



## Methanol-Gasoline Fuel Effectiveness Analysis Study

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### Abstract

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This study aims to determine the effect of adding methanol to the methanol-gasoline fuel mixture. It was hoped that the addition of methanol improves the performance of the four-stroke two-wheeled engine, considering that methanol has a better octane rating than gasoline and is more environmentally friendly. The fuels used were pure gasoline and a mixture of methanol-gasoline of M5, M10, M15, M20, M25, and M30. The study used a type of 100cc four-stroke two-wheeled motor fuel. The data collected includes the motor torque, motor power, and fuel consumption. In the research, the M20 fuel produced the highest torque of 7.32 Nm at 5500 rpm. The maximum power obtained from the engine was 6.8 HP at 7000 rpm rotation using M15 fuel. Increasing the concentration of oxygen in the fuel can lead to better combustion quality. The addition of methanol will increase the oxygen concentration in the fuel and cause the calorific value of the fuel mixture to decrease.

**Keywords:** Fuel, Methanol, Gasoline, Torque, Power

### Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh penambahan methanol dalam campuran bahan bakar methanol-gasoline. Diharapkan dengan menambahkan metanol dapat meningkatkan performa dari mesin 4 langkah roda dua, mengingat methanol memiliki nilai oktan lebih baik dari gasoline dan metanol lebih ramah lingkungan. Bahan bakar yang digunakan adalah gasoline murni, campuran metanol-gasoline M5, M10, M15, M20, M25, M30. Motor bakar yang digunakan adalah jenis 4 tak 100 CC roda 2. Pengambilan data adalah mengenai torsi motor, daya motor dan konsumsi bahan bakar Dalam penelitian bahan bakar M20 menghasilkan torsi tertinggi yaitu sebesar 7.32 Nm di saat rpm mesin 5500. Daya maksimal yang di peroleh dari mesin sebesar 6,8 hp pada putaran 7000 rpm dengan menggunakan bahan bakar M15. Peningkatan konsentrasi oksigen dalam bahan bakar dapat menyebabkan kualitas pembakaran lebih baik. Penambahan metanol akan meningkatkan konsentrasi oksigen dalam bahan bakar dan dapat menyebabkan nilai kalor campuran bahan bakar tersebut menurun

**Kata-kata kunci:** Bahan bakar, Metanol, Gasoline, Torsi, Daya



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## 1. Introduction

The increase in the number of fossil fuel transportation is currently expeditious. The number of transportations increases because the number of requests to meet the needs of human transportation is increasing. The increase in the amount of transportation also has an impact on increasing the amount of fossil fuel consumption, and without a doubt, also on increasing air pollution. Combustion of fuel in the combustion chamber of the vehicle produces exhaust gas emissions, particularly the very high levels of CO and HC. The increase in air pollution certainly poses a threat to human health [1] [2].

Steps to reduce vehicle exhaust emissions have been carried out, including the use of CO and HC adsorbents in vehicle exhausts. The Government of Indonesia, through the Minister of Environment Regulation number 23 of 2012, regulates that we must not exceed the threshold for motor vehicle exhaust emissions, including CO, HC, and NO<sub>x</sub>. In addition, large trees planted at several points in the city functions as the lungs of the city, absorbing CO<sub>2</sub>, and converting it into oxygen during photosynthesis. In addition, findings from several studies imply that alternative fuels produce better exhaust gases and can reduce exhaust emissions, but these efforts are still experiencing obstacles. The obstacle is that the price of fossil fuels is cheaper than the price of alternative fuels, and the availability of alternative fuels is still very limited.

Methanol (CH<sub>3</sub>OH) [3] is another alternative that is expected to be more environmentally friendly [4]. Methanol is an alternative fuel that offers lower CO emissions and higher efficiency. Methanol comes from biomass [5]. In addition to reducing CO, methanol fuel does not produce soot when burning in the combustion chamber, so the NO<sub>x</sub> content in the exhaust gas is not large.

For standard engine performance, ignition does not need to be advanced for gasoline-derived fuels because it burns quickly, but it needs to be advanced because methanol burns more slowly than fossil fuels [6] [7]. With the addition and mixing of methanol in fossil fuels, carbon monoxide and NO<sub>x</sub> decreased by 1.09% and 11.82%, respectively, in exhaust gases. The average value of thermal efficiency increased by 0.07% and 0.61%. Optimal specific fuel consumption and NO<sub>x</sub> values are 68.61 Nm to 74.55 Nm from engine load for methanol-gasoline test fuel. Overall, engine performance, combustion, and emission characteristics increase with the addition of hydrogen from methanol as a fuel mixture because methanol has several advantages [8] [9].

