

Optimization of Material Variations and Installation Angle Catalytic Converter in Muffler to Emission Gas

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Abstract
Air pollution from burning fossil fuels (oil and coal) continues to rise. Many efforts have been made. Starting from the reduction of the combustion process to providing equipment as a reducer of exhaust emissions or increase the quality of combustion, but still high air pollution. Especially the combustion of gasoline engine. As the number of motors continues to increase significantly.Automobile air pollution comes from exhaust gases from unburned or burning combustion. The poor exhaust gas is caused by incomplete combustion of fuel in the combustion chamber. The elements contained in the flue gases include CO, NO_2, HC, C, H_2, CO_2, H_2O and N_2, among these gases very radical are CO and CO_2 gases. CO gas is a poisonous gas if humans inhale this gas can cause death. While CO_2 gas is a radical that can cause an increase in geothermal greenhouse effect.The purpose of this research are: 1 Knowing the effect of converter catalyst material and installation angle to decrease CO and CO_2 emission in motor vehicles. 2. Seek material type and installation angle a catalyst converter of optimum to reduce emission of CO and CO_2 exhaust of motor vehicles.Research and development with the aim to reduce exhaust emissions until now has been done by installing the katalic on the exhaust. In this study studied are copper, brass and stainless steel. While the variation of installation angle is 60o, 90o and 120o. Especially the poisonous gas. The material is mounted on a muffler filter. Analysis using Minitab software and it can be concluded that: 1. Catalyst converter material and mounting angle effect on CO and CO_2 gas emission can reduction. 2. To produce toxic exhaust gas emission optimum is stainless steel material with installation of catalytic converter corner 60^0.
Keywords: Muffler, catalytic converter, exhaust emissions, motor gasoline, gas CO and CO_2

1. Introduction

The exhaust emissions from both motor vehicles and factory chimneys are a major contributor to air pollution. Exhaust gases generated from petroleum combustion derived from these fossils can cause toxic gas. This poisonous gas will inevitably be inhaled by humans. Which can eventually cause shortness of breath can even cause poisoning. Indirectly also can cause cancer disease in humans. Because of the cumulative poisonous gases that enter into the blood and circulate in the body. In the blood circulation, toxic gases can be left in the lungs, liver and even heart. This is where this toxic gas can trigger cancer.

This exhaust gas can also cause increased geothermal. Because the ozone layer is thinning due to the gases produced by burning the fossil oil. Over time the ozone layer becomes a hole and can cause heat from the sun directly received by the earth's surface. So that the earth is getting hot. This global warming can also harm the state of the existing creature of the earth's surface.

Therefore, the reduction of toxic gas from the combustion of both petroleum combustion from fossils and other mining products continues to be sought. For example, the internal combustion process of the engine and combustion of coal and others. In addition to providing a mixture of the combustion process also prevents the spread of toxic gas produced by the combustion. To reduce or reduce these toxic gases can also use the catalytic mounted on the vehicle exhaust flue. The use of catalytic metal has been done by many researchers. As the research conducted by Muchamad Sudjada tahun 2014, the research title: The Effect of Metallic Catalytic Converter Copper Chrome and Water Induction System (AIS) Against Yamaha Emission Reduction of New Jupiter Mx

The gasoline engine in its process can produce various pollutants such as carbon monoxide (CO), hydrocarbon (HC), nitrogen oxide (NOx), and lead (Pb). One way to reduce exhaust emissions is by installing a catalytic converter in a motor vehicle exhaust (exhaust). The purpose of this research is to know the effectiveness of metallic catalytic converter chrome copper (CuCr) and water induction system technology (AIS) as catalyst material to reduce exhaust gas emission of motorcycle. The object of research is Yamaha New Jupiter MX motorcycles in 2011. This research has five, that is standard exhaust with AIS, standard exhaust without AIS, sample 1 (catalyst CuCr 3mm + AIS), sample 2 (CuCr 5mm + AIS catalyst), and sample 3 (CuCr 7mm + AIS catalyst). Standard exhaust gas emission testing based on SNI 19-7118.3-2005. From the research result, it is concluded that the reduction of CO emission with high CuCr catalyst 3 mm, 5 mm, 7 mm, and AIS averages 58,19%, 55,11% and 46,33%. Increased O2 flue gas with high CuCr catalysts of 3 mm, 5 mm, 7 mm, and AIS averages of 59.15%, 45.32%, and 24.80%. Increased CO2 emissions with high-CuCr catalysts of 3 mm, 5 mm, 7 mm, and AIS averages of 15.83%, 11.04%, and 7.31%. While the reduction of HC emissions with high CuCr catalysts of 3 mm, 5 mm, 7 mm, and AIS averages of 36.49%, 23.46%, and 11.36%.

