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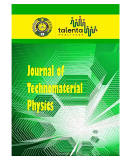

Comparative Analysis of Gasoline and Liquefied Petroleum Gas (LPG) on Motorcycle Engine Performance

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ABSTRACT

This research aims to determine the efficiency of LPG fuel performance compared to gasoline in motorcycle engines. The research method involves a brake dynamometer test with engine speed variations of 2000 rpm, 2200 rpm, and 2500 rpm. Based on the results obtained, the exhaust gas temperature (°C) at an engine speed of 2000 rpm with gasoline is 148°C and 146°C, while with LPG, it is 107°C and 108°C. The fuel consumption rate (cc/min) at 2000 rpm is 15.8 cc/min, 16.2 cc/min with gasoline, and 9.36 cc/min with LPG. At 2200 rpm, the fuel consumption is 16.2 cc/min, 22.8 cc/min with gasoline, and 10.48 cc/min with LPG. At 2500 rpm, it is 20.2 cc/min, 19.4 cc/min with gasoline, and 14.40 cc/min with LPG. In terms of fuel consumption savings, using LPG as a fuel can significantly reduce fuel usage.

Keywords: Liquefied Petroleum Gas (LPG), Gasoline, Motorcycle Engine Performance, Brake Dynamometer Test, Fuel Consumption Efficiency.

ABSTRAK

Penelitian ini bertujuan untuk mengetahui efisiensi kinerja bahan bakar LPG dibandingkan bensin pada mesin sepeda motor. Metode penelitian melibatkan pengujian dengan menggunakan dynamometer rem dengan variasi kecepatan mesin 2000 rpm, 2200 rpm, dan 2500 rpm. Berdasarkan hasil yang diperoleh, suhu gas buang (°C) pada kecepatan mesin 2000 rpm dengan bahan bakar bensin adalah 148°C dan 146°C, sedangkan dengan LPG adalah 107°C dan 108°C. Laju konsumsi bahan bakar (cc/menit) pada 2000 rpm adalah 15,8 cc/menit dan 16,2 cc/menit dengan bensin, serta 9,36 cc/menit dengan LPG. Pada 2200 rpm, konsumsi bahan bakar adalah 16,2 cc/menit dan 22,8 cc/menit dengan bahan bakar bensin, serta 10,48 cc/menit dengan LPG. Pada 2500 rpm, konsumsi bahan bakar adalah 20,2 cc/menit dan 19,4 cc/menit dengan bahan bakar bensin, serta 14,40 cc/menit dengan LPG. Dalam hal penghematan konsumsi bahan bakar, penggunaan LPG sebagai bahan bakar dapat secara signifikan mengurangi penggunaan bahan bakar.

Kata Kunci: Liquefied Petroleum Gas (LPG), Bensin, Kinerja Mesin Sepeda Motor, Uji Dynamometer Rem, Efisiensi Konsumsi Bahan Bakar.

1. Introduction

Alternative fuel usage is becoming increasingly popular due to rising prices of liquid fuels derived from crude oil and growing attention to environmental issues. There are two main reasons for the use of alternative fuels in the transportation sector. First, it will reduce dependence on traditional fossil fuels, and second, it will lower engine emissions. The urgency of this research lies in the performance of internal combustion engines that still use fossil fuels, which significantly impact air pollution. Alternative fuels include compressed natural gas, liquid petroleum gas, hydrogen, and alcohol fuels (methanol and ethanol). Liquefied Petroleum Gas (LPG) is considered a clean fuel and is therefore widely used as an alternative fuel in internal combustion engines due to its ease of liquefaction at relatively low pressures and lower fuel costs.

The composition of LPG mainly consists of propane, n-butane, isobutane, ethane, propene, and butene, with small amounts of methane and other C4-C5 hydrocarbons. LPG is generally extracted from natural gas flows from oil and gas fields or obtained as a byproduct of crude oil refining at refineries (primarily responsible for olefins in LPG fuel). The proportions of species in LPG can vary significantly depending on the extraction region, season, and processing methods. Its composition differs from country to country when used as an automotive fuel, with propane concentrations ranging from nearly 100% to as low as 50% [9].

This research focuses on the use of alternative fuels, which are becoming increasingly popular due to rising prices of liquid fuels derived from crude oil and growing environmental concerns. There are two main reasons for the use of alternative fuels in the transportation sector: first, to reduce dependence on traditional fossil fuels, and second, to decrease engine emissions. Various alternative fuels suitable for gasoline engines can be categorized as industrial gasoline, alcohol, and gas. Liquefied Petroleum Gas (LPG) also has advantages over gasoline engines because it can operate with a lean mixture, which helps improve fuel savings and reduce CO and hydrocarbon emissions.

The general structural characteristics of LPG engines are essentially similar to gasoline engines, differing only in the fuel supply system. It has been shown that LPG engines provide better fuel savings than gasoline engines due to lower fuel consumption levels. LPG has a low carbon/hydrogen ratio, is highly pure, non-toxic, non-corrosive, and free from aromatic hydrocarbons. LPG is produced as a byproduct of natural gas and crude oil refineries. The composition of LPG is approximately 70% propane and 30% butane. Emissions from gasoline and LPG engines can be measured using exhaust gas analyzers that assess CO_2, HC, O_2, and CO emissions.

