Effect of the Use of Fuel LPG Gas and Pertamax on Exhaust Gas Emissions of Matic Motorcycle

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Abstract— In addition to the burning of fossil fuels has a negative impact on the environment. Diminishing air quality due to smoke of burning fossil fuels is one of the effects that we can see clearly. Then the effects of greenhouse gases generated by the combustion CO2 gas oil. As we know that burning fossil fuels will result in imperfect gases CO, which over time will accumulate in the atmosphere. Radiation emitted by the sun to earth should be reflected back into space, but the CO2 buildup will block the reflection. As a result, the radiation will be re-absorbed by the earth which ultimately increases the air temperature at the earth. Both effects are just some of the negative effects of fossil fuels which later was followed by a series of other negative effects for humans. Therefore the use of a renewable fuel that is safer for the environment is an absolute thing. Recent times, there have been some people apply the LPG fuel in gasoline motorcycle by doing some modifications on certain parts. So that LPG gas fuel can be used. This shows that the trend of the future of transportation fuels leads to the obvious, which is fuel efficient and do not pollute the environment. So that the levels of air pollution in Indonesia can be minimized.

Scarcity of fuel oil that happened recently has given a very broad impact across various sectors of life. The sectors most affected are fast transport sector. Fluctuations in supply and price of petroleum should make us aware that the amount of oil reserves on earth are running low. Thus needed saving fuel by finding alternative fuels more efficient and environmentally friendly, which is then examined their effects on power, fuel consumption and exhaust emissions are produced. Starting from this, the authors try to do some research on the effect of using LPG fuel, hoping to determine the extent of the influence of the fuel on the performance and exhaust emissions are produced. In this research used Suzuki Motor Spin 2008 as the research object. How to research and data collection was done on the variation round 4000, 5000, 6000, 7000, and 8000. The results showed that the use of LPG gas torque average 29.14% smaller, less power 8.28%, 7.44% BMEP smaller, fuel consumption rate of 39.57% smaller, bigger engine efficiency 26.43%, lower CO levels 72.10 %, lower levels of 42.39% HC, CO2 levels greater than 33.21% using pertamax fuel.

I. INTRODUCTION

Recent times, there have been some people apply the LPG fuel in gasoline motorcycle by doing some modifications on certain parts. So that LPG gas fuel can be used. This shows that the trend of the future of transportation fuels leads to the obvious, which is fuel efficient and do not pollute the environment. So that the levels of air pollution in Indonesia can be minimized.

A. Problem Formulation

Based on the above background, the researchers formulate the problem as follows:

1. How much influence the use of LPG gas fuel to torque when compared to using a fuel pertamax.
2. How much influence the use of LPG gas fuel for power when compared to using LPG fuel.
3. How to influence the use of LPG gas fuel for BMEP when compared to using pertamax.
4. How to influence the use of LPG gas to sfc when compared to using pertamax.
5. How to influence the use of LPG gas to the engine efficiently when compared to using pertamax.
6. How much influence the emissions generated by the use of LPG gas when compared to using pertamax.

Benefits of Research: experiment and analysis of the results expected to be known to what extent the influence of the use of LPG gas fuel for torque, motor power, BMEP, fuel consumption, efficiency, and exhaust emissions generated by the motor, when compared to using a fuel pertamax.

B. Equations Used in The Study

The resulting torque engine (Heywood, 1988: 46):

\[ T = F x b \]

\[ P = 2 \pi N x T x 10^{-3} \]

\[ \text{work per cycle} = \frac{Pn_x}{N} \]
II. RESEARCH METHODOLOGY

Performance Testing Machine. Tests carried out using Suzuki engines Spin Testing is focused on engine performance and exhaust emissions. The variables measured include torque, shaft power, engine speed, fuel consumption, and efficiency.

In this test done with the engine speed variation from 4000 to 8000 rpm. Settings by turning the throttle to raise the engine speed, at any multiple of 1000 Rpm done once data collection for each of the above two variables. The following flow chart shown from the research conducted.

![Flowchart of the study](image)

![Installation of LPG fuel delivery to the motor gasoline](image)

III. RESULT AND DISCUSSION

AFR is the theoretical weight ratio of air to fuel mixture in the fuel theoretically, theoretical AFR obtained by reacting fuel with chemical equation in which combustion is considered perfect. Figure 4. shows a comparison between the engine speed with the torque generated from the data with the test results using LPG fuel.

