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ENERGY ANALYSIS PRODUCED IN MIXTURE OF LIQUID (PERTALITE) AND GAS (LPG) IN CONVENTIONAL MACHINE 4 CYLINDER

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Abstract. *Increased mobility of transportation plays a major role in the economic growth of a region. Despite the rapid growth of the automotive industry, there are still quite a lot of people who use old-type vehicles to support their mobility. Conventional 4-cylinder engine is one type of engine that is widely used in public transportation modes. The purpose of this study was to obtain an analysis of the energy produced in a mixture of liquid fuel (pertalite) and gas (LPG) in a conventional engine 4-cylinder. The research method used was an experiment, carried out on a conventional engine 4-cylinder. A dynamometer is used to determine the power and torque produced. As for testing the rate of fuel consumption using a measuring burette, then the fuel consumption is calculated. The research data are arranged in tables and graphs to obtain the analysis of the energy produced at each rotation speed variation (Rpm). The results showed there were differences in power, torque and fuel consumption produced by a mixture of the two types of fuel used. For maximum power generated at a standard injector variation that uses Pertamax plus fuel of 11.61 kW and a maximum torque of 12.98 Nm. While the lowest power is produced by Pertamax using a racing injector of 2.26 kW and the lowest torque of 8.67 Nm. The lowest fuel consumption is obtained from the use of a standard fuel injector Pertamax plus of 0.12 kg / kW while the highest fuel consumption produced by Pertamax Plus uses a standard injector of 1.28 kg / kW.*

Keywords : Energy, mixed, liquid fuel, gas

1. INTRODUCTION

The number of studies on natural gas (LPG) applied to vehicles is a step and effort to find alternative fuels, in it's development the majority of studies only incorporate natural gas into the combustion chamber using conventional types of vehicles or injection vehicles.

Liquid fuel is a combination of hydrocarbon compounds obtained from nature and artificially. Liquid fuels are generally derived from petroleum, in the future, the possibility of liquid fuels derived from oil shale, tar sands, coal and biomass will increase. Petroleum is a natural mixture of liquid hydrocarbons with little sulfur, nitrogen, oxygen, very little metal, and minerals [1].

Gas fuel is a compressed natural gas. In general, more than 80% of the natural gas component used as CNG is methane gas, 10% -15% ethane gas, and the rest is carbon dioxide gas, and other gases, the composition of BBG used in Jakarta 93% consists of methane gas , 3.2% ethane gas, and the remaining 3.8% are nitrogen, propane, and carbon dioxide, the composition of the natural gas varies from one source to another [2].

Study comparative of gasoline fuel energy with gas fuel in motor vehicles, the results obtained from the use of gas fuel energy is more efficient up to 10% compared to Gasoline fuel, with the overall power (kW) on gas-fueled engines 2% smaller to 5% compared to gasoline fuel, this value shows the performance of the engine with gas fuel is not as good as the Gasoline engine [3]. The difference of octane rate will give significant impact to emision characteristic when using different rate of octane showing differen percentage [4]. The use of LPG fuels as an alternative to conventional engine is very likely to be more efficient than fossil fuels [5].

From the description above it can be concluded, most research on the change of liquid fuel to gas fuel, not a mixture of the two fuels, so researchers here will examine the Effect of Mixing Liquid Fuel (Pertalite) and Gas Fuel (Lpg) Against Fuel Consumption in Conventional 4-cylinder engine, is it able to be more economical by mixing the two fuels into the combustion chamber.

2. METHODS

Mindset of research as follow:

