Jurnal E-KOMTEK (Elektro-Komputer-Teknik)
Vol. 5, No. 1 (2021) pp. 102-109
https://jurnal.politeknik-kebumen.ac.id/index.php/E-KOMTEK
p-ISSN : 2580-3719 e-ISSN : 2622-3066

Honda Tiger 2000 Bike Engine Modification Test against Exhaust Emissions and Fuel Consumption

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https://doi.org/10.37339/e-komtek.v5i1.535

Published by Politeknik Dharma Patria Kebumen

Artikel Info
Submitted:
30-03-2021
Revised:
09-06-2021
Accepted:
09-06-2021
Online first :
30-06-2021

Abstract

This study aims to determine the effect of modification of the Honda Tiger 2000 on exhaust emissions of CO and HC. The method used is to modify the carburettor venturi piston and replace the rocker arm with a roller rocker arm. The exhaust emission test used a gas analyzer type SUKYOUNG SY-GA 401. The object of the study was a Honda Tiger 2000 motorcycle. The results showed that modification of the Honda Tiger 2000 motorcycle at idle, 1000 rpm, 1500 rpm, and 2000 rpm increased CO emissions but reduced HC emissions. Based on comparing the motorcycle emission threshold values for manufacture ≤ 2010, namely CO emissions exceeding 5.5% and HC emissions less than 2400 ppm. Pertamax Turbo fuel consumption is more efficient than Pertalite with a distance ratio of 45 km requiring 1L Pertamax Turbo and 1.4L Petalite.
Keywords: *Modifications, Honda tiger 2000, Exhaust emissions, Fuel consumption*

Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh modifikasi Honda Tiger 2000 terhadap emisi gas buang CO dan HC. Metode yang digunakan adalah memodifikasi venturi karburator, piston, dan mengganti rocker arm menjadi roller rocker arm. Uji emisi menggunakan gas analyzer tipe SUKYOUNG SY-GA 401. Objek penelitian adalah sepeda motor Honda Tiger 2000. Hasil penelitian menunjukan bahwa modifikasi sepeda motor Honda Tiger 2000 pada putaran idle, 1000 rpm, 1500 rpm dan 2000 rpm meningkatkan emisi CO namun menurunkan emisi HC. Berdasarkan perbandingan nilai ambang batas emisi sepeda motor tahun pembuatan ≤ 2010 yaitu emisi CO melibihi 5,5 % dan emisi HC kurang dari 2400 ppm. Konsumsi bahan bakar Pertamax Turbo lebih irit digunakan dari pada Pertalite dengan perbandingan jarak 45 km membutuhkan 1L Pertamax Turbo dan 1,4L Pertalite.
Kata-kata kunci: *Modifikasi, Honda tiger 2000, Emisi gas buang, Konsumsi bahan bakar*

1. Introduction

Chemical compounds of gas emissions in motor vehicle exhaust include hydrocarbons (HC), carbon monoxide (CO), carbon dioxide (CO2), and lead (Pb) [1]. The amount of chemical compounds in motor vehicle exhaust emissions depends on driving conditions, engine type, fuel emission control devices, and vehicle technology [2]. Motorcycle vehicles are one of the emitters of exhaust gases, thus causing air pollution [3].

In Indonesia, old or classic motorcycles are still high due to the limited number, model, and relatively high price [4]. Old motorcycles will increase exhaust emissions because the engine components wear a lot, and many dirt sticks to the air filter [5]. One of the old motorcycles in Indonesia that is still in use is the Honda Tiger 2000. Older motorcycle users can improve the quality of exhaust emissions by updating technology, fuel, and engine maintenance [6]. Modification of Honda Tiger 2000 technology is expected to enhance the quality of exhaust emissions produced. The exhaust emission standards for the old type 4 stroke motorcycle in manufacture 2010 are CO 5.5% and HC 2400 ppm [7].