Automobile air pollution comes from exhaust gases from unburned or burning combustion. The poor exhaust gas is caused by incomplete combustion of fuel in the combustion chamber. The elements contained in the flue gases include CO, NO2, HC, C, H2, CO2, H2O and N2, where many are polluting the surrounding environment in the form of air pollution and disrupt health to cause death to some degree.

Hydrocarbon / HC is an element of gasoline fuel compound. The HC present in the exhaust gas is from unburned fuel compounds in the combustion process of the motor, HC is measured in units of ppm (part per million). Hydrocarbon emissions are formed from a variety of sources. Not burning the fuel completely, not burning the lubricating oil on the cylinder, is one cause of emission of HC.Emisi hydrocarbon is in the form of methane gas that can cause leukemia and cancer.

CO is a toxic gas compound formed by incomplete combustion in the motor work process, CO is measured in% volume units. Vehicles at the time of operation will experience the combustion process. Burning often happens not perfect, so it will produce pollutants. The greater the percentage of incomplete combustion, the greater the resulting pollutant. Carbon monoxide and motor vehicle fumes occur due to incomplete combustion caused by the lack of air in the mixture coming into the combustion chamber or possibly because of the lack of time available to complete the combustion.

Several methods have been carried out to reduce emissions from the combustion process such as Wijaya (2002) has conducted re-heating test to reduce exhaust emissions which he wrote in the journal of Gas Dissemination Measurement Tool on Motor, Car, Paste Motor and Furnace Engine. Wahyudi (2013) analyzed the effect of the magnetic field to reduce the exhaust gas. According to Kusuma (2002) the decrease in carbon monoxide levels depends on emissions control such as the use of catalyst materials that convert carbon monoxide materials to carbon dioxide. Motorcycles, cars as the largest supplier of exhaust emissions that cause polluted environment, so it needs a study in the form of research on the effect of catalytic use with various variations of mounting angle. The purpose of this research are: 1. Knowing how far the influence of catalytic converter material to the decrease of exhaust gas emission level on motor vehicle. 2. Finding the optimal catalytic converter angle to reduce emission of motor vehicle exhaust gas.

2. Literature Review

2.1 Past Research Results

1. Muchamad Sudjada 2014, research title: Effect of Copper Metallic Catalytic Converter Copper Chrome and Water Induction System (AIS) Against Yamaha Emission Reduction of New Jupiter Mx

The gasoline engine in its process can produce various pollutants such as carbon monoxide (CO), hydrocarbon (HC), nitrogen oxide (NOx), and lead (Pb). One way to reduce exhaust emissions is by installing a catalytic converter in a motor vehicle exhaust (exhaust). The purpose of this research is to know the effectiveness of metallic catalytic converter chrome copper (CuCr) and water induction system technology (AIS) as catalyst material to reduce exhaust gas emission of motorcycle. The object of research is Yamaha New Jupiter MX motorcycle 2012. This research has five, that is the standard exhaust with AIS, standard exhaust without AIS, sample 1 (3mm catalyst + AIS), sample 2 (CuCr 5mm + AIS catalyst), and sample 3 (CuCr 7mm + AIS catalyst). Standard exhaust gas emission testing based on SNI 19-7118.3-2005. From the research result, it is concluded that the reduction of CO emission with high CuCr catalyst 3 mm, 5 mm, 7 mm, and AIS averages 58,19%, 55,11% and 46,33%. Increased O2 flue gas with high CuCr catalysts of 3 mm, 5 mm, 7 mm, and AIS averages of 59.15%, 45.32%, and 24.80%. Increased CO2 emissions with high-CuCr catalysts of 3 mm, 5 mm, 7 mm, and AIS averages of 15.83%, 11.04%, and 7.31%. While the reduction of HC emissions with high CuCr catalysts of 3 mm, 5 mm, 7 mm, and AIS averages of 36.49%, 23.46%, and 11.36%.

