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The Effect of Aluminum Catalyst Material on Motorcycle Engine Performance

[1]Yuniarto Agus Winoko, [2]Sulthan Zanky Naufal
[1]*Department of Mechanical Engineering, Malang State Polytechnic, Malang State Polytechnic, Indonesia*
[2] *Department of Mechanical Engineering, Malang State Polytechnic, Malang State Polytechnic, Indonesia*
Corresponding Author:[2]Sulthan Zanky Naufal (sulthanzankyn87@gmail.com)

Abstract
The aim of the research is to compare the results of exhaust emissions before and after using an aluminum catalyst, determine the largest and smallest values of CO, HC and CO2 gases and determine the power and torque values before and after using an aluminum catalyst. The test method is carried out by measuring exhaust emissions and full throttle for testing power and torque. When using standard exhaust, the CO level is 1.70% at 4500 Rpm, there is a decrease in CO value when using catalysts 16, 20 and 24 grams, respectively 1.40%, 1.10% and 0.90% at 4500 Rpm. When using a standard exhaust with HC content of 84 ppm at 5500 Rpm, there was a decrease in HC levels when using 16, 20 and 24 gram catalysts, respectively 73 ppm, 65 ppm and 51 ppm at 5500 Rpm.
When using a standard exhaust, the CO2 level is 15.80% at 5000 Rpm, there is a decrease in CO2 levels when using catalysts 16, 20 and 24 grams, respectively 14.80%, 14.10% and 13.70% at 5000 Rpm. The largest CO gas content is 4.00% at 1500 Rpm and the smallest is 0.30% at 6000 Rpm. The highest HC content was 200 ppm at 1500 Rpm and the smallest was 42 ppm at 6000 Rpm. The largest CO2 level is 13.90% at 1500 Rpm and the smallest is 12.50% at 6000 Rpm. When using a standard exhaust, the highest power value is 27.38 Hp at 11000 Rpm and when using a catalyst of 16, 20 and 24 grams the highest power value is 26.11 Hp, 26.08 Hp and 26.04 Hp at 11000 Rpm respectively. When using a standard exhaust, the maximum torque is 18.95 Nm at 8000 Rpm and when using a catalyst of 16, 20 and 24 grams, the maximum torque is 17.16 Nm, 17.51 Nm and 17.35 Nm at 8000 Rpm.

Keywords: *aluminum, catalytic converter, exhaust emissions, power.*

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I. INTRODUCTION

Exhaust emissions occur due to imperfect combustion in the combustion process of the air and fuel mixture. Combustion is the process of rapid oxidation between the fuel and the oxidizer to produce heat or light [1]. The exhaust emissions produced by motor vehicles are carbon monoxide (CO), hydrocarbons (HC), carbon dioxide (CO2) these gases have an adverse impact on humans and the environment. The addition or use of a catalytic converter in the exhaust gas system is one way to reduce exhaust gases and reduce air pollution. Broadly speaking, the working principle of the catalytic converter converts and decomposes exhaust gas pollutant levels by chemical reactions into compounds that are oxidized.

A catalytic converter is a device for reducing exhaust emissions from the combustion of a mixture of air and fuel [2]. Most of the catalytic converters widely applied and used in motor vehicles are monolithic pellets and catalysts made of precious metals, for example Platinum (Pt), Rhodium (Rh) and palladium (Pd). Catalytic converter researchers mention that selecting the right and maximum material is needed for components in the manufacture of catalytic converters. Catalytic converters are the right and perfect choice in overcoming increasing motor vehicle pollution to meet environmental requirements [3].

Motorized vehicles produce power from the conversion of heat energy into motion energy, motion energy comes from the results of the process of burning fuel in the combustion chamber. Air fuel ratio and lambda affect the amount of gas emissions coming out of the vehicle and the power produced. Combustion is a chemical process that occurs between carbon and water substances which combine with acids in the air, if combustion takes place, fuel and air are needed which are put into the combustion chamber and heated to flame temperature [4]. Air Fuel Ratio (AFR) is the ratio of the mass of fuel to air or vice versa. The minimum ratio of fuel and air containing oxygen is required to burn the fuel completely.Stoichiometric fuel-air ratio is a condition that occurs when the entire mixture of air to fuel is right or ideal. The theory of ideal combustion says that to burn 1 gram of gasoline completely requires 14.7 grams of oxygen, in a gasoline engine the ratio of fuel to air is

1: 14.7. Which means one part fuel mixed with 14.7 parts air. The magnitude of the comparison between the actual AFR conditions and the theoretical AFR is called the lambda (λ).

