and procedure

The motorcycle was checked and tuned-up according to standard specifications before tested. The specification of motorcycle is given in Table 1.

2.2. Record of power and torque data

The data of power and torque are recorded by computerized dynamometer. Motorcycle was installed with the front tire position on the wheel lock and the rear tire put in the roller so the motorcycle is balanced and in right position. The sensor is attached to the

Table 1: Specification of Honda Vario Techno 125 eSP.

Engine Type	Four-stroke, Air cooled, single cylinder, SI Engine
Bore x Stroke	52,4 x 57,9 mm
Stroke Volume	124,8 cc
Max. Power	8,3 kW / 8500 rpm
Max. Torque	10,8 N.m / 5000 rpm
Compression Ratio	11:1
Fuel Supply System	Injection

spark plug cable so that rpm can be monitored on the computer. The engine turned on for approximately 10 minutes to reach the engine working temperature.

Turn on the computer to monitor dyno activity to determine power, torque, monitor brake temperature and room temperature during testing, room humidity, engine speed, actual vehicle speed, etc.

The blower or centrifugal fan blows directly to the engine to stabilize the engine temperature when tested. The gas pedal pulled from the zero throttles opening to full. This is done to see the difference in performances of each of the gas throttle openings. At each condition, the dyno engine pressure is hold to ensure the rpm on opening throttle is remains stable.

Figure 1: Computerized Dynamometer.

Computerized Dynamometer specification is given in Table 2. This procedure was conducted for both M0 and M30 fuel blends.

Table 2: Computerized Dynamometer specification.

Max. Power	940HP
Max. Torque	1254 lbs-ft
Load Control System	Eddy Current
Load Capacity	4,500kg

2.3. Record of brake specific fuel consumption (BSFC) data

The fuel tank marked every 10 ml of volume. The consumption of fuels tested from 5000 to 8500 rpm, same as power and torque conditions. At each pressure differences, the engine dynamometer is hold so the rpm on the throttle opening tested remains stable. Then the time is recorded to know how long the duration of time needed to spend as much as 10 ml to find out fuel consumption.

The test is carried out for both data collection with M0 and M30 blends fuel

2.4. Record of exhaust gas emissions data

Exhaust gas emissions are recorded by Exhaust Gas analyzer KEG-500. The specification of exhaust gas analyzer is given in Table 3.

Table 3: Exhaust Gas analyzer KEG-500 specification.

Parameter	Range	Resolution
O2	0 – 25%	0.01%
CO	0 – 9.99%	0.1%
CO2	0 – 20%	0.01%
HC	0 – 10,000 ppm	1 ppm
Nox	0 – 5000 ppm	1 ppm
AFR	0.0 – 0.99	0.01

3. Result

The results of the motor torque test with dynamometer using two different fuel samples of each variation of engine rotation for each fuel is obtained, as shown in Table 4 and Figure 2.

The results of the power test with dynamometer using two different fuel samples of each variation of engine rotation for each fuel is obtained, as shown in Table 5 and Figure 3.

Table 4: Torque Comparison.

TORQUE (N.M)		
RPM	M0	M30
5000	3,6	4,82
5500	5,31	7,1
6000	5,03	6,11
6500	4,26	4,76
7000	6,14	6,47
7500	7,02	6,81
8000	6,58	5,85
8500	6,39	5,44
MAX	**7,02**	**7,1**

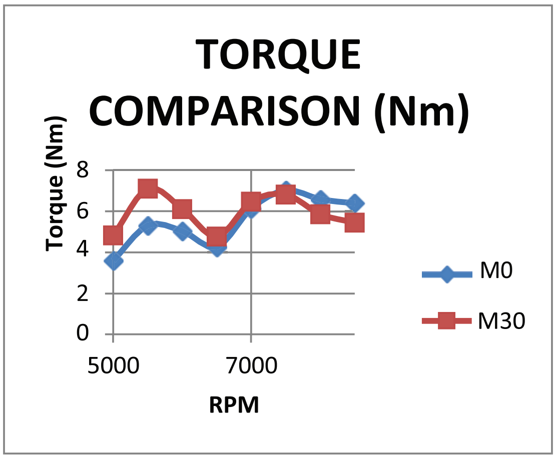

Figure 2: Torque comparison between two fuel blends on various rpm.