2. Bagus lrawan, 2005, research title "Performance of Catalytic Converter Capability With Brass Substrate Material (CuZn Alloy) To Reduce Gas Discharge Gas" This research using two different treatments. First emissions gas on the second standard exhaust emissions on the exhaust mounted catalityc converter brass metal. The purpose of this study was to determine the effect of brass catalytic converter on the exhaust gasoline motor. Result of research: l. Based on the results of performance test Catalytic Converter Brass (CuZn) found that Brass metal can reduce the gas emission gas exhaust gas concentration 2. Carbon Monoxide emissions gas degradation depends on the variation of Rpm and variation of catalyst cell number. 3. There is a tendency that more and more cell numbers will decrease the emission concentration of exhaust gases is greater.

3. Andi Sanata, 2012, research title "Analysis of Variation of Metal Temperature Copper Catalyst (Cu) In Catalytic Converter To Reduce Carbon Monoxide (Co) And Hydrocarbon (Hc) Emissions Of Motor Vehicles "The level of air pollution caused by vehicles in big cities now reaches critical limits. It affects environmental health as well as financial factors. To reduce pollutant gases from vehicle engine emissions, the necessary technology. One technology is the application of catalytic converters in exhaust emissions. A study has been conducted on 125 cc motorcycle engines to modify exhaust emissions. The catalyst used in this study was made of copper and was designed using a honeycomb system with various diameters (4, 6, 8, 10, 12 mm). Observation variables were catalyst temperature, CO and HC emission levels. The emissions of

CO and HC from the sample machine are then compared with the tariff emission standard. The results showed that the increase in copper catalyst temperature resulted in decreased CO and HC emission levels. Decrease starts to occur for all catalysts at 225 oC. Optimum conversion efficiency is up to 47.93% (CO) and 50.36% (HC). second is optimal. The efficiency was achieved at 325 ° C using 8 mm diametered catalyst

4. Heri Purnomo, in 2010, the research title of Catalytic Converter Effect Exhaust Analysis

With Copper (Cu) Copper (Cu) Catalyst Over Gas Dispose At Honda. Exhaust emissions include Carbon Monoxide (CO), Hydrocarbon (HC), Nitrogen Dioxide (NOx) and ulfury oxide (SO2), which have a devastating impact on human body health and ozone deposition present in the atmosphere. One way to reduce the concentration of exhaust emissions is by installation of catalytic converter (CC), CC is a type of exhaust that serves as a reducer of exhaust emissions in vehicle motion such as lowering CO, HC, NOx, Sox and so on.

In this research, a catalytic converter exhaust design using copper (Cu) encapsulated (Mn) as a catalyst mounted on the exhaust channel is tested. The test result data is then analyzed and compared the emission concentration between normal exhaust and catalytic converter exhaust. The result of this research is the reduction of emission concentration (CO, HC, O2) and the increase of CO2 concentration after comparing the result of standard exhaust comparison with catalytic converter exhaust

Motor gasoline is a power plant that turns fuel gas into heat power and eventually becomes mechanical power The standard fuel of gasoline motor is isooktana (C4H18). Motor gasoline that existed today is the development and evolution of the machine that was originally known as the motor otto. The motor is equipped with spark plugs and carburetors. Spark plugs generate electric fire jumps that ignite fuel and air mixtures, therefore gasoline motors tend to be named Spark Ignition Engine (Irianto, 2013).

2.2 Combustion Reaction in Gasoline Motor

The power generated by a motor vehicle is generated from changes in the energy of the fuel calor to the power of motion. Energy changes are sourced from the burning of fuel in the combustion chamber. Air fuel ratio and lambda influence on vehicle exhaust emissions and power generated from the combustion process. Here's an explanation of the air fuel ratio and lambda:

Air Fuel Ratio

The Air Fuel Ratio is the theoretical fuel-air ratio. This ratio is the minimum fuel ratio and air (containing oxygen) needed to burn the fuel perfectly.

