



ANALYSIS OF THE EFFECT OF CYCLONE TURBO INSTALLATION AND INTAKE MANIFOLD MODIFICATION ON WASTE GAS EMISSIONS IN CARBURETOR MOTORCYCLE

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KEYWORDS

exhaust emission of CO and HC
turbo cyclone
intake manifold modification

ABSTRACT

The purpose s of this research are: (1) to Investigate the influence of the installation of turbo cyclone against the exhaust emissions of CO and HC on a motorcycle carburetor; (2) to study the influence of the intake manifold towards the exhaust emissions of CO and HC on the carburetor motorcycle; (3) to investigate the installation of turbo cyclone and modification of intake manifold toward the exhaust emissions of CO and HC on a carburetor motorcycle. The research uses the experimental method with a quantitative descriptive data analysis. The population in this research is a carburetor motorcycle. A selected sample in this research is Yamaha Byson 150CC year 2012. Data were obtained from a large measurement exhaust emission levels CO and HC for 20 seconds at the idle rotation with the installation of turbo cyclone and intake manifold (swirl) modification. The research results are: (1) the installation of turbo cyclone decreases the quality of the exhaust emission of CO and HC of Yamaha Byson 150 CC motorcycle. (2) the installation of intake manifold modification (swirl) can be lower the level of exhaust emissions of CO and HC for Yamaha Byson 150 CC motorcycle. (3) the installation of turbo cyclone and swirl can lower the level of exhaust emissions of the Yamaha Byson 150 CC motorcycle.

INTRODUCTION

Increasing the amount of transportation, especially motorized vehicles, is always increasing every year. The increase in the number of motorized vehicles, especially motorbikes, occurs along with the rise in the number of residents in a region. An increase in the number of motorized vehicles can increase the number of air pollutants coming from vehicle exhaust.

The composition of the contribution of sectors as a cause of air pollution is the transportation sector with motor vehicle exhaust gas which reaches 60%, the rest from the industrial area 25%, and waste 5% (Soedomo et al., 1983 quoted from Suryanto, 2012: 1). The percentage of air pollution that is so large taken over by exhaust emissions from the transportation sector (motorized vehicles), where the main problem is regarding the process of combustion of fuel in an imperfect cylinder that can produce chemical elements that can pollute the air such as carbon monoxide (CO), sulfur oxides (SO_x), Nitrogen oxides (NO_x), hydrocarbons (HC), particulates and lead (Pb) (Hertel, O. Berkowicz, R., 1989 & 1989a quoted from Suryanto, 2012: 1).

Various ways are done to overcome the emission problems that are increasing. The solution that has been done to improve combustion and reduce the level of exhaust emissions produced is by changes in conventional motors with carburetors into Fuel Injection (FI) motorcycles. EFI (Electronic Fuel Injection) is an automotive technology innovation that works with the principle of refining fuel mixtures based on information on

sensors on the engine whose job is to know the performance of the engine so that the system can provide fuel supply according to needs. It is intended to improve fuel mixing to provide fuel supply according to engine performance. So a perfect mixture of fuel and air can be created to make complete combustion in the combustion chamber. Another step taken to reduce the level of exhaust emissions in the automotive world is the addition of Catalytic Converter (CC). It is one of the innovations in automotive technology that serves as a reduction in the level of exhaust emissions in motor vehicles. Catalytic converters act to accelerate the oxidation process of CO and HC exhaust. And also play a role in reducing NOx. It is a tool to stimulate the occurrence of oxidation and/or reduction of residual combustion gases by catalyst material so that the output from emissions becomes less pollution level. The next technological development is electric cars, is a breakthrough by creating a machine that converts electrical energy into mechanical energy (motion), electric cars are environmentally friendly technologies that will not produce pollutant exhaust emissions because the main source of driving comes from the electrical component. Electric vehicles use an electric motor as a driver. Electrical energy is converted into mechanical energy through an electric motor to drive a car, but for now, electric cars are still relatively expensive for the people of Indonesia and only able to be used for use in the city.