Modifications to the Honda Tiger 2000 motorcycle technology include the carburettor, piston, and rocker arm. Changing the carburettor on the Jupiter Z motorcycle by replacing the smaller main jet can reduce the CO content by 1.31%, and the HC does not decrease [8]. Modifying the flat and dome pistons of Jupiter Z motorcycles at 2000 RPM experienced a 5% reduction in CO exhaust emissions and 0.047 ppm HC [9]. However, in modifying the rocker arm into a roller rocker arm on a 5D9 motorcycle, CO and HC exhaust emissions have increased [10].

Based on this background, modifications to the carburettor, piston, and rocker arm were applied to the Honda Tiger 2000B to reduce exhaust emissions and fuel consumption. Exhaust emissions were measured using a gas analyzer with rpm variations, and fuel consumption was measured using a measuring cup with variations in distance travelled. Furthermore, the measurement results are compared with the regulation standards for motorcycle exhaust emissions in the year of manufacture 2010. Fuel consumption is compared between using Pertamax Turbo and Pertalite fuels to find out which power is more efficient.

2. Method

The specifications of the 2000 year Honda Tiger motorcycle are presented in **Table 1**.

Table 1. Specifications Honda Tiger 2000

Component Name	Specification
Length x WIDTH X HEIGHT	2029 x 747 x 1124 mm
Machine Type	4 Langkah, OHC, 1 Silinder
Power	11,5 HP
Cylinder Volume	196,9 cc
Compression Comparison	9,0: 1
Maximum Power	17,0 PS / 8.500 RPM
Maximum Torque	1,60 kgf.m / 7000 RPM
Operating Pattern	Gigi 1-N-2-3-4-5-6
Ignition System	CDI-DC, Magneto
Step Diameter	63,5 – 62,2 mm
Cooler	Udara

Modification of the Honda Tiger 2000 motorcycle carburettor has been done by changing the diameter of the carburettor venture. Changes in the size of the venture carburettor of a Honda Tiger 2000 motorcycle are presented in **Table 2**.

Table 2. Changes in Carburetor Venture Size for Honda Tiger 2000

Before	After
28 mm	30 mm

Table 2. shows that the venture carburettor is enlarged by 2 mm from the standard size. The change in the size of the venture carburettor of a Honda Tiger 2000 motorcycle is shown in **Figure 1.**

Figure 1. Enlarged Honda Tiger 2000 Carburetor Venture

After making changes to the venture carburettor, then replace. The piston is replaced with a size larger than the factory standard. The piston sizes are presented in **Table 3.**

Table 3. Changes in Piston Diameter Size Honda Tiger 2000

Before	After
64 mm	70 mm

The standard rocker arm is replaced with a roller rocker arm. Change the standard rocker arm to a roller rocker arm by modifying the camshaft. The camshaft surface is welded using argon, then the base circle, ramp, flank, and cam lift are changed. The camshaft and roller rocker arm changes affect the in and ex valve clearances of Honda Tiger 2000 motorcycles. Changes in the in and ex valve clearances are presented in **Table 4.**

Table 4. Valve Gap Honda Tiger 2000

Component Name	Before	After
Katup *In*	0,10 mm	0,20
Katup *Ex*	0,10 mm	0,20

After making modifications to the carburettor, piston, and rocker arm, exhaust emissions were measured. Exhaust emissions were measured using a gas analyzer type SUKYOUNG SY-GA 401. Measurements were made to determine the levels of HC and CO. The data obtained will be compared with the regulation standards for motorcycle exhaust emissions in manufacture 2010. Furthermore, fuel consumption is measured at a maximum distance of 45 km. Fuel consumption measurement is carried out with variations in length, namely: 15 km, 25 km, 35 km, and 45 km. Fuel consumption is measured using a measuring cup.

3. Result and Discussion

The modifications applied to the Honda Tiger 2000 motorcycle, then tested for exhaust emissions. The emission test results using a gas analyzer obtained data on the amount of CO and HC. CO and HC emission test data are presented in **Figure 2** and **Figure 3.**

3.1 CO Emission Test

CO emissions are gases that arise due to incomplete combustion due to a mixture of air and fuel that is too rich, and the temperature is low around the cylinder wall [11]. CO