The effects of adding methanol to gasoline on performance and fuel costs in SI engines are as follows. The material used was methanol with a concentration of 100% mixed in gasoline and resulted in an increase in the temperature of combustion in the combustion chamber [10]. The methanol mixture in the fuel mixture affects the engine torque and power: the more methanol in the fuel mixture, the lower the power and torque [11].

The highest efficiency value obtained was the 20% methanol gasoline mixture for all test conditions. The best performance on gasoline is on unleaded gasoline. The addition of the compression

ratio increased the efficiency of each of the tested fuels, except for pure gasoline. M-20 mixture has the best performance in modifying ignition timing [12] [13].

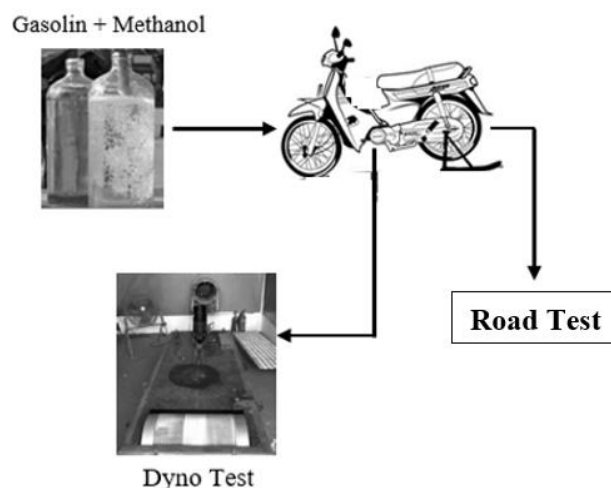
## 2. Method

The material used in this research was a mixture of gasoline and methanol. The fuel used in the test was pure gasoline, and a mixed gasoline-methanol fuel M5, M10, M15, M20, M25 and M30. The specification of the vehicles used for testing are presented in [Table 1](#).

**Table 1.** Grand Motor Specifications

Category	Description
Machine Type	4-stroke, single cylinder, SOHC, air cooling
Cylinder Volume	85,8cc
Diameter x Stride Length	47,0 x 49,5 mm
Compression Ratio	9,4:1
Maximum Power	7,3 dk @ 8.000 rpm
Maximum Torque	7,55 Nm

Dyno test was used for testing engine power and torque. Variation of data can be adjusted to time, speed, and engine speed. A measuring cup was used to make a mixture of gasoline and methanol fuel. A gas analyzer was used to determine the level of exhaust gas. The gas analyzer brand used is Q-rotech. Research equipment settings is presented in [Figure 1](#).



**Figure 1.** Research Equipment Settings

The fuel used were gasoline purchased at Pertamina gas stations, methanol purchased at a chemical shop, and a mixing fuel namely M5, M10, M15, M20, M25, and M30. Gasoline and methanol were measured according to the variation to be tested, then mixed in a bottle and shaken to blend manually. The vehicle used for data collection was modified in the fuel input section, so the fuel to test entered the carburetor easily; without going through the main route,

namely the fuel tank. The testing of torque and engine power were at 4000 rpm to 8000 rpm. The data obtained in the testing process was in the form of a graph of engine power against engine speed and road testing. Data on fuel consumption by road test, with the total volume of the fuel mixture as much as 100 CC the distance traveled as far as how many km.

### 3. Results and Discussion

To determine the effect of adding methanol to the gasoline-methanol fuel mixture, a torsion test, power test, and road test were carried out. The engine speed was 4000-8000 rpm. Engine test is presented in **Figure 2**.