The next step to reduce exhaust emissions in the automotive world is to improve combustion with the addition of turbo cyclone and/or swirl. Turbo cyclone is one of the technologies that can compress air, utilizing air passing through the turbo cyclone blade, a more focused vortex is made. So that the results of the compressed air can be continued according to the number of turbo cyclone blades produced. Turbo cyclone can be indicated that the air entering the intake manifold will go into the combustion chamber turbulently. It is because the air will falter with the turbo bladecyclone, until the air that has passed the turbo cyclone blade will form a more compressed wind vortex (Meiraga and Muhaji, 2013: 206). Swirl is a rotational motion of a vortex of fluid in a cylinder around the axis. This Swirl is a modification of the addition of grooves or internal threads on the intake manifold.

RESEARCH METHODS

This paper is an experimental method. The data analysis technique of this study uses quantitative descriptive analysis. This exhaust emission test refers to SNI 09-7118.3-2005 for the measurement of CO and HC. The experiment was carried out at the Automotive Laboratory of Mechanical Engineering Education Program FKIP UNS Surakarta using the Technotest Gas Analyzer type STARGAS 898. The population in this study was a four-stroke motorcycle. The sample in this study was a Yamaha Byson 150 CC motorcycle in 2012.

The research data was taken from the results of measurement of exhaust emissions and opacity using gas equipment analyzer which will know the value of CO and HC exhaust emissions from the print out of STARGAS 898 emission test equipment.

RESULTS AND DISCUSSION

CO Emissions

Data from CO exhaust emission measurements from initial measurements to standard engines showed 1.603% CO as a comparison with turbo cyclone installation, with an average CO emission level in free vane turbo cyclone type of 0.818% and fixed vane turbo cyclone types. Amounting to 1.536% of the three times the exhaust emissions testing. Conclusions can be generalized findings according to research problems, can also be a recommendation for the next step.

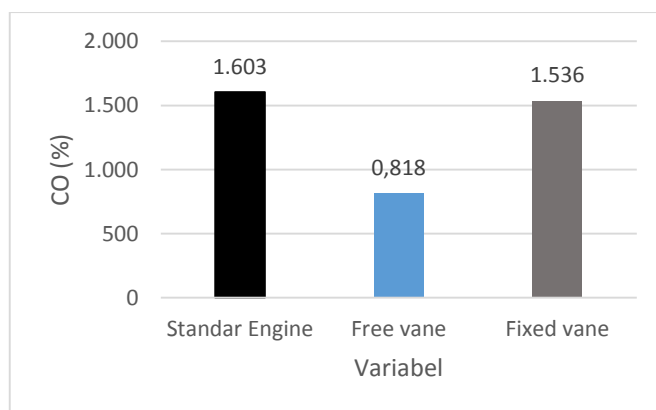


Figure 1. Results of Examination of CO (%) Exhaust Gas Levels on Turbo Cyclone Installation

Exhaust gas emissions data from the initial measurement with the standard engine obtained results of 1.603% CO. while the installation of the intake manifold (swirl) modification obtained an average emission level of 1.523% from the three times test.

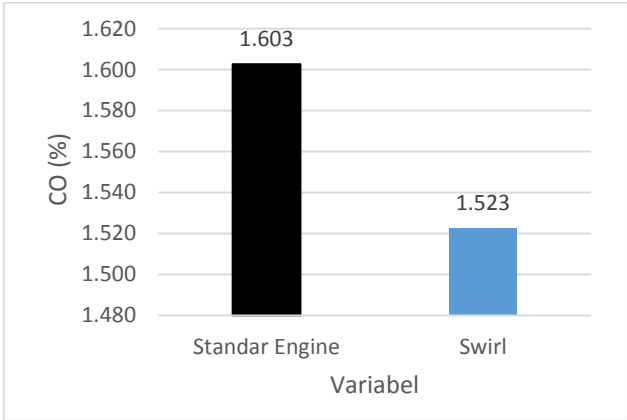


Figure 2. Test Results of CO (%) Exhaust Emissions against Swirl Installation

Data from CO exhaust emission measurements from initial measurements to standard engines showed 1.603% CO as a comparison with turbo cyclone and swirl installation, with an average CO emission level in fixed vane type with swirl of 1.391% and in the free vane type. With a swirl of 1.328% of the three times exhaust gas testing.