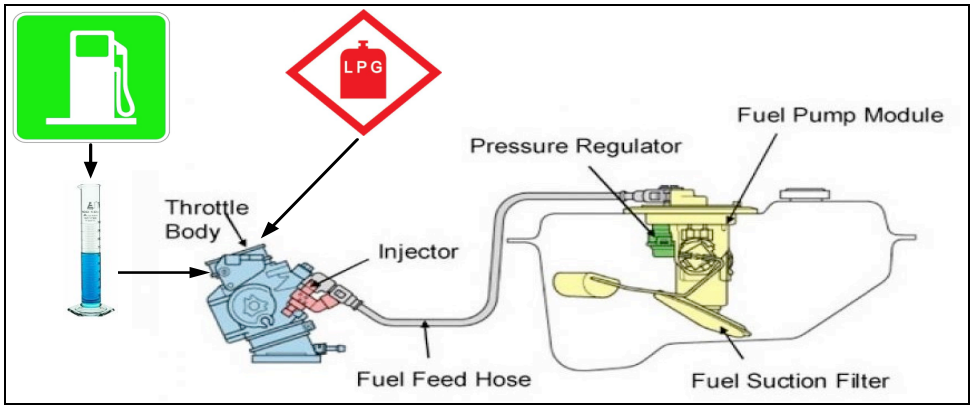


Figure 1. Mindset

Research variables

1) Independent variable:
   a. 4 variations of Rpm: 1000, 1500, 2000 and 2500 Rpm
   b. 4 variations of fuel discharge: 0.9; 1.4; 1.8; and 2.2 ml/sec
   c. Fuel : pertalite and liquified Petroleum gas (LPG)

2) Dependent variable: engine power

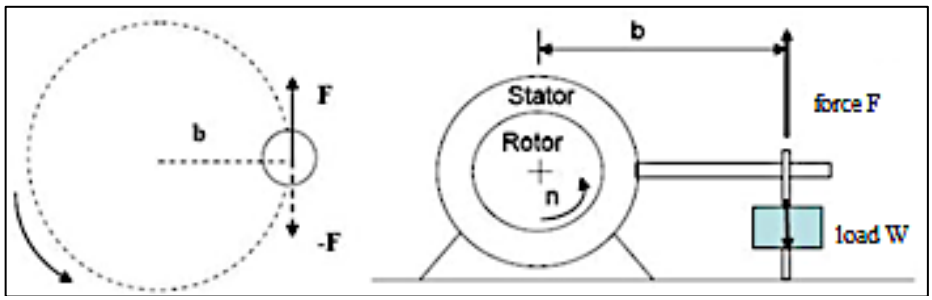


Figure 2. research measurement techniques

The dynamometer is used to measure the power, torque generated by the engine after it is given variations in the treatment of fuel mixture types.

3. RESULTS AND DISCUSSION

3.1 Figur And Table

The data obtained from the research through observation and experiment still needs to be processed. The processed data results in the average value and then it is tabulated in table.

Table 1 Data collection table for liquid fuel consumption (pertalit) without the addition of LPG

Type of Fuel	(RPM)	Used Fuel (ml)	Time (sec)	Consumption / time	Average Time (ml/sec)
Pertalite	1000	10	44,58	0,22	0,22
		10	46,5	0,21	
		10	45,02	0,22	
	1500	10	28,2	0,35	0,36
		10	27,2	0,36	
		10	27,6	0,36	
	2000	10	24,7	0,4	0,42
		10	23,9	0,41	
		10	23,2	0,43	
	2500	10	18,9	0,52	0,56
		10	17,7	0,56	
		10	17,2	0,58	

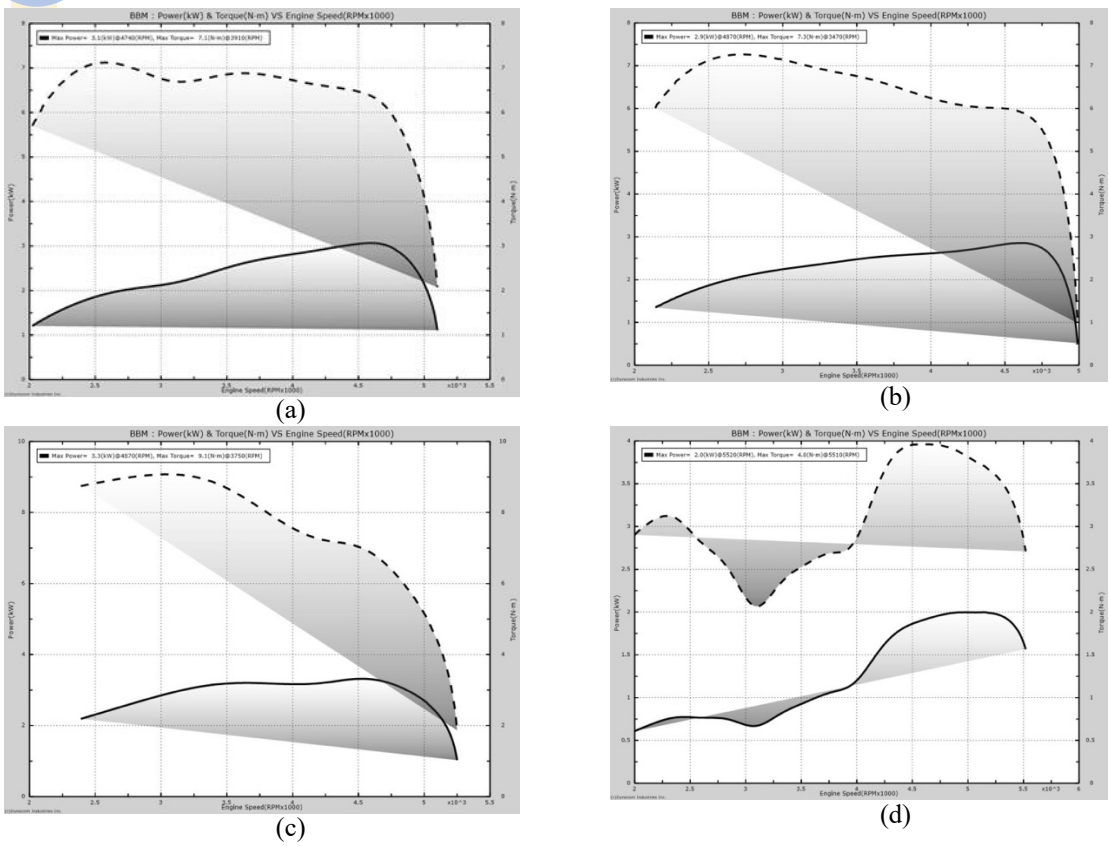
Table 2 Table of results of taking data on liquid fuel consumption (pertalit) with the addition of LPG