Perfect chemical combustion reaction,

$$C6H14 + O2 \longrightarrow CO2 + H2O$$

$$C12H28 + 19O2 \longrightarrow 12CO2 + 14H2O$$

In order for 1g octane to produce water (H2O) and carbon dioxide (CO2) when burned, it takes 15g of air. The actual fuel is not pure octane, but octane and diverse HC. Therefore the theoretical fuel-air ratio is about 14.7.

The chemical combustion reaction is not perfect in the engine combustion chamber,

C6H14 + O2 + N2 --- »CO + CO2 + HC + NOx + SO2 + Pb + O2 + other particles

Joining the nitrogen gas with a mixture of fuel and oxygen results in incomplete combustion, causing emissions gases that are harmful to the environment.

Lambda

Lambda is a symbol of the ratio of air entering the engine cylinder by the amount of air according to the theory.

a. Lambda equals 1

The amount of air entering the engine cylinder is equal to the amount of air requirements in theory.

b. Lambda is smaller than 1

The amount of air entering is smaller than the amount of air requirements in theory. In this situation the engine lacks air, a mixture of grease and within certain limits can increase engine power.

c. Lambda is greater than 1

The amount of air entering is more than the air condition theoretically. At this time the engine excess air, a mixture of skinny and less power.

2.3 Exhaust Emissions Gas

Vehicle exhaust emissions are residual fuel combustion in vehicle engines discharged through the engine exhaust system, while the combustion process is a chemical reaction between oxygen in the air and hydrocarbon compounds in the fuel to generate power. In a perfect reaction, the rest of the combustion product is a flue gas containing carbon dioxide (CO2), water vapor (H2O), Oxygen (O2) and Nitrogen (N2). In practice, the combustion that occurs inside a vehicle's engine does not always run perfectly so that in the exhaust gases contains harmful compounds such as carbon monoxide (CO). Carbon monoxide (CO), created from partially combusted fuel due to incomplete combustion or due to a mixture of fuel and too-rich air (lack of air).

The CO removed from the rest of the combustion product is heavily influenced by the ratio of fuel and air mixtures exposed by the engine. To reduce the CO ratio of this mixture should be made thin, but this way has other side effects, ie NOx will more easily arise and the power generated by the machine will be reduced. CO is very dangerous because it is colorless or smelly, causing dizziness, nausea, respiratory disorders, can even lead to death.

Exhaust emissions are pollutants that pollute the air produced by vehicle exhaust (Wardan Suyanto, 1989: 345). The vehicle exhaust gas intended here is the residual gas of the combustion process which is discharged into the free air through the vehicle exhaust. There are four major emissions generated by the vehicle. The four emissions are Hydrocarbon (HC), Carbon Monoxide (CO), Nitrogen Oxide (NOx), and particles emitted from the flue gas. 1. Hydrocarbon compound (HC), occurs because the fuel has not been burned but has been wasted with the exhaust gas due to incomplete combustion and fuel evaporation. Hydrocarbon (HC) compounds are divided into two: unburned fuel leaving out the raw gas, as well as fuels that are split because the heat reaction changes to another HC group that comes out with the flue gas.

$C_8H_{18} \rightarrow H + C + HC$ (1) The onset of HC is generally caused by: a. The resulting fire spark plug in the combustion chamber moves very fast but the temperature around the wall of the combustion chamber is low. This results in a mixture of fuel and air in low temperatures that fail to burn (quenching zone). The unburned fuel mixture is then pushed out by the piston into the exhaust. b. At the time of deceleration, the gas valve (throttle valve / skep) closes so that engine brakes occur while the engine speed is still high. This will lead to massive fuel suction, the mixture becomes very rich and a lot of unburnt fuel is wasted. (on the carburetor fuel system) c. The overlapping step (the inlet and exhaust valve open) is too long so that HC acts as a flushing / cleaning gas (occurring especially in low rotation, carburetor fuel systems). HC compounds will have a painful effect on the eyes, resulting in sore throat, lung disease and cancer. The graph of the relationship between air-fuel mixture and HC can be observed in the figure below. Figure 2. Relationship Between Fuel-Air Combustion and HC 2. Carbon monoxide (CO), created from partially burned fuel due to incomplete combustion or due to a mixture of fuel and air that is too rich (lack of air). The Carbon element in the fuel will burn in a process as follows: $2C + O_2 \rightarrow 2CO$ (2) CO is removed from the rest of the burning lot influenced by the ratio of fuel and air mixtures exposed by the engine. To reduce the CO ratio of this mixture should be made thin, but this way has other side effects, ie NOx will more easily arise and the power generated by the machine will be reduced. CO is very dangerous because it is colorless or smelly, causing dizziness, nausea, respiratory disorders, can even lead to death.