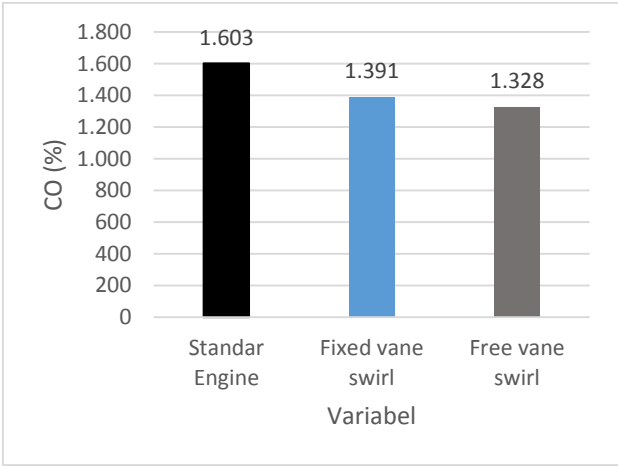


Figure 3. Results of CO (Emission) Exhaust Emission Test Results on Turbo Cyclone and Swirl Installation

HC emissions

Data from HC exhaust emission measurement results from initial measurements with standard engine obtained results of 142 ppm HC. The installation of turbo cyclone obtained an average HC emission level in the free vane turbo cyclone type of 75 ppm and in the fixed vane turbo cyclone type amounting to 82.67 ppm from the three times of exhaust gas emission testing.

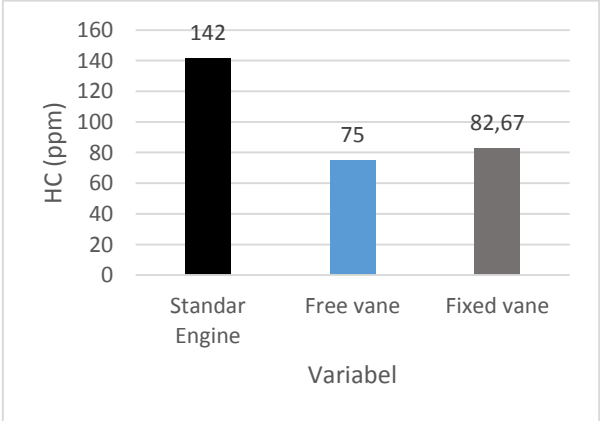


Figure 4. Results of Examination of HC (Ppm) Exhaust Gas Levels on Turbo Cyclone Installation

Data from the measurement of HC exhaust emissions from initial measurements with standard engines showed that 142 ppm of HC level as a comparison with swirl installation obtained an average HC emission level of 108 ppm from three times exhaust emission testing.

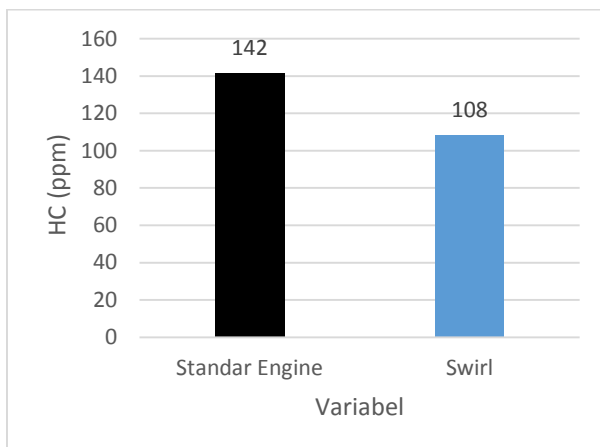


Figure 5. Results of Examination of HC (Ppm) Exhaust Emissions against Swirl Installation

Data from HC emission level measurement from initial measurement with standard engine obtained 142 ppm HC level as a comparison with turbo cyclone and swirl installation obtained an average HC emission level in fixed vane type with a swirl of 81 ppm and in free vane type amounting to 80 ppm from three times the exhaust gas testing.

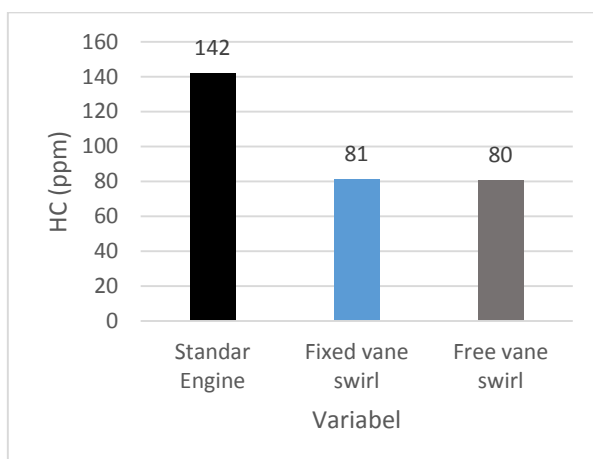


Figure 6. Results of Examination of HC (Ppm) Exhaust Gas Levels on Turbo Cyclone and Swirl Installation