Type of Fuel	(RPM)	Used Fuel (ml)	Time (sec) with LPG	Anemometer m/s
Perttalite & LPG	1000	10	50	0,9
	1000	10	49,9	0,9
	1000	10	49,1	0,9
	1500	10	38,8	1,4
	1500	10	38,3	1,4
	1500	10	38,6	1,4
	2000	10	34,1	1,8
	2000	10	34,9	1,8
	2000	10	34,7	1,8
	2500	10	27,5	2,2
	2500	10	26,7	2,2
	2500	10	27,1	2,2

Table 3 Table of calculation of average results and percentages

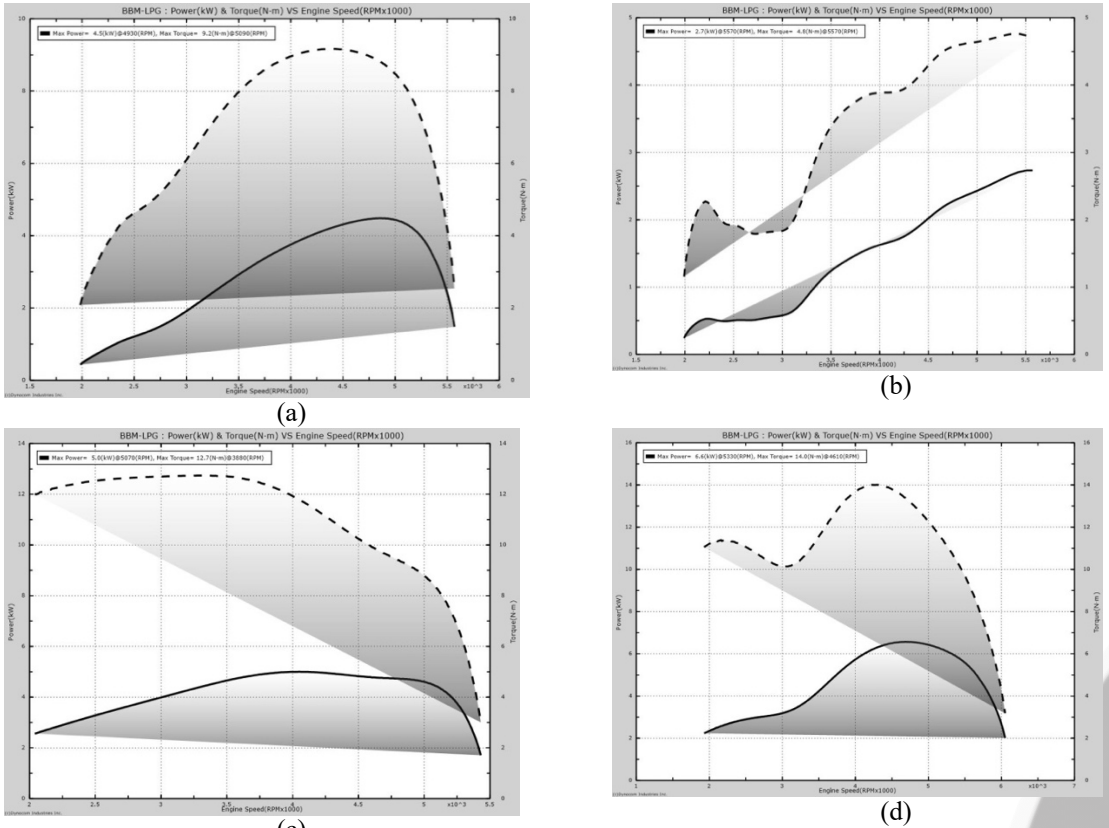
RPM	Average Time (Sec) Pertalite	Average Pertalite & LPG	Difference Time (Sec)	Percentage
1000	45,37	49,67	4,3	1,95
1500	27,67	38,57	10,9	3,02
2000	23,93	34,57	10,63	2,54
2500	17,93	27,1	9,17	1,64
Average Difference			8,75	2,29