The catalytic converter is a component of the emission control system which aims to reduce the amount of exhaust emissions on the vehicle, one of which is carbon monoxide, hydrocarbons and nitrogen oxides contained in the gas produced from engine combustion [4]. The catalytic converter is generally placed before the muffler to obtain optimal working temperatures so that it can work more efficiently at temperatures of more than 200°C [5]. The Catalytic Converter works by carrying out reduction and oxidation reactions on the surface of the catalyst media by utilizing the remaining combustion gas that hits the cross section of the catalyst media, the slower the exhaust gas flow rate will be which results in a faster rate of reduction and oxidation reactions to reduce exhaust emissions. A catalyst medium is a substance that speeds up the rate of a chemical reaction at a certain temperature, without being changed or used up by the reaction itself. The workings of the catalytic converter is a chemical reaction to change the form of a compound into another compound with the help of a catalyst medium, the workings of a catalytic converter when the exhaust gas from the combustion products passes through the catalyst media arrangement, the gas from the combustion engine will be bound so that the exhaust gas comes out after the catalyst more environmentally friendly.

II. RESULT AND DISCUSSION

The compiler performs data processing on exhaust emission test data, torque power test. The data that has been obtained is then plotted onto a graph and processed using the ANOVA method.After data collection was carried out three times, the average was taken from each test carried out.

1. CO Exhaust Emissions

Table 1: CO Exhaust Emission Data

Machine Rotation (Rpm)	Standard Exhaust	Catalyst Exhaust 16gr	Catalyst Exhaust 20gr	Catalyst Exhaust 24gr
1500	4.00	3.70	3.50	2.90
2000	3.07	3.40	3.20	2.60
2500	3.20	2.90	2.70	2.40
3000	2.70	2.40	2.10	2.00
3500	2.40	2.10	1.80	1.60
4000	2.00	1.70	1.40	1.30
4500	1.70	1.40	1.10	0.90
5000	1.50	1.30	1.10	0.90
5500	1.00	0.90	0.70	0.50
6000	0.70	0.70	0.50	0.30

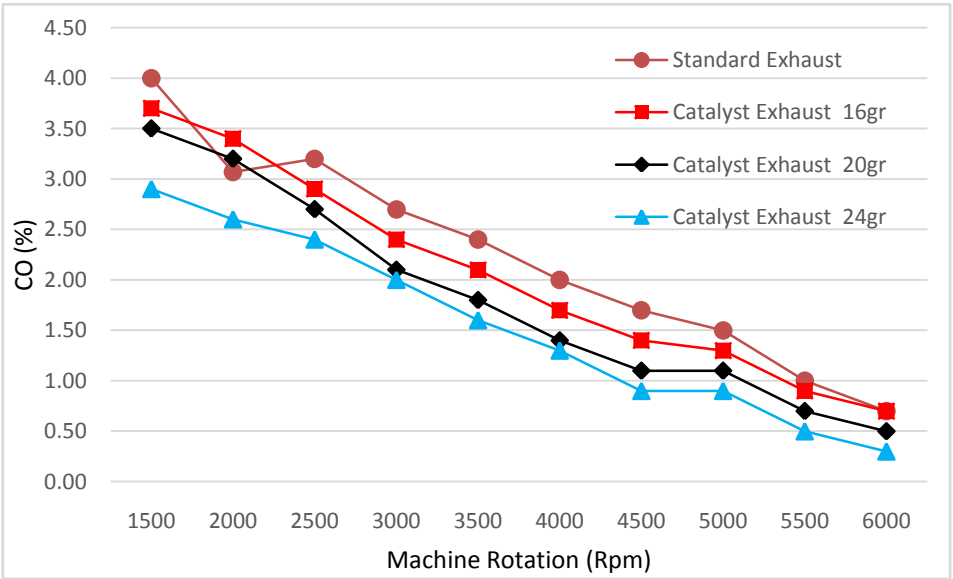

Figure 1: Graph of CO Exhaust Emission Comparison

Figure 1 shows the data from the CO exhaust emission test results presented in graphical form when using a standard exhaust and exhaust using a catalyst weighing 16 grams, 20 grams and 24 grams. 1500 Rpm

