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Analysis of the Effect of Hydrocarbon Crack System Catalyst Pipe Length Variation on Gasoline Motor Exhaust Gas Emissions

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Abstract
The number of motorized vehicles is currently getting higher. Exhaust gas emissions are one of the problems for the environment and for human health. Therefore, in overcoming emission problems, research was carried out with the aim of minimizing exhaust gas emissions by using the Hydrocarbon Crack System (HCS) tool. HCS is a tool used to break down hydrocarbon compounds present in fuel so that it is more homogeneous. The purpose of this study is to determine the variation in the length of the best catalyst pipe for HC, CO, and CO_2 exhaust gas emissions. The independent variable in this study is the variation in the length of the catalyst pipe of 100, 150, and 200mm and the control variable in this study is the exhaust gas emission. This test was carried out with 90 octane fuel. The test method was carried out using a gas analyzer. The results of HC emissions decreased by 29.7% from the standard condition with a variation of the length of the catalyst pipe of 200mm, the results of CO emissions decreased by 4.3% from the standard condition with a variation in the length of the catalyst pipe of 200mm and the results of CO_2 emissions increased by 1.6% from the standard condition with a variation in the length of the catalyst pipe of 200mm.
Keywords: *Exhaust Gas Emissions, HCS, Catalyst Pipes*

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I. INTRODUCTION

Exhaust emissions are not harmful if complete combustion occurs in a vehicle engine, because perfect combustion of fuel produces carbon dioxide (CO_2) and pure water vapor (H_2O). On the other hand, incomplete combustion will produce pollutant gases including hydrocarbon gas (HC), monoxide gas (CO), and (NOx). These pollutant gases will pollute the surrounding air environment and are harmful to humans. In overcoming the problem of negative exhaust emissions, many studies have been carried out with the aim of minimizing exhaust gas emission levels. Among them is the installation of the Hydrocarbon Crack System (HCS), which is a tool used to break down hydrocarbon compounds in the fuel liquid through a heated catalyst pipe. So that the fuel is more homogeneous when mixed with air and burns perfectly in the engine compartment of the vehicle (Rahmat et al., 2023)[1].

HCS is a tool to improve the performance of motor vehicles, by using a catalyst pipe that is used as a tool to accelerate the process of burning fuel in the combustion chamber. Hydrocarbons contained in the fuel are broken down into hydrogen atoms (H_2) and carbon (C) using a catalyst pipe heated from the exhaust of this system is also called the Hydrocarbon crack System (Firdaus et al., 2017)[2].

The use of HCS on the Honda Supra X 125 motorcycle can reduce CO gas emissions by 32.65%. For HC gas emissions, the use of HCS can reduce HC gas emissions by 8.02%, while for CO_2 exhaust emissions, the use of HCS can increase CO_2 gas emissions by 12.98% (Saputra, 2019)[3].

1.1.1 Motor Bakar

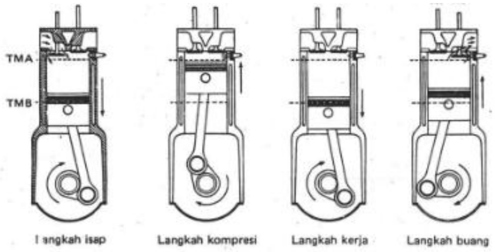

Figure 1 Motor Bakar

A four-stroke combustion motor is an internal combustion engine, which in one combustion cycle will experience four piston strokes. Four-stroke gasoline-fired motorcycles have four steps, namely the suction step, compression, effort step and exhaust step. The suction step causes the combustion chamber in the cylinder to become a vacuum, so that fuel and air enter the combustion chamber. The compression step is the step at which the mixture of fuel and air is compressed inside the cylinder. Combustion Stroke is the work step of the combustion of a mixture of fuel and air that occurs in the cylinder. The last is the exhaust step where the gas from combustion is removed from the cylinder. The conditions for the engine to run must to the maximum must meet the criteria of good combustion, namely compression, proper ignition, spark on the spark plug, fuel and air (Arfan, 2017)[4].

1.1.2 Hydrocarbon Crack System

(HCS) is a method for breaking down chains of large hydrocarbon compounds into simpler chains of compounds. HCS functions to break the chains of hydrocarbon atoms present in fuels into H2 hydrogen atoms and smaller carbon bonds such as CH4. This is done through a heated catalyst. HCS as a system breaks down hydrocarbon atoms into hydrogen atoms (H) and carbon (C) using a heated catalyst pipe. The installation of HCS can be done by utilizing the external or exothermic heat from the internal engine combustion on the exhaust manifold can reach temperatures of up to 300°C, HCS pipes as power supelmen for fuel savings. The tool works by inserting an air pipe into a pretamax tube (bubbler tank) to produce hydrocarbon vapor. Hydrocarbon vapor is channeled to the carburetor intake through a catalyst pipe as a hydrogen and carbon breaker. The increase in hydrogen and carbon makes combustion perfect, and BB consumption is more economical (Mastur et al., 2018)[5].