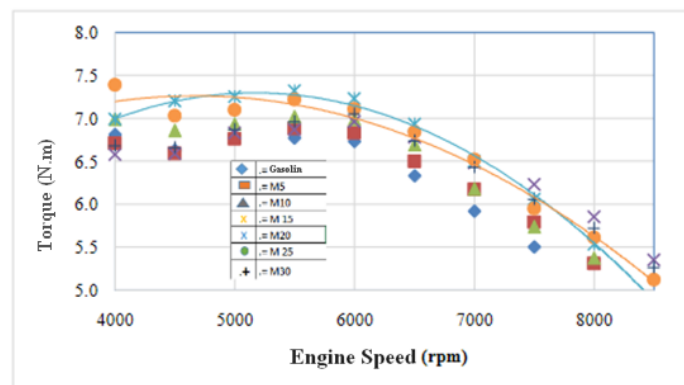


**Figure 2.** Engine Test

**Figure 2** is a motor test using an engine dynamometer to determine the power and torque of the motor.

#### a. Engine Torque

**Figure 3** is the graph of the results of testing the variation of fuel on the torque.



**Figure 3.** Engine Torque Test Results

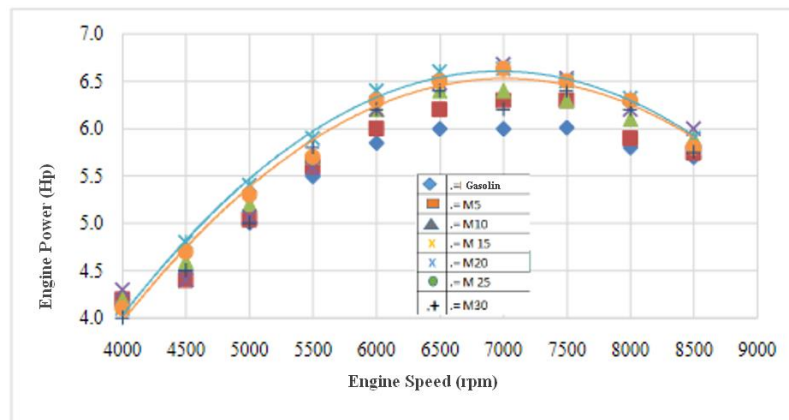
It indicates that at 5500 rpm engine speed, the torque on the M20 has the highest value. Also, the acceleration of the crankshaft decreases due to the coefficient of speed fluctuation. As a result, the moment of inertia on the crankshaft increases. The moment of inertia of acceleration decrease at 6000 engine speed resulting in the torque decrease. The test results also

show that the use of ethanol fuel in the M20 composition increases the torque significantly compared to gasoline without the addition of methanol.

The test results obtained the following data: engine torque using gasoline fuel was 6.78 Nm / 4000 rpm, engine torque using M-5 fuel was 6.88 Nm / 5500 rpm, engine torque using M-10 fuel was 7, 02 Nm / 5500 rpm, engine torque using M-15 fuel was 6.87 Nm / 6000 rpm, M-20 was 7.32 Nm / 5500 rpm, engine torque using M-25 fuel was 7.22 Nm / 5500 rpm, and engine torque using M-30 fuel was 7.05 Nm / 6000 rpm. From these data, it can be concluded that the addition of methanol to premium affected the maximum torque produced. Fig 2 indicates that the highest torque is produced by the M-20 mixture, which is 7.32 Nm at 5500 rpm engine speed.

#### b. Engine Power

**Figure 4** is the result of the engine power test using a methanol-gasoline fuel mixture.



**Figure 4.** Engine Power Test Results

It demonstrates that in all variations of fuel, starting from 4000 rpm, the engine power gradually rises and reaches its peak point at 7000 rpm, after which it continues experiencing a decrease. This is caused by the choked flow phenomenon. Choked flow is a boundary condition that occurs when the flow rate will not increase with further pressure drops at the inlet. When this choking flow phenomenon occurs, there is a significant decrease in volumetric efficiency; and consequently, the power will decrease [14].

As the engine speed increases, the volumetric efficiency increases to a peak but later decreases. The test results imply that high engine speed can increase the vacuum pressure at the inlet and air flow rate and the volumetric efficiency. Engine speed higher than 7000 rpm will result in a decrease in power [15]. Increasing the concentration of oxygen in the fuel can lead to better combustion quality. Methanol contains oxygen, so adding it to the fuel mixture will increase the oxygen concentration and can cause the calorific value to decrease.

On the other hand, with the addition of volume-based methanol, the calorific value in the mixed fuel decreases. Based on these two opposite phenomena, the result is that the maximum power occurs in the M-15 mixture, which is 6.8 HP at 7000 rpm. Engine power at 7000 rpm engine speed is presented in **Table 2**.

**Table 2.** Engine Power at 7000 rpm Engine Speed

No	Variation	Power (Hp)	% Increase
1	Gasoline	6.02	-
2	M5	6.31	4.8
3	M10	6.41	6.48
4	M15	6.68	11.14
5	M20	6.63	10.08
6	M25	6.625	10.05
7	M30	6.62	9.97

**Table 2** reveals that the maximum power of the M-15 mixture increases by 11.14% compared to the maximum power that occurs in gasoline at 7000 rpm.

#### c. Fuel Consumption by Road Test

The fuel consumption test was carried out by testing the motor being driven on a straight highway. Modifications were made for the fuel supply to the carburetor so the tests could be carried out well. The results obtained are presented in **Table 3**.

**Table 3.** Road Test Results

No	Fuel	Fuel Volume (ml)	Speed (Km/hour)	Distance (km)
1	Gasoline	100	40	4.5
2	M5	100	40	4.3
3	M10	100	40	4.2
4	M15	100	40	4.1
5	M20	100	40	4
6	M25	100	40	3.3 (unstable engine condition)
7	M30	100	40	3.1(unstable engine condtion)

## 4. Conclusion

The results of testing variations in methanol-gasoline fuel are as follows: M15 mixed fuels were able to increase the maximum output power of the engine by 12.7%. The methanol content in the fuel mixture affects the increase of fuel consumption and the SFC. More methanol in the fuel causes the calorific value of the gasoline and methanol mixture to decrease.

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