and the smallest CO content is 0.70% at 6000 Rpm. At 1500 Rpm or engine idle conditions the CO level is quite high because the AFR is richer than the stoichiometric conditions, as the engine speed increases the CO level also decreases, it is said that the CO level is in an ideal position at 5500 Rpm to 6000 Rpm each CO level is 1.00% and 0.70%. Using a 16 gram catalyst exhaust, the test results showed the highest CO content was 3.70% at 1500 Rpm and the smallest CO content was 0.70% at 6000 Rpm. At 1500 Rpm or the engine is idle, the CO level is quite high because the AFR is richer than the stoichiometric conditions, as the engine speed increases, the CO level also decreases, it is said that the CO level is in an ideal position at 5500 Rpm to 6000 Rpm, each CO level is 0.90% and 0.70%. In the 16 gram catalyst exhaust, there was a decrease in CO gas levels compared to using standard exhaust, the decrease occurred because the catalyst reduced CO gas produced from the rest of the combustion products.

Using a 20 gram catalyst exhaust, the test results showed the highest CO content was 3.50% at 1500 Rpm and the smallest CO content was 0.50% at 6000 Rpm. At 1500 Rpm or engine idle conditions the CO level is quite high because the AFR is richer than the stoichiometric conditions, as the engine speed increases the CO level also decreases, it is said that the CO level is in an ideal position at 5500 Rpm to 6000 Rpm each CO level is 0.70% and 0.50%. In the 20 gram catalyst exhaust, there was a decrease in CO gas levels compared to using standard exhaust, the decrease occurred because the catalyst reduced CO gas produced from the rest of the combustion products. Using a 24 gram catalyst exhaust, the test results showed the highest CO content was 2.90% at 1500 Rpm and the smallest CO content was 0.30% at 6000 Rpm. At 1500 Rpm or engine idle conditions the CO level is quite high because the AFR is richer than the stoichiometric conditions, as the engine speed increases the CO level also decreases, it is said that the CO level is in an ideal position at 4500 Rpm to 6000 Rpm each CO level is 0.90% , 0.90%, 0.50% and 0.30%. In the 24 gram catalyst exhaust, there was a decrease in CO gas levels compared to using standard exhaust, the decrease occurred because the catalyst reduced CO gas produced from the rest of the combustion products.

Table 2: Two Way Anova CO Exhaust Emissions

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	108.4512	9	12.050134	1302.3652	7.26E-83	1.9991148
Columns	8.008402	3	2.6694675	288.5131	8.61E-43	2.718785
Interaction	1.371623	27	0.0508008	5.4904981	1.39E-09	1.6255133
Within	0.7402	80	0.0092525			
Total	118.5714	119				

The results of data processing carried out using the two-way ANOVA method, it can be concluded from the ANOVA processing table that there is an influence on the results of testing exhaust emissions produced by motorbikes from the use of standard exhausts on the use of catalysts made of aluminum at a weight of 16 grams, 20 grams and 24 grams. This is known in the ANOVA table which shows the calculated F value of the sample 1302.3652 > 1.9991148 the F table sample value, the F calculated column value 288.5131 > 2.718785 the F table column value, the F calculated interaction value 5.4904981 > 1.6255133 the F table interaction value.

2. HC Exhaust Emissions

Table 3: HC Exhaust Emission Data

Machine Rotation (Rpm)	Standard Exhaust	Catalyst Exhaust 16gr	Catalyst Exhaust 20gr	Catalyst Exhaust 24gr
1500	200	195	189	185
2000	194	184	178	170
2500	174	169	164	159
3000	159	148	132	125
3500	132	123	115	104
4000	120	115	100	93
4500	109	99	85	78
5000	92	83	73	66
5500	84	72	65	51
6000	78	60	55	42