1.1.3 Exhaust Gas Emissions

Vehicle exhaust emissions are the remnants of fuel combustion in the vehicle's engine that are discharged through the engine exhaust system. In a perfect reaction, the residual combustion product is in the form of exhaust gases containing carbon dioxide (CO_2), water vapor (H_2O), oxygen (O_2), and nitrogen (N_2). In practice, the combustion that occurs in the vehicle engine does not always run perfectly, so that the exhaust gas contains harmful compounds such as carbon monoxide (CO), and hydrocarbons (HC).

1. Hydrocarbons (HC)
   Hydrocarbon Compounds (HC), occur because the fuel has not been burned but has been wasted with exhaust gases due to incomplete combustion and fuel evaporation. Hydrocarbon compounds (HC) are divided into two, namely fuels that do not burn so that they come out as raw gases, and fuels that are split due to the heat reaction turning into other HC groups that come out with the exhaust gases. HC compounds will have an impact on feeling stinging in the eyes, resulting in sore throats, lung diseases and cancer (Fatnawati, 2021)[6].
2. Carbon Monoxide (CO)
   Carbon monoxide (CO) is created from fuels that burn partly due to incomplete combustion or because the fuel and air mixture is too rich. The CO emitted from the combustion residue is greatly influenced by the ratio of the fuel and air mixture is not perfect. CO is very dangerous because it is neither colored nor smelly, causing dizziness, and nausea.
3. Carbon Dioxide (CO_2)
   CO_2 emissions are the release of carbon dioxide gas into the atmosphere because of various human and natural activities that are one of the main causes of air pollution and global warming. Motor vehicles are the main contributor to producing CO_2 emissions due to the increase in the number of motor vehicles (Kaparang et al., 2023)[7].

1.2 Method

The method of obtaining data by laboratory experiments, because it aims to determine the effect of the variation of the catalyst pan on exhaust gas emissions using a Gas Analyzer. The data will be processed into tables and graphs.

1.2.1 Tools and Materials

The tools and materials used for this research are as follows:

Tabel 1 Tools and Material

No	Information	
1	Material	100, 150, and 200mm Catalyst Pipes
		Octane 90
		4-cylinder gasoline engine
2	Tool	Gaz Analyzer

1.2.2 Equipment Setup

The procedure for using an exhaust gas emission test device is explained as follows:

1. Preparing the Gas Analyzer Perform a test calibration of the emission tool by clicking the select button until it shows the word "CALIBRATION" then click enter and wait for 20 seconds. After the calibration is complete, click "ZERO" until the "READY" button appears, which means the Gas Analyzer is ready to use.
2. Setting the engine rotation that has been determined. Then test at 800 (idle), 1000, 2000, 3000, and 4000 rpm.
3. Install the Gas Analyzer Probe on the exhaust to the maximum.
4. To obtain emission result data, wait 30 seconds to 1 minute in stable rpm conditions to get valid results.
5. Press the "HOLD PRINT" button once for the test result reading, then "HOLD PRINT" again to print the measurement result.
6. The test is carried out 3 times to get more valid data and record the test results.

II. RESULTS AND DISCUSSION

2.1 CO Exhaust Gas Emissions

Table 1 CO Exhaust Gas Emission Test Results

CO (%)				
Rpm	Standard	100mm	150mm	200mm
800	4.43%	3.86%	3.84%	3.55%
1000	3.06%	3.43%	3.00%	2.54%
2000	1.58%	0.89%	1.07%	0.90%
3000	3.64%	3.04%	2.65%	2.66%
4000	3.74%	3.78%	3.69%	3.80%
Average	3.29%	3.00%	2.85%	2.69%