Not all compounds contained in the vehicle exhaust gas are known to affect the environment other than humans. Some compounds produced from perfect combustion such as non-toxic CO_2, have recently become a concern of people. CO_2 compounds are actually components that are naturally present in the air. Therefore, CO_2 has previously not kept the air pollution sequence that is more attention than normal due to excessive fuel use every year. The effect of CO_2 is called the greenhouse effect where CO_2 in the atmosphere can absorb heat energy and block the net of heat energy from the atmosphere to a higher surface. This leads to an increase in average temperatures on the surface of the earth and may result in rising sea levels due to the melting of the icebergs, which will ultimately change the natural circles.

The CO_2 concentration shows the immediate status of the combustion process in the combustion chamber. The higher the better.

When AFR is in ideal terms, CO_2 emissions range from 12% to15%. If AFR is too thin or too rich, CO_2 emissions will drop drastically.

If CO_2 is below 12%, then we should see the else of emision indicating whether AFR is too rich or too thin.

2.4 Basic Principles of Catalysts

The basic principle of the catalyst is the process of changing the level of exhaust emissions from the beginning of combustion to reach the final disposal process is the exhaust gas content that comes out after passing the catalyst, while the process that occurs on the catalyst is as follows.

• Chemical reaction of fuel combustion process (pertalite): $C_6H_{14} + O_2 \longrightarrow CO_2 + H_2O$
$C_{12}H_{28} + 19O_2 \longrightarrow 12CO_2 + 14H_2O$

• After the process of combustion it will produce flue gas, in the process of combustion of flue cash produced is $CO_2 + H_2O$ but in kenyaatan no perfect combustion and the resulting exhaust gas is $NOx + HC + CO$

• In the Catalytic Converter room the first reaction to occur is the reaction of breaking the NOx content to N_2 and O_2.

• After the reaction above the remaining gas content is $N_2 + HC + CO + O_2$

• The second reaction that occurs is carbon monoxide reacts with the following oxygen is the reaction of $CO + O = CO_2$

• The third reaction that occurs is unburned hydrocarbons in action with oxygen and will produce water (H_2O) and also carbon dioxide (CO_2) following is the reaction $HC + O_2 = H_2O + CO_2$

• Of all the processes that occur above it will produce various exhaust gas content such as $N_2 + CO_2 + H_2O$

3. Research Methods

3.1 Research design

The objective of this research is to get optimal katalytic muffler angle to produce / absorb toxic gas in gasoline motor. Factors other than those previously conditioned for each sample. The samples / specimens in this study used steel sheets that were cut in the manufacture of the muffler.

The exhaust wall is made of steel sheets with a thickness of 2 mm. Exhaust made oval with size 10 x 15 cm and length 40 cm. In the exhaust is given catalytic converter with installation according to the angle under study. Testing is done with varying engine speed. Data is recorded and collected on a data sheet prepared with three factors.

This research was conducted in Mechanical Engineering Laboratory of State Polytechnic of Malang. The research time for 60 (days) begins. The samples we use as much as 40 (four pulse) pieces are selected are good. The selected variable is

1. Independent variables ie there are two factors: the catalyst material and the catalyst angle
2.Level factor of kk material. are: copper, brass and stainless steel
3. Converter catalityc level angle. Is: 60o, 90o, and 120o
4. The dependent variable is the value of exhaust emissions

3.2 Analysis

With two way variance analysis for CO gas obtained as follows:
General Linear Model: CO versus Material, Catalytic Angle
Factor Type Levels Values
Fixed ingredients 3 1, 2, 3
Catalytic angle fixed 3 60, 90, 120
Analysis of Variance for CO, using Adjusted SS for Tests
Source DF Seq SS Adj SS Adj MS F P
Ingredients 2 0.018706 0.018706 0.009353 5.35 0.011
Corner Catk 2 0.009756 0.009756 0.004878 2.79 0.079
Matr * Angle C 4 0.032544 0.032544 0.008136 4.65 0.005
Error 27 0.047225 0.047225 0.001749
Total 35 0.108231
S = 0.0418219 R-Sq = 56.37% R-Sq (adj) = 43.44%
Variant analysis showed that the catalyst material had significant effect, while the installation angle had little effect on exhaust emission.
Next we can do by looking at the test with the graph. The results are as follows