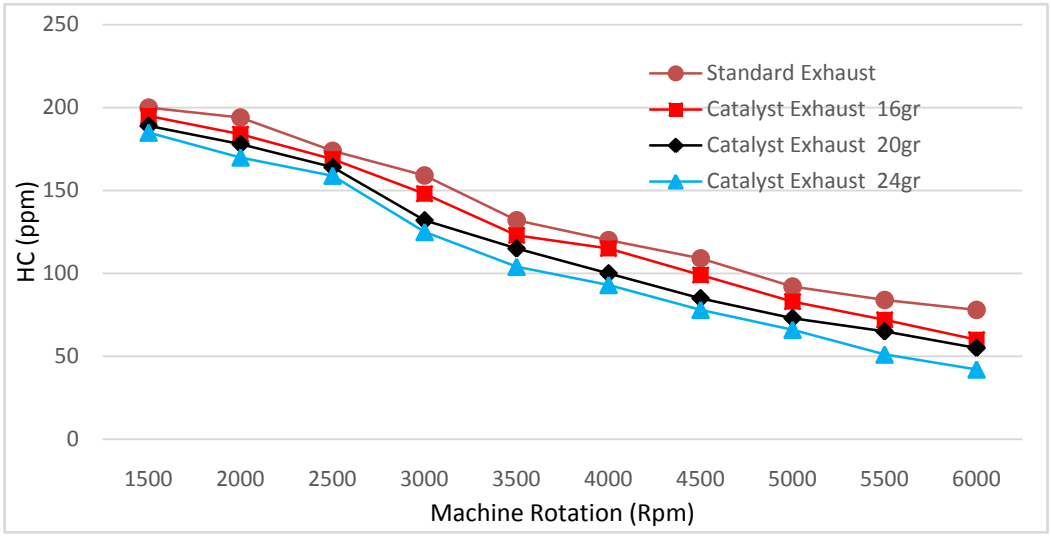

Figure 2: Graph of HC Exhaust Emission Comparison

Figure 2 shows the data from the HC exhaust emission test results presented in graphical form when using a standard exhaust and exhaust using a catalyst weighing 16 grams, 20 grams and 24 grams. Using a standard exhaust, the test results showed the highest HC level was 200 ppm at 1500 Rpm and the smallest HC level was 78 ppm at 6000 Rpm. At 1500 Rpm or the engine is idle, the HC level is quite high because the temperature of the air/fuel mixture is too low when it enters the combustion chamber, increasing the engine speed, the HC level is also decreasing, it is said that the HC level is in an ideal position at 5000 Rpm to 6000 Rpm respectively HC levels were 92 ppm, 84 ppm and 78 ppm. Using a 16 gram catalyst exhaust, the test results showed the highest HC content was 195 ppm at 1500 Rpm and the smallest HC content was 60 ppm at 6000 Rpm. At 1500 Rpm or the engine is idle, the HC level is quite high due to the temperature of the air/fuel mixture which is too low when it enters the combustion chamber, increasing the engine speed, the HC level is also decreasing, it is said that the HC level is in an ideal position at 4500 Rpm to 6000 Rpm respectively HC levels were 99 ppm, 83 ppm, 73 ppm and 60 ppm. In the 16 gram catalyst exhaust, there was a decrease in HC gas levels compared to using standard exhaust, the decrease occurred because the catalyst reduced HC gas produced from the rest of the combustion products.

Using a 20 gram catalyst exhaust, the test results showed the highest HC content was 189 ppm at 1500 Rpm and the smallest HC content was 55 ppm at 6000 Rpm. At 1500 Rpm or the engine is idle, the HC level is quite high due to the temperature of the air/fuel mixture which is too low when it enters the combustion chamber, increasing the engine speed, the HC level is also decreasing, it is said that the HC level is in an ideal position at 4500 Rpm to 6000 Rpm respectively HC levels were 85 ppm, 73 ppm, 65 ppm and 55 ppm. In the 20 gram catalyst exhaust, there was a decrease in HC gas levels compared to using standard exhaust, the decrease occurred because the catalyst reduced HC gas produced from the rest of the combustion products.

Using a 24 gram catalyst exhaust, the test results showed the highest HC content was 185 ppm at 1500 Rpm and the smallest HC content was 42 ppm at 6000 Rpm. At 1500 Rpm or the engine is idle, the HC level is quite high due to the temperature of the air/fuel mixture which is too low when it enters the combustion chamber, increasing the engine speed, the HC level is also decreasing, it is said that the HC level is in an ideal position at 4500 Rpm to 6000 Rpm respectively HC levels were 78 ppm, 66 ppm, 51 ppm and 42 ppm. In the 24 gram catalyst exhaust, there was a decrease in HC gas levels compared to using standard exhaust, the decrease occurred because the catalyst reduced HC gas produced from the rest of the combustion products.

Table 4: Two Way Anova HC Exhaust Emissions

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	248025	9	27558.333	12817.829	1.8E-122	1.9991148
Columns	12159	3	4053	1885.1163	4.32E-74	2.718785
Interaction	1014	27	37.555556	17.4677	1.79E-23	1.6255133
Within	172	80	2.15			
Total	261370	119				

The results of data processing carried out using the two-way ANOVA method, it can be concluded from the ANOVA processing table that there is an influence on the results of testing exhaust emissions produced by motorcycles from using standard exhaust on the use of catalysts made of aluminum at 16 grams, 20 grams and 24 grams. grams. This is known in the ANOVA table which shows the F calculated sample value 12817.829 > 1.9991148 F table sample value, F calculated column value 1885.1163 > 2.718785 F table column value, F calculated interaction value 17.4677 > 1.6255133 F table interaction value.