![Torque versus engine speed](image)

<table>
<thead>
<tr>
<th>Engine Rpm</th>
<th>Specific fuel consumption (2cc/s)</th>
<th>Torque (N.M)</th>
<th>Power (Kw)</th>
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![Research data engine performance materials for use fuel Pertamax](image)

<table>
<thead>
<tr>
<th>Engine Rpm</th>
<th>Specific fuel consumption (2cc/s)</th>
<th>Torque (N.M)</th>
<th>Power (Kw)</th>
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Torque is measured in this test is the torque after through automatic centrifugal clutch work optimally. At Figure 3. shows that the engine torque decreases with increase in engine rotation. Torque resulting from the use
of LPG fuel decreased at 7000 rpm which then increases again at 8000 rpm rotation. The maximum torque generated from the use of 11:50 PERTAMAX Nm at 4000 rpm engine speed, while the use of LPG at 11:21 Nm at 4000 rpm engine speed, so the maximum torque by using a smaller LPG 29 % of the maximum torque by using pertamax. Average torque resulting from the use of PERTAMAX of 8.44 Nm, while the use of LPG amounted to 5.98 Nm, so the average torque by using LPG smaller 24 % of the first to use. Chart 1. shows the ratio between engine speed with the power generated from the data with the test results using pertamax fuel and LPG Gas. Figure 4. shows that on Power Machines will rise in line with the increase in engine rotation. The power generated in this test is the following through automatic centrifugal clutch work optimally.

**Figure 4.** Power versus engine speed.

In the Figure 4. shows that the power generated increased along with the increase in engine speed. Power is the result of torque, so the value of power is highly dependent on the value of the motor torque generated. In this test the power generated from the use of PERTAMAX relatively higher when compared to the use of LPG. Maximum power of 7.4 KW for use PERTAMAX at 8000 rpm engine speed, whereas the use of LPG for maximum power 6.8 Kw at 8000 rpm engine speed, so the maximum power with using LPG smaller 60% of the maximum power by using pertamax. Average power resulting from the use of 6.76 Kw PERTAMAX, while the use of LPG by 6.2 kW, so the average power by using smaller LPG 56% of the average power by using pertamax. Figure 5. shows the comparison between the mean effective pressure (BMEP) using fuels with LPG gas PERTAMAX.

**Figure 5.** Bmep versus engine speed.

BMEP of use PERTAMAX of 1002.72 Kpa at 6000 rpm engine speed, whereas the use of LPG at 686.99 kPa at 7000 rpm engine speed, so the average effective pressure maximum by using LPG gas 31.48 % lower than the average effective pressure by using pertamax. BMEP average PERTAMAX resulting from the use of 876.47 kPa, while the use of LPG amounted to 616.61 Kpa, so BMEP average LPG gas by using a smaller 29.6 % of BMEP using pertamax. Chart 5. shows the comparison between the spin machine with the fuel consumption rate of the data generated by the test results using Pertamax fuel and LPG Gas. In the graph 5. shows that the rate of fuel consumption will increase along with the increase in engine speed. The rate of fuel consumption is the large amount of fuel mass required for each one unit of time. The amount of fuel consumption rate depends on the value of the engine speed, the higher the engine speed is generated, the greater the fuel required for the combustion process.

**Figure 6.** Specific fuel consumption versus engine speed.

Maximum fuel consumption rate of use PERTAMAX of 0395 g/s at 8000 rpm engine speed, while the use of LPG by 0201 g/s at 8000 rpm engine speed, so the rate of maximum fuel consumption using LPG gas is smaller than the rate of 37.18% fuel consumption by using pertamax. Fuel consumption rate of the average of the first to use at 0.169 g/s, while the use of LPG amounted to 0.116 g/s, so the rate of fuel consumption on average by using LPG gas 31.36% less than the rate of fuel consumption on average using pertamax. Figure 6. shows the comparison between the engine speed with the specific fuel consumption (sfc) which is derived from the data with the test results using Pertamax and LPG Gas.

**Figure 7.** Specific fuel consumption versus engine speed.

Specific fuel consumption (sfc) is needed in the testing machine is automatic centrifugal clutch sfc after work optimally. On Figure 7. indicates that specific fuel consumption is decreasing due to higher engine speed. This proves that the mass of fuel per unit of weight that
can be converted into heat energy per unit mass of energy, the better. By using specific fuel consumption pertamax smaller than using LPG. This is because that the specific fuel consumption is the result for the rate of fuel consumption with power, so if the value of the rate of fuel consumption and the resulting power of the specific fuel consumption will be smaller. Specific fuel consumption (sfc) maximum on condition automatic centrifugal clutch is working optimally from the use PERTAMAX of 0.0516 mg/J, while the use of LPG amounted to 0.0401 mg/J, so the specific fuel consumption by using smaller LPG 22.28 % of specific fuel consumption by using pertamax. Specific fuel consumption (sfc) the average of the use PERTAMAX of 0.0325 mg/J, while the use of LPG amounted to 0.0296 mg/J, so the specific fuel consumption (sfc) average LPG gas by using a smaller 8.92 % of consumption specific fuel using pertamax.