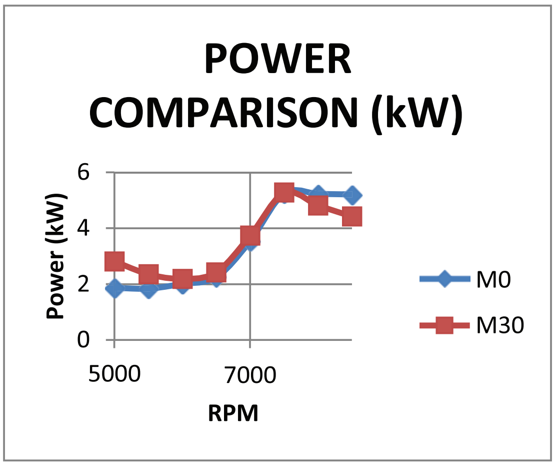

Figure 3: Power comparison between two fuel blends on various rpm.

The results of the power test with dynamometer using two different fuel samples of each variation of engine rotation for each fuel is obtained, as shown in Table 6 and Figure 4.

Table 5: Power Comparison.

POWER (kW)		
RPM	M0	M30
5000	1,87	2,82
5500	1,84	2,36
6000	2,01	2,19
6500	2,24	2,42
7000	3,54	3,74
7500	5,25	5,28
8000	5,22	4,82
8500	5,2	4,42
MAX	**5,25**	**5,28**

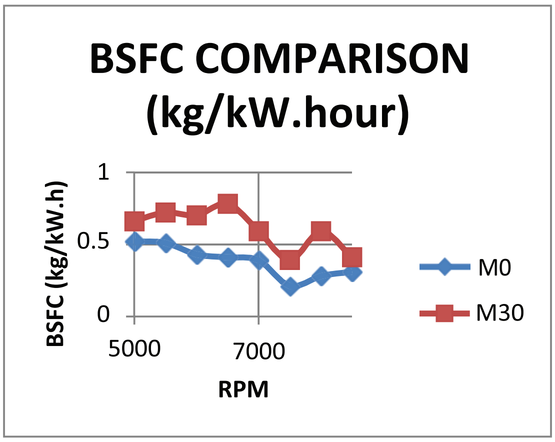

Figure 4: BSFC comparison between two fuel blends on various rpm.

Table 6: Brake-specific fuel consumption (BSFC) comparison.

BSFC (kg/kW·hour)		
RPM	M0	M30
5000	0,52	0,66
5500	0,51	0,72
6000	0,43	0,7
6500	0,41	0,78
7000	0,39	0,59
7500	0,21	0,39
8000	0,28	0,59
8500	0,31	0,41
MAX	**0,21**	**0,39**

4. Discussion

Based on the graph in Figure 3, the torque produced by a motor that used M30 more stable and higher than M0. The power produced using M30 is bigger than M0 as

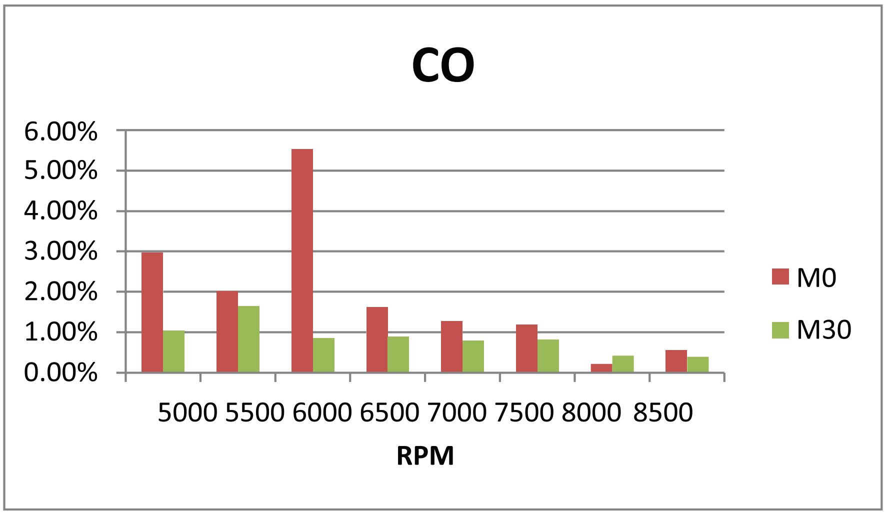

Figure 5: Comparison of CO gas levels between two fuel blends on various rpm.