2. Methods

The research procedure includes installing a converter kit, which converts gasoline fuel to LPG fuel for motorcycle engines. A high-pressure regulator installed on the LPG tank directs gas to the evaporator. The motorcycle is tested using gasoline through exhaust gas temperature, engine surface temperature, and fuel consumption measurements. The materials and tools used in this research include a stopwatch, a 3 kg LPG cylinder, a dynamometer, a thermometer, a measuring cup, a scale, a converter kit, an automotive emission analyzer, and RPM testing equipment.

3. Results and Discussion

Based on the results obtained, the surface temperatures of the engine (°C) using gasoline fuel and LPG at 2000 rpm were: gasoline 117 °C, 120 °C; LPG 87 °C, 92 °C. At 2200 rpm, the temperatures were: gasoline 125 °C, 127 °C; LPG 95 °C, 97 °C. At 2500 rpm, the temperatures were: gasoline 132 °C, 134 °C; LPG 99 °C, 98 °C (Table 1), with the difference in surface temperature (°C) given in Table 2.

Table 1. The surface temperature of the engine (°C) using gasoline and LPG at engine speeds of 2000, 2200, and 2500 RPM.

Treatment	RPM Observation					
	2000 rpm		2200 rpm		2500 rpm	
	Gasoline	LPG	Gasoline	LPG	Gasoline	LPG
1	117	87	125	95	132	99
2	120	92	127	97	134	98

Table 2. The difference in surface temperature (°C) using gasoline and LPG at engine speeds of 2000, 2200, and 2500 RPM.

Fuel Type	Difference in engine temperature		
	2000 rpm	2200 rpm	2500 rpm
Gasoline	30	30	33
LPG	18	30	36

Furthermore, as can be seen from Table 3, The exhaust gas temperatures (°C) using gasoline and LPG at 2000 rpm were: gasoline 148 °C, 146 °C; LPG 107 °C, 108 °C, with the difference given in Table 4.

Table 3. Exhaust gas temperature (°C) using gasoline and LPG at 2000, 2200, and 2500 RPM engine speeds.

Treatment	RPM Observation					
	2000 rpm		2200 rpm		2500 rpm	
	Gasoline	LPG	Gasoline	LPG	Gasoline	LPG
1	148	107	158	107	168	114
2	146	108	155	109	170	110

Table 4. Difference in Exhaust Gas Temperature (°C) Using Gasoline and LPG at Engine Speeds of 2000, 2200, and 2500 RPM.

Fuel Type	Difference In Engine Temperature		
	2000 rpm	2200 rpm	2500 rpm
Gasoline	41	51	54
LPG	38	46	60

Table 5 shows the engine's fuel consumption (FC) (cc/min) when using gasoline and LPG at 2000 rpm was: gasoline 15.8 cc/min, 16.2 cc/min; LPG 9.36 cc/min. At 2200 rpm, the values were: gasoline 16.2 cc/min, 22.8 cc/min; LPG 10.48 cc/min. At 2500 rpm, they were: gasoline 20.2 cc/min, 19.4 cc/min; LPG 14.40 cc/min. The difference in fuel consumption rate is given in Table 6.

Table 5. Fuel Consumption Rate (cc/min) of the engine using gasoline gasoline and LPG at engine speeds of 2000, 2200, and 2500 RPM.

Treatment	RPM Observation					
	2000 rpm		2200 rpm		2500 rpm	
	Gasoline	LPG	Gasoline	LPG	Gasoline	LPG
1	15.8	9.36	16.2	10.48	20.2	14.40
2	16.2	9.36	22.8	1.48	19.4	14.40

Table 6. Difference in Fuel Consumption Rate (cc/min) of the Engine Using Gasoline Gasoline and LPG at Engine Speeds of 2000, 2200, and 2500 RPM.

Fuel Type	Difference In Engine Temperature		
	2000 rpm	2200 rpm	2500 rpm
Gasoline	6.44	5.72	5.8
LPG	6.84	12.32	5

From these results, it can be concluded that the use of LPG fuel can reduce the surface temperature of the engine and exhaust gas temperature compared to engines operating on gasoline fuel. The lower engine temperatures when using LPG are due to the high octane content of LPG, which is 112, while gasoline gasoline in Indonesia generally has an octane rating of 85-90. When the air-LPG mixture occurs, the air-fuel ratio becomes lean, meaning the stoichiometric ratio is one part fuel to 15 parts air, resulting in hotter combustion gases. This leads to lower engine and exhaust gas temperatures than gasoline fuel combustion reactions. Lower exhaust emissions, maintained engine conditions, and longer service life are also observed.

4. Conclusion

The comparison of gasoline fuel and LPG usage technically reduces engine surface temperature, exhaust gas temperature, and fuel consumption in the engine. In terms of fuel savings, the use of LPG as fuel can reduce fuel consumption. The difference in fuel consumption rate (cc/min) of the engine when using gasoline fuel is as follows: at an engine speed of 2000 RPM, the fuel consumption for gasoline fuel is 15.8 cc/min and 16.2 cc/min, while for LPG it is 9.36 cc/min. At an engine speed of 2200 RPM, the fuel consumption for gasoline fuel is 16.2 cc/min and 22.8 cc/min, while for LPG, it is 10.48 cc/min. At an engine speed of 2500 RPM, the fuel consumption for gasoline fuel is 20.2 cc/min and 19.4 cc/min, while for LPG, it is 14.40 cc/min.

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