Basiclly the fuel conversion efficiency shows the comparison between the amount of power generated by an engine in one cycle to the amount of fuel energy supplied per cycle that can be released in a combustion process. Therefore if the price of the fuel consumption (sfc) is getting smaller, the price will increase efficiency. In the Figure 8. shows that the efficiency tends to decrease with increase in engine speed. first to use the maximum efficiency obtained at 5000 rpm engine speed, it shows that the rotation 5000 rpm, the fuel used can be converted into heat energy optimally, while at the engine speed is too high engine efficiency will decrease, this is caused by a variety of factors such as the valve opening late because the engine speed is too high so that the charging and exhaust in the cylinder to work less effectively. Maximum machine efficiency from first to use by 98 % at 5000 rpm engine speed, while the use of LPG amounted to 97.4 % at 4000 rpm engine speed , so the maximum engine efficiency by using less gas LPG 0.61 % of the maximum efficiency by using pertamax.

Average engine efficiency of 75.8 % at first to use, while the use of LPG amounted to 79.23 %, so the average engine efficiency of larger use of LPG 4.53 % of the efficiency of the engine by using fuel pertamax. Figure 9. shows the comparison between the results of the engine speed exhaust emissions of carbon monoxide (CO) which is derived from the data with the test results using LPG gas. Figure 9. From the graph it can be seen that the CO emissions produced decreases with increasing engine speed. With the use of CO emissions pertamax be high Lei high LPG. So for LPG gas emissions is smaller than pertamax.

From the graph 10. is known that HC exhaust emissions produced decreased due to higher engine speed. In the combustion exhaust gas HC emissions are low due to the fuel carburetion the better, which means better kesilinder distribution, so that the combustion to be perfect, while the combustion with flue gas HC emissions rate is high due to unburned fuel and out into the raw gas, the valve overlap so that a gas flushing, a common cause of poor ignition system. Maximum levels of HC exhaust emissions in the use of 0.0024 % vol PERTAMAX at 4000 rpm engine speed, while the LPG at 0.00055 % vol at 5000 rpm engine speed, so the maximum HC levels using LPG gas fuel 77 % smaller than the maximum levels of HC using fuel pertamax. HC average levels of use PERTAMAX of 0.00094 % vol, while HC levels using LPG gas of 0.00029 % vol, so the average HC concentration resulting from the combustion of LPG 68.9 % lower than the average level of HC using pertamax.

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IV. CONCLUSION

Based on the study the effect of using LPG fuel in 4-stroke Suzuki Motor Spin as well as from the results of calculations and data analysis has been done in the previous chapter, it can be concluded as follows:

1. Average torque with fuel pertamax of 8.44 Nm, while the use of LPG gas fuel by 5.98 Nm. So the average torque using LPG gas 29.14 % less than the average torque using pertamax.

2. Average shaft power using fuel Pertamax of 6.76 Kw, whereas the average shaft power generated using LPG gas is equal to 6.2 Kw. So the average shaft power using gas fuel LPG 8.28 % smaller than the average shaft power using pertamax.

3. BMEP average with the use of LPG gas fuel Kpa at 1066.7 while the average BMEP using pertamax at 1152.52 Kpa. So BMEP mean using less gas LPG 7.44 % of fuel use pertamax.

4. Kosumsi rate average fuel using PERTAMAX of 0.245 g/s while using LPG gas, the rate of fuel consumption average of 0148 g/s. Thus, the rate of fuel consumption on average by using LPG gas 39.57 % less than the rate of fuel consumption on average by using pertamax.

5. Sfc average using pertamax fuel by 0036 mg/h, while the average Sfc using LPG fuel at 0.024 mg/j. Thus, specific fuel consumption on average by using smaller LPG gas 98.8 % of the specific fuel consumption on average by using pertamax.

6. Average engine efficiency with fuel pertamax by 58.34 %, while the average engine efficiency by using LPG is equal to 79.30 %. Average engine efficiency using LPG gas 26.43 % greater than the average engine efficiency by using pertamax.

7. CO levels on average by using pertamax of 3.37 % vol, while using LPG CO level is the average of 0.94 % vol. Average CO levels using LPG gas 72.10 % smaller than the average CO level using pertamax.

8. HC exhaust emissions average for pertamax of 0.000342 % vol, while using LPG gas HC concentration is equal to the average 0.000197 % vol. It shows that the average level of HC from the use of LPG gas fuel is smaller 42.39 % of fuel use pertamax.

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REFERENCES