3. CO2 Exhaust Emissions

Table 5: CO2 Exhaust Emission Data

Machine Rotation (Rpm)	Standard Exhaust	Catalyst Exhaust 16gr	Catalyst Exhaust 20gr	Catalyst Exhaust 24gr
1500	13.90	13.00	12.80	12.60
2000	15.00	14.50	14.00	13.80
2500	16.40	15.90	15.30	14.40
3000	17.00	16.40	16.10	15.30
3500	16.90	16.10	15.60	14.80
4000	17.30	16.50	15.80	15.00
4500	16.20	15.20	14.70	14.50
5000	15.80	14.80	14.20	13.70
5500	14.80	14.00	13.60	13.00
6000	14.00	13.50	12.90	12.50

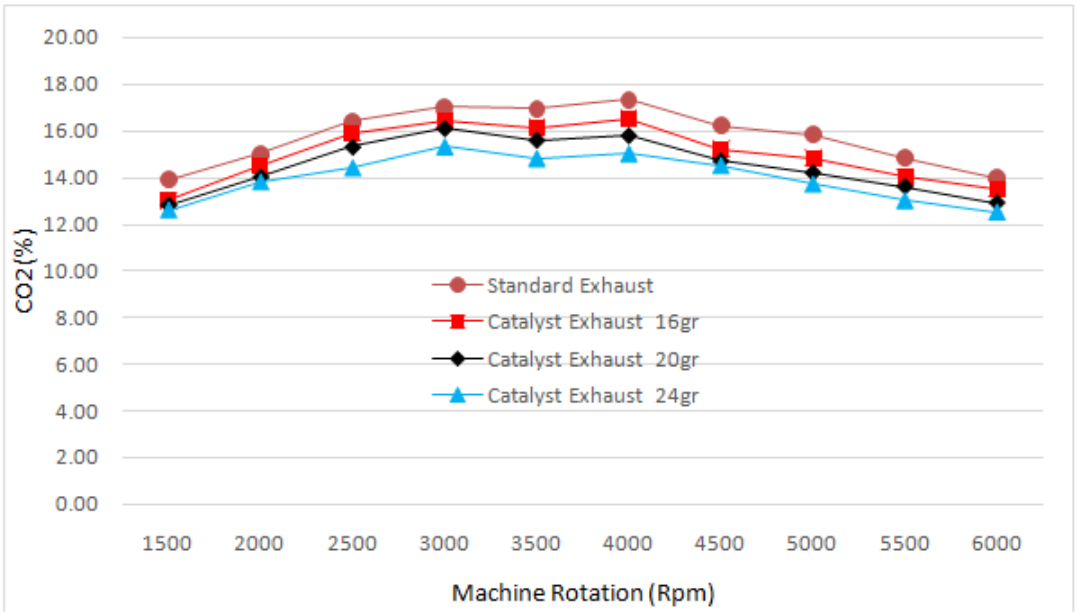

Figure 3: Graph of CO2 Exhaust Emission Comparison

Figure 3 shows the data from CO2 emission testing results presented in graphical form when using a standard muffler and muffler using a catalyst weighing 16 grams, 20 grams and 24 grams. In using standard exhaust, the test results showed that the highest CO2 level was 17.30% at 4000 Rpm and the smallest CO2 level was 13.90% at 1500 Rpm. At 4000 Rpm the CO2 level is quite high this is caused by the availability of sufficient oxygen during combustion to fully oxidize the carbon atoms, this results in higher CO2 levels as the main by-product of efficient combustion. Using a 16 gram catalyst exhaust, the test results showed the highest CO2 level was 16.30% at 4000 Rpm and the smallest CO2 level was 13.00% at 1500 Rpm. At 4000 Rpm the CO2 level is quite high this is caused by the availability of sufficient oxygen during combustion to fully oxidize the carbon atoms, this results in higher CO2 levels as the main by-product of efficient combustion. At 16 grams of catalyst exhaust, CO2 gas levels are lower than standard exhaust CO2 gas levels, the use of a catalyst can reduce CO2 gas levels.