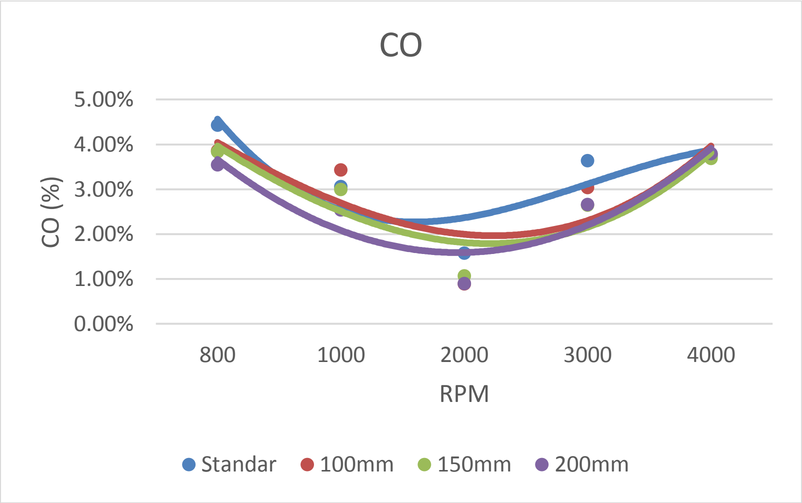

Figure 2 CO exhaust emissions graph

In the graph above, you can see the graph between the relationship between the use of HCS and the variation without using HCS with the variation of catalyst lengths of 100, 150, and 200mm. It can be seen that the use of HCS can improve CO emission levels. The largest decrease occurred at 800 rpm, which was 1.9% of the condition without HCS using HCS with a catalyst pipe length of 200mm. At 1000 rpm, there was a decrease in CO levels by 1.6% from the condition without HCS by using HCS with a catalyst length of 200mm. At 2000 rpm, there was a decrease in CO levels by 4.3% from the condition without HCS using HCS with a catalyst length of 200mm. At 3000 rpm, there was a decrease in CO levels by 2.7% from the condition without HCS by using HCS with a catalyst length of 150mm. And at 4000 rpm there was a decrease in CO levels by 0.1% from the condition without HCS by using HCS with a catalyst length of 150mm.

2.2 HC Exhaust Emissions

Table 2 HC Exhaust Gas Emission Test Results

HC (ppm)				
Rpm	Standard	100 mm	150 mm	200 mm
800	616	514	511	440
1000	406	398	421	359
2000	245	188	173	197
3000	267	255	231	256
4000	256	250	248	242
Avarege	358	321	317	299

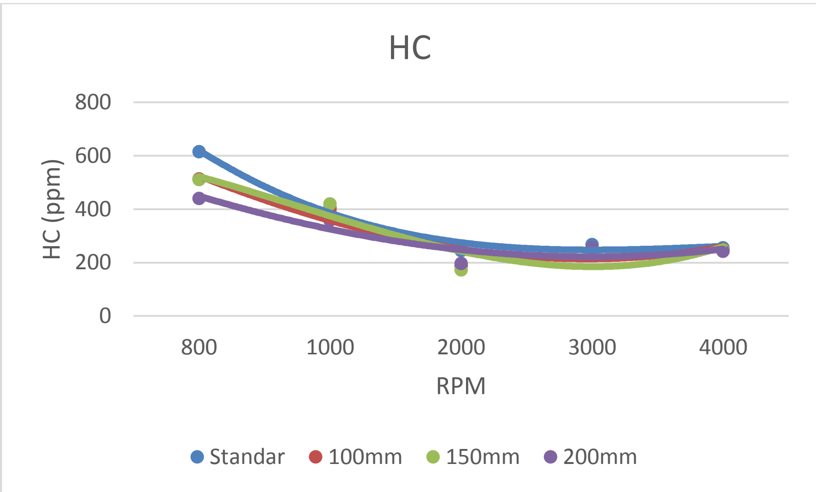

Figure 3 CO exhaust emissions graph

In the graph above, you can see the graph between the relationship between the use of HCS and the variation without using HCS with the variation of catalyst lengths of 100, 150, and 200mm. It can be seen that the use of HCS can improve HC emission levels. The use of HCS has decreased HC levels starting at 800 rpm to 4000 rpm. The largest decrease occurred at 800 rpm, which was 28.4% of the condition without HCS using HCS with a catalyst pipe length of 200mm. At 1000 rpm, there was a decrease in HC levels by 11.3% from the condition without HCS by using HCS with a catalyst length of 200mm. At 2000 rpm, there was a decrease in HC levels by 29.7% from the condition without HCS using HCS with a catalyst length of 150mm. At 3000 rpm, there was a decrease in HC levels by 13.4% from the condition without HCS by using HCS with a catalyst length of 150mm. And at 4000 rpm there was a decrease in HC levels by 13.9% from the condition without HCS by using HCS with a catalyst length of 150mm.