The Graphic of the Research Result



(a) (b) (c) (d)

Figure 2. Histogram power and torque with pertalite



(a) (b) (c) (d)

Figure 3. Histogram power and torque with pertalite and LPG

Based on figures (2) and (3), the test results show that there is a difference between the torque using pertalite fuel oil and LPG gas fuel. As rpm increases torque using pertalite decreases. Maximum torque at pertalite is 4470

rpm at 3.1 Kw and minimum torque is at 3910 rpm at 7.1 Nm. While the maximum torque at LPG is at 4930 rpm at 4.5 Kw, and the minimum torque at 5090 rpm at 9.2 Nm. This means that the difference in torque between pertalite fuel and LPG gas is significant. In other words there is a significant difference in motor torque by using pertalite fuel oil and LPG gas fuel.

Research on the conversion of fuel oil to natural gas produces lower torque and power in the use of LPG gas fuel compared to using pertalit fuel, this occurs because in the use of pertalite fuel with octane (RON) 90 the maximum yield of combustion pressure because it is supported by compression pressure and also when proper ignition so that the resulting torque is also maximum. Whereas in the use of LPG gas with octane (RON) 112 the combustion pressure is not maximal because it is not supported by high compression pressure and also during proper ignition so that the resulting torque is also not maximal. Based on data obtained from the difference in motor torque using pertalite fuel oil and LPG gas fuel, variations in engine speed and the use of fuels with different octane values will affect the value of torque produced. This can be proven by the results of the study in figures (2) and (3), when the rpm is increased the torque using pertalite decreases.

Power is the amount of effort done by the motor in a period of time or the results of the effort divided by a certain period of time. The amount of power produced is very influential on variations in engine speed and the effect of the fuel which has different octane values. As rpm increases, power using pertalite tends to increase. From the test results show that motor torque using pertalite fuel is higher than motor torque using LPG gas fuel and motor power using pertalite fuel which is higher than motor power using LPG gas fuel.

There is a significant difference in motor power using pertalite fuel oil and LPG gas fuel. So that in motor research using pertalite fuel oil produces higher torque and power compared to using LPG gas fuel. The causes of torque and motor power generated are small in the use of LPG gas fuel, namely, a) The speed of energy per unit volume owned by LPG gas is lower than gasoline fuel, especially pertalite, so the combustion energy decreases, b) LPG has more carbon chains shorter than pertalite, c) LPG has a short hydrocarbon (CH) chain than pertalite, so that the total energy and peak combustion pressure resulting from the LPG combustion process is not as much as that produced in the pertalite combustion process, d) LPG gas pressure entering the chamber the fuel is constant, but the inlet air pressure changes, so that the torque and power of the LPG usage are lower than the pertalite, and e) The better the converter kit is used, the better performance.

4. CONCLUSION

The conclusions that the author can give from the effect of the comparison of the use of LPG gas fuel and pertalite fuel on the performance of this 4 stroke gasoline fuel motor are as follows :

1. There is a significant difference in motor torque by using pertalite fuel oil and LPG gas fuel.
2. There is a significant difference in motor power using pertalite fuel oil and LPG gas fuel.
3. Maximum torque at pertalite is 4470 rpm at 3.1 Kw and minimum torque is at 3910 rpm at 7.1 Nm. While the maximum torque at LPG is at 4930 rpm at 4.5 Kw, and the minimum torque at 5090 rpm at 9.2 Nm

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