Using a 20 gram catalyst exhaust, the test results showed the highest CO2 level was 15.80% at 4000 Rpm and the smallest CO2 level was 12.80% at 1500 Rpm. At 4000 Rpm the CO2 level is quite high this is caused by the availability of sufficient oxygen during combustion to fully oxidize the carbon atoms, this results in higher CO2 levels as the main by-product of efficient combustion. At 20 grams of catalyst exhaust, CO2 gas levels are lower than standard exhaust CO2 gas levels, the use of catalysts can reduce CO2 gas levels.
Using a 24 gram catalyst exhaust, the test results showed the highest CO2 level was 15.00% at 4000 Rpm and the smallest CO2 level was 12.50% at 6000 Rpm. At 4000 Rpm the CO2 level is quite high this is caused by the availability of sufficient oxygen during combustion to fully oxidize the carbon atoms, this results in higher CO2 levels as the main by-product of efficient combustion. At 24 grams of catalyst exhaust, CO2 gas levels are lower than standard exhaust CO2 gas levels, the use of catalysts can reduce CO2 gas levels.

Table 6: Two Way Anova CO2 Exhaust Emissions

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	142.4918	9	15.832417	550.69275	4.36E-68	1.9991148
Columns	50.27025	3	16.75675	582.84348	3.07E-54	2.718785
Interaction	3.49725	27	0.1295278	4.505314	8.21E-08	1.6255133
Within	2.3	80	0.02875			
Total	198.5593	119				

The results of data processing carried out using the two-way ANOVA method, it can be concluded from the ANOVA processing table that there is an influence on the results of testing exhaust emissions produced by motorcycles from using standard exhaust on the use of catalysts made of aluminum at 16 grams, 20 grams and 24 grams. grams. This is known in the ANOVA table which shows the calculated F value of the sample 550.69275 > 1.9991148 the F value of the sample table, the F calculated value of columns 582.84348 > 2.718785 the F value of the column table, the F calculated interaction value of 4.505314 > 1.6255133 the F table interaction value.

4. Power

Table 7: Power Data

Machine Rotation (Rpm)	Standard Exhaust	Catalyst Exhaust 16gr	Catalyst Exhaust 20gr	Catalyst Exhaust 24gr
2000	2.64	1.77	1.73	1.71
3000	6.92	5.99	5.77	5.55
4000	9.74	8.52	8.39	8.15
5000	11.89	10.96	10.86	10.76
6000	12.83	11.85	11.65	11.35
7000	15.24	14.07	13.67	13.37
8000	19.53	17.88	17.85	17.78
9000	21.79	20.56	20.49	20.53
10000	25.97	24.97	24.87	24.77
11000	27.38	25.42	25.32	25.30
12000	26.95	26.11	26.08	26.04
13000	25.96	25.30	25.26	25.23

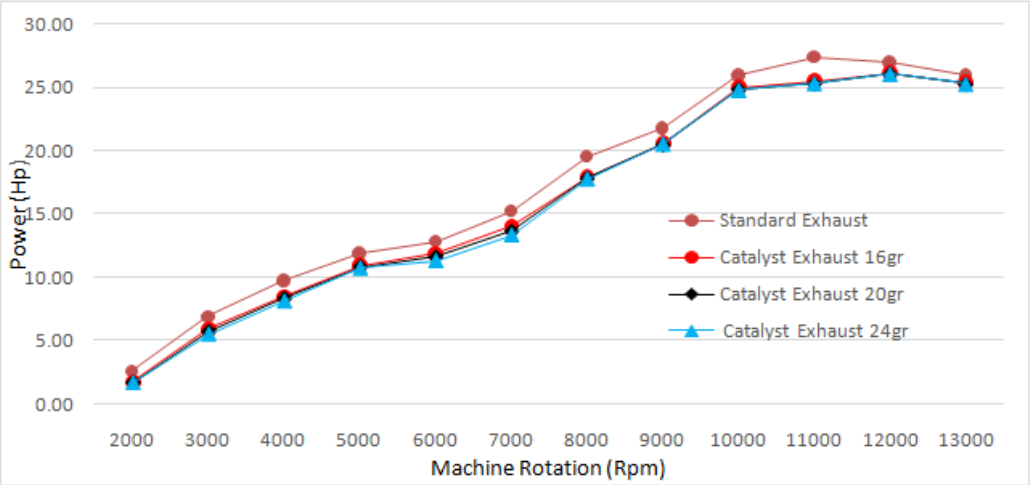

Figure 4: Graph of Power Comparison

Figure 4 shows the power test results data presented in graphical form when using a standard muffler and muffler using a catalyst with a weight of 16 grams, 20 grams and 24 grams. Using a standard exhaust, the test results show that the highest power value is 27.38 Hp at 11000 Rpm, this value is smaller than the power value in motorcycle specifications, which is 35.49 Hp. The decrease in power value occurs due to the length of years of use. Using a 16 gram catalyst exhaust, the test results show the greatest power value, namely 26.11 Hp at 12000 Rpm, this value is smaller than the power value in motorcycle specifications, which is 35.49 Hp. The decrease in power value occurs due to the long years of use and the use of catalysts in the exhaust gas channel.