In Figure 1, Figure 2, Figure 3, Figure 4, Figure 5 and Figure 6 show the effect of installing a turbo cyclone and modification of the intake manifold (Swirl) on exhaust emissions of CO and HC based on the tests that have been carried out. The data shows the results of testing the standard exhaust emissions on Yamaha Byson 150 CC motorcycles, namely CO levels of 1.603% and HC of 142 ppm.

In figure 1 and figure 4, show that the installation of turbo cyclone can reduce the level of CO and HC exhaust emissions, and the best results were obtained in the installation of free vane turbo cyclone with CO levels of 0.818% and HC of 75 ppm. Decreased levels of CO and HC exhaust emissions occur because these moving fans can absorb air according to the needs of the engine load so that the rotation produced by the fan on the free vane turbo cyclone is under the engine load or the vacuum level in the carburetor. The turbulent flow of air that has been created by rotating fans in the free vane turbo cyclone forms an irregular airflow in the carburetor which can mix with the fuel more homogeneously to improve combustion inside the cylinder. According to Sudrajat's research (2013), the installation of an electric turbo moving / rotating can reduce CO exhaust emissions by 0.66%, and the installation of a silent electric turbo can reduce CO emissions by 0.331%. According to Handoko (2011) that the addition of turbo cyclone to the air duct can change the characteristics of air flow and pressure drop and increase the intensity of outlet turbulence. According to Muchammad (2007), the installation of turbo cyclone in the air duct

can change the characteristics of air flow due to the pressure drop so that the intensity of outlet turbulence increases.

In figure 2 and figure 5 it can be seen that the installation of a modified intake manifold (swirl) can reduce the levels of CO, and HC exhaust emissions, the results obtained in the swirl installation are CO levels of 1.523% and HC of 108 ppm. Decreased levels of exhaust emissions of CO and HC occur because the internal thread on the swirl with a 30° angle creates a flow of fuel and air that is hostile when entering the combustion chamber. This air and fuel vortex creates homogeneity before and when it comes to the combustion chamber. But due to the addition of internal threads that take up the place makes the intake channel smaller so that some of the fuel flow is blocked in the intake channel and will enter after further fuel flow and air thus causing the fuel mixture to be incompatible and less homogeneous. According to Shrirao (2012) and Kumar (2013) said that making internal threads on the intake manifold can create turbulence in the flow of a mixture of fuel and air to develop perfect homogeneity and combustion.

This shrinking intake channel makes it a nozzle that can suppress the fuel and air mixture so that when the fuel mixture and the mixed air increase it will cause the temperature to increase and when it enters the combustion chamber it causes combustible fuel.

In figure 3 and figure 6 shows that the installation of turbo cyclone (fixed vane and free vane) with swirl can reduce the level of CO and HC exhaust emissions, the best results are obtained from the installation of free vane turbo cyclone with swirl with CO levels of 1.342% and HC is 80 ppm. Decreased levels of exhaust gas emissions CO and HC occur because the fans that move on the free vane turbo cyclone can absorb air according to the level of the vacuum carburetor and the workload on the engine, turbulent flow was successfully created in the air into the carburetor to create homogeneity of the fuel mixture and air.

After the carburetor, the modified intake manifold repels the air and fuel to create turbulence in the fuel and air flow and increases the fluid flow pressure by reducing the intake channel so that it functions as a nozzle.

CONCLUSIONS

Based on the results of the study, data analysis and discussions that have been carried out, namely regarding the installation of turbo cyclone and modification of the intake manifold (swirl). It can be concluded that of free vane turbo cyclone and fixed vane turbo cyclone can reduce CO and HC exhaust emissions on Yamaha Byson 150 CC motorcycles. The best results were obtained in the installation of turbo cyclone type free vane turbo cyclone. Installation of a modified intake manifold with a 30° angle screw can reduce CO and HC exhaust emissions on a Yamaha Byson 150 CC motorcycle. Installation of a turbo cyclone and a modified intake manifold (swirl) on a Yamaha Byson 150 CC motorcycle can reduce CO and HC exhaust emissions.

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