2.3 CO_2 Exhaust Gas Emissions

Table 3 CO_2 Exhaust Gas Emission Test Results

CO_2 (%)				
Rpm	Standard	100mm	150mm	200mm
800	6.17 %	7.0 %	6. 7 %	7.73 %
1000	8.00 %	7.9 %	8.0 %	8.33 %

2000	10.3 %	10.7 %	10.7 %	10.8 %
3000	8.87 %	9.5 %	9.87 %	10.0 %
4000	8.83 %	9.0 %	9.13 %	9.30 %
Avarege	8.42 %	8.82 %	8.89 %	9.17%

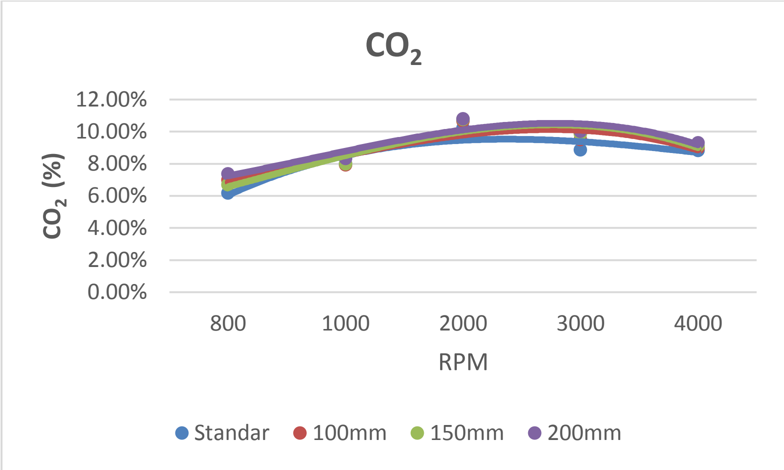

Figure 4 CO_2 exhaust emissions graph

In the graph above, you can see the graph between the relationship between the use of HCS and the variation without using HCS with the variation of catalyst lengths of 100, 150, and 200mm. It can be seen that the use of HCS can improve CO_2 emission levels. The use of HCS causes an increase in CO_2 levels starting at 800 rpm to 4000 rpm. The largest increase occurred at 800 rpm, which was 1.6% from the condition without HCS using HCS with a catalyst pipe length of 200mm. At 1000 rpm, there was an increase in CO_2 levels by 0.3% from the condition without HCS by using HCS with a catalyst length of 200mm. At 2000 rpm, there was an increase in CO_2 levels by 0.5% from the condition without HCS using HCS with a catalyst length of 200 mm. At 3000 rpm, there was an increase in CO2 levels by 1.1% from the condition without HCS using HCS with a catalyst length of 200mm. And at 4000 rpm there was an increase in CO_2 levels by 0.5% from the condition without HCS using HCS with a catalyst length of 200mm.

III. CONCLUSION

The length of the catalyst pipe has an influence on the exhaust gas emissions produced because the longer the catalyst pipe, the more fuel undergoes the cracking process so that more fuel phases turn into liquid gas phases. Fuel consumption will be more economical because the volume of fuel that enters the float chamber is greater than the volume of liquid fuel.

REFERENCE

[1]. Arfan, K. (2017). Performance Analysis of Gas-Fired Gasoline Motorcycles Against Fuel Valve Opening Variations. 1–42.
[2]. Fatnawati, E. (2021). Comparative Study of the Impact of Exhaust Gas Emissions of High School Motor Vehicles in Bandar Lampung. Angewandte Chemie International Edition, 6(11), 951–952., 2013–2015.
[3]. Firdaus, A. N., Solechan, & Raharjo, S. (2017). The Effect of Adding Spiral Hydrocarbon Crack System Pipes on Exhaust on Fuel Economy and Exhaust Emissions of Suzuki Carry Futura 1500 cc Car Introduction The dependence on fuel must be reduced immediately and needs to be carried. 17(1), 21–29.
[4]. Kaparang, A. C., Mangangka, I. R., & Riogilang, H. (2023). Handling Co 2 emissions from various types of motor vehicles. 21(85).
[5]. Mastur, Setiawan, K., & Susanto, T. D. (2018). Critical design of copper and aluminum catalyst pipes in the Hydrocarbon Crack System (HCS) for gasoline engine combustion optimization and exhaust emission reduction. Proceedings of the Unimus National Seminar, 1, 688–696.
[6]. Rahmat, F., Prasetiyo, D. H. T., & Wahyudi, D. (2023). The Effect of HCS on Pertalite Fuel Consumption, Emissions and Performance in Vehicles. Mechonversio: Mechanical Engineering Journal, 6(1), 22–27. Https://Doi.Org/10.51804/Mmej.V6i1.13544
[7]. Saputra, D. (2019). The Effect of the Use of Hydrocarbon Crack System (Hcs) on the Exhaust Gas Emission Content on the Honda Supra X 125 Motorcycle. Angewandte Chemie International Edition, 6(11), 951–952., 2, 1–11.