Using a catalyst exhaust of 20 grams, the test results show the greatest power value, namely 26.08 Hp at 12000 Rpm, this value is smaller than the power value in motorcycle specifications, which is 35.49 Hp. The decrease in power value occurs due to the long years of use and the use of catalysts in the exhaust gas channel. Using a 24 gram catalyst exhaust, the test results show the greatest power value, namely 26.04 Hp at 12000 Rpm, this value is smaller than the power value in motorcycle specifications, which is 35.49 Hp. The decrease in power value occurs due to the long years of use and the use of catalysts in the exhaust gas channel.

Table 8: Anova Two Way Power

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	9551.128	11	868.28433	27888.6	5.4E-163	1.89
Columns	42.09944	3	14.033145	450.7334	2.05E-56	2.699
Interaction	4.045206	33	0.122582	3.937236	8.65E-08	1.558
Within	2.988867	96	0.031134			
Total	9600.261	143				

The results of data processing carried out using the two-way ANOVA method, it can be concluded from the ANOVA processing table that there is an influence on the results of testing the power produced by motorbikes from the use of a standard exhaust on the use of catalysts made of aluminum at a weight of 16 grams, 20 grams and 24 grams. This is known in the ANOVA table which shows the calculated F value of the sample 27888.6 > 1.89 the F value of the sample table, the F calculated value of columns 450.7334 > 2.699 the F value of the column table, the F calculated interaction value of 3.937236 > 1.558 the F table interaction value.

5. Torque

Table 9: Torque Data

Machine Rotation (Rpm)	Standard Exhaust	Catalyst Exhaust 16gr	Catalyst Exhaust 20gr	Catalyst Exhaust 24gr
2000	8.95	7.10	7.00	7.13
3000	13.57	12.55	12.25	11.65
4000	14.55	14.29	14.00	13.84
5000	15.82	15.51	15.21	15.01

6000	16.75	16.47	16.21	16.09
7000	17.94	16.59	16.29	17.09
8000	18.26	17.16	17.51	17.35
9000	18.95	16.85	17.15	16.69
10000	17.83	16.49	16.23	16.07
11000	16.93	15.33	15.20	15.08
12000	15.97	14.48	14.23	14.03
13000	13.74	13.32	13.14	13.12