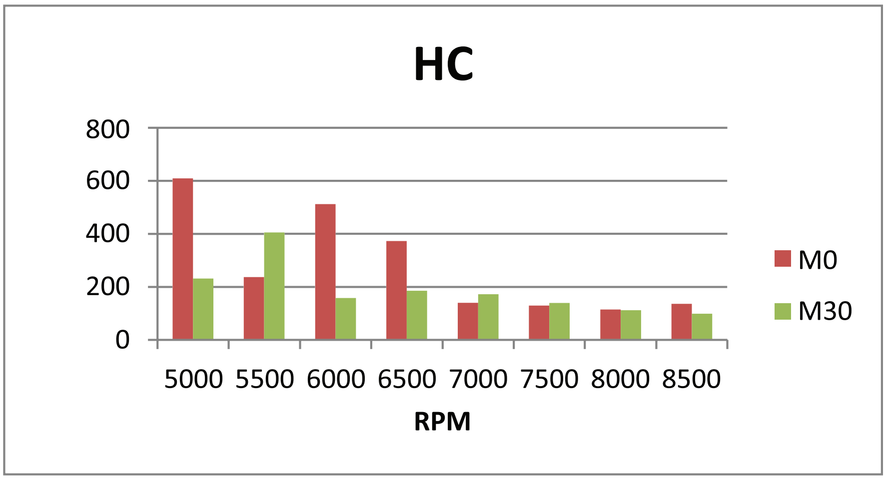

Figure 6: Comparison of HC gas levels between two fuel blends on various rpm.

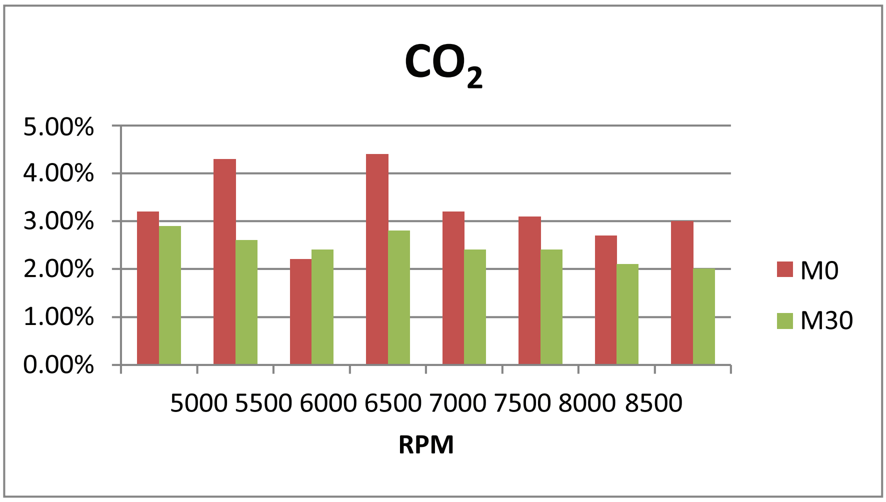

Figure 7: Comparison of CO2 gas levels between two fuel blends on various rpm.

shown in Figure 4. These related to the value of the RON (Research Octane Number) on methanol which is higher than Pertalite gasoline. The value of RON methanol is 106, while Pertalite gasoline is only 90. The greater the RON value, the more perfect the combustion, so the motor torque and power produced are greater. The maximum torque for M30 is 7,1 Nm at 5500 RPM, while for M0 is 7,02 Nm at 7500 RPM. The maximum power for M30 is 5,28 kW at 7500 RPM, while for M0 is 5,25 kW at 7500 RPM.

The value of BSFC produced by M30 looks higher for each rpm than produced by M0. This indicates the consumption of motor fuel that uses M0 more efficient than M30. The minimum recorded BSFC value is 0.39 kg / kW.hour for M30, while for M0 fuel is 0.21 kg / kW.hour. The minimum BSFC value difference recorded is 0.2 kg / kW.hour. The figure is not far adrift when compared to the reduction in consumption of Pertalite gasoline which is reduced by 30%.

Based on these data of Figure 5, M0 produced more CO gas than M30 for each different rpm. Only at 8000 RPM engine speed which shows the level of CO gas are produced by M30 more than M0. This is in accordance with the theory of combustion reactions between the two fuels.

Based on Figure 6, M0 produced more HC gas than M0. Only at 7000 and 7500 RPM show that the level of HC produced by M30 more than M0.

The level of CO2 produced M0 fuel is more than M30 fuel for each different engine speeds. Only at 6000 RPM shows the level of CO2 gas produced by M30 more than M0.

5. Conclusion

The M30 blend generated the largest power, 5.28 kW, at 7500 RPM. The M30 fuel also produced the highest torque, 7.1Nm, at 5500 RPM. For the specific fuel consumption, the best value of M30 fuel was 0.39 kg/kW.h, at 7500 RPM, while the M0 fuel has the best value at 7500 RPM that was 0.21 kg / kW.h. The effect of the addition 30% methanol to Pertalite fuel as an additive can increase the power value and torque of the gasoline motor. However, it is also makes fuel consumption increase. Generally, the M30 blend fuel decreased the emissions of carbon monoxide (CO), carbon dioxide (CO2) and hydrocarbon (HC).

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