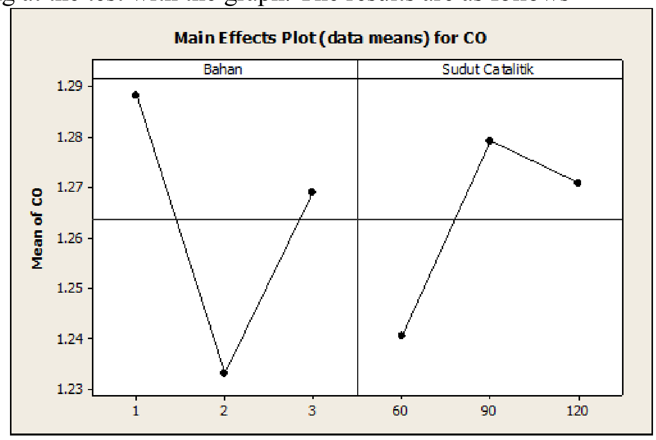

Figure 1 Graph of Material and Angle mounting of CO gas

Interpretation:

The material used as a catalyst converter significantly affects the reduction of CO gas on motor exhaust emissions. While the installation angle of catalytic convertor does not affect the reduction of CO gas emissions. In the interaction between the material and the installation angle of the catalytic converter are 3 materials ie stainless steel and mounting angle 80o and 100o. In these two can produce the minimum CO gas. Therefore, in the application which can optimize the CO gas is the material of stainless steel catalytic converter and the installation with an angle of 100o. Because in this position the possibility of CO gas may decrease. The resulting graph of interaction can be seen as follows:

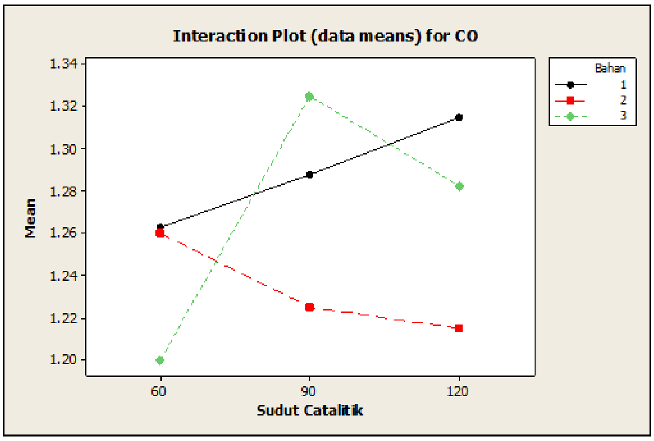

Figure 2 Graph of Optimum gas CO

Viewed from the graph interaction between the material and the installation of the catalytic converter angle indicates that the material that produces the lowest CO is stainless steel. Besides it also disa produce the highest CO. Both of these depend on the installation of the angle. While copper catalytic material tends to increase CO gas even though the angle is varied. Similarly, the brass catalytic material can lower CO gas even if the mounting angle is varied. From the interaction graph it is also shown that: the copper catalytic is installed at an angle of 60 ° resulting in the lowest CO gas and when mounted with an angle of 120 ° CO the resulting gas reaches a maximum. Applies vice versa for catalytic brass. Catalytic installation with a 60o inclination angle produces maximum CO gas. And the bigger the catalytic mounting angle the resulting CO gas decreases. As for the catalytic stainless steel that can produce the minimum CO gas with a mounting angle of 60^{o}.

Analysis:

Stainless steel material is a material that has a high enough hardness and a good heat sink so that the ability to reduce CO gas to another gas is pretty good. By using the 100^{o} angle the gas rate does not become turbolen. A portion of the CO gas will be bound by air and produce CO_2. Thus CO gas can be derived.

Variant analysis showed that the catalyst material had significant effect, while the mounting angle of the effect was very significant. In the interaction between the material and the installation angle of the catalyst converter its influence in CO_2 emission reduction is very significant. The following can be seen with the test graph. The graph scale is made times (x 10).

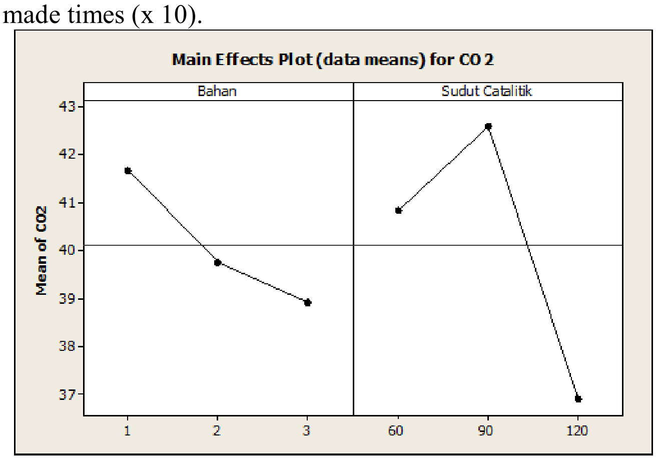

Figure 3 Graph of Material and Angle of Installation of CO2 gas

Materials 1, 2 and 3 with the mounting angle of catalyst converter angle may affect the CO_2 gas yield. A good catalyst converter material is Stainless steel whereas the ugliest copper is in CO2 emission reduction. The results of this interaction can be seen in this carrying chart test.

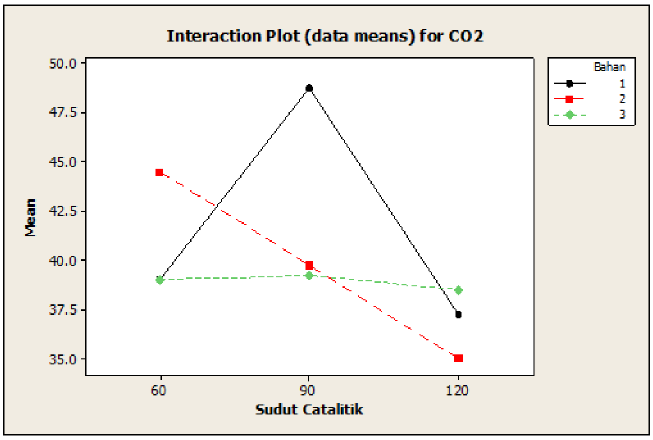

Figure 4 Gratic optimum CO2 gas

The above graph shows the same result with CO gas which is the maximum produced CO2 gas that the copper material 1 is installed at 900 angle produces the highest CO2 emissions. While the 2nd material is brass with an installation angle of 1200 produces the smallest CO2 gas. So to produce the optimum CO2 gas the catalyst uses a brass material with a catalyst angle mounting of 1000.

Analysis:

Brass material is a material that has a high enough hardness and heat absorber that is not good so that the ability to reduce CO2 gas to become another gas is pretty good. By using the 1000 angle the gas rate does not become turbolen. Some of the CO2 gas will be reduced to the air. Thus CO2 gas can be derived.

5. Conclusion

From the analysis it can be concluded that:

1. Catalytic converters with brass materials can produce the smallest CO gas emissions. While the stainless steel materials produce the smallest CO2 gas emissions . But conversely the catalytic converters with brass materials can produce the smallest CO2 gas emissions and the smallest CO2.
2. Thus to produce CO gas and CO2 gas the optimum used catalyst is stainless steel with catalyst the installation angle 60^o.

In the muffler standard CO2 emissions produced by 1.809%, while the resulting CO2 of 5.345%. Muffler installated catalytic converter with stainless steel CO2 gas emissions produced by 1.234%, while CO2. gas produced by 3.97%. While at the optimum point of CO gas produced by 1.2%. And CO2 gas produced by 3.9%. This occurs in the installation of a catalytic converter of stainless steel materials with an installation angle of 600. By comparing this means that CO can be reduced by 0.6%. While CO2 emissions can be reduced by 1.545%.

From the research that has been done there is still a lack of both in determining factors and levels for that next research suggested by developing factors and levels of a wider and more meetings. Especially for materials that use metals that undergo special treatment. For example forged or hardening and so forth.

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