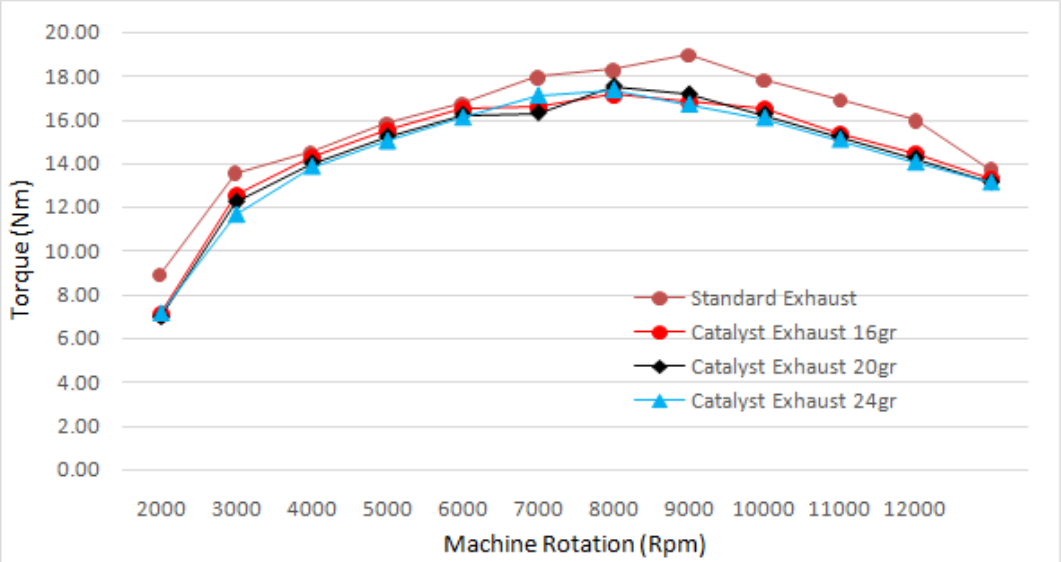

Figure 5: Graph of Torque Comparison

Figure 5 shows the torque test results data presented in graphical form when using a standard muffler and muffler using a catalyst with a weight of 16 grams, 20 grams and 24 grams. When using a standard exhaust, the test results show the greatest torque value, namely 18.95 Nm at 9000 Rpm, this value is smaller than the torque value in motorcycle specifications, which is 22.6 Nm. The decrease in torque value occurs due to the length of years of use. Using a 16 gram catalyst exhaust, the test results show the greatest torque value, namely 17.16 Nm at 8000 Rpm, this value is smaller than the torque value in motorcycle specifications, which is 22.6 Nm. The decrease in torque value occurs due to the length of years of use.

When using a 20 gram catalyst exhaust, the test results show the greatest torque value, namely 17.51 Nm at 8000 Rpm, this value is smaller than the torque value in motorcycle specifications, which is 22.6 Nm. The decrease in torque value occurs due to the length of years of use. When using a 24 gram catalyst exhaust, the test results show the greatest torque value, namely 17.35 Nm at 8000 Rpm, this value is smaller than the torque value in motorcycle specifications, which is 22.6 Nm. The decrease in torque value occurs due to the length of years of use.

Table 10: Anova Two Way Torque

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	1039.905	11	94.536774	122642.3	7.3E-194	1.89
Columns	41.52566	3	13.841886	17957.04	8E-132	2.699
Interaction	11.83569	33	0.3586573	465.2852	2.69E-92	1.558
Within	0.074	96	0.0007708			
Total	1093.34	143				

III. CONCLUSION

Based on the results of testing and data processing that has been carried out on exhaust emissions, power and torque from the use of standard exhaust and aluminum catalyst exhaust, it can be concluded as follows:

1. In the standard exhaust, the CO level is 1.70% at 4500 Rpm after using a catalyst, there is a decrease in CO levels, on a 16 gram catalyst, which is 1.40% at 4500 Rpm, a 20 gram catalyst, which is 1.10% at 4500 Rpm and a 24 catalyst gram which is 0.90% at 4500 Rpm. In the standard exhaust, the HC level is 84 ppm at 5500 Rpm. After using a catalyst, there is a decrease in HC levels, for a 16 gram catalyst, which is 73 ppm at 5500 Rpm, a 20 gram catalyst, which is 65 ppm at 5500 Rpm and a 24 gram catalyst, which is 51 ppm at 5500 Rpm. In standard exhaust the CO2 level is 15.80% at 5000 Rpm after using a catalyst there is a decrease in CO2 levels, on a 16 gram catalyst that is 14.80% at 5000 Rpm, for the largest 20 gram catalyst is 14.10% at 5000 Rpm and for a catalyst The biggest 24 grams is 13.70% at 5000 Rpm.
2. The highest CO gas content is when using a standard exhaust, which is 4.00% at 1500 Rpm and the smallest CO level is when using a 24 gram catalyst exhaust, which is 0.30% at 6000 Rpm. The highest HC content was when using a standard exhaust, which was 200 ppm at 1500 Rpm, and the smallest HC level was when using a 24 gram catalyst exhaust, which was 42 ppm at 6000 Rpm. The highest CO2 content was when using standard exhaust, namely 13.90% at 1500 Rpm and the smallest CO2 level when using 24 gram catalyst exhaust, namely 12.50% at 6000 Rpm.
3. In terms of power there is the biggest shift, in the exhaust standard power which is 27.38 Hp at 11000 Rpm, in the 16 gram catalyst which is 26.11 Hp at 11000 Rpm, for the largest 20 gram catalyst which is 26.08 Hp at 11000 Rpm and for the catalyst 24 grams which is 26.04 Hp at 11000 Rpm. In torque there is the biggest shift, in the standard exhaust the torque value is 18.95 Nm at 8000 Rpm, for a 16 gram catalyst which is 17.16 Nm at 8000 Rpm, for a 20 gram catalyst which is 17.51 Nm at 8000 Rpm and for a 24 gram catalyst namely 17.35 Nm at 8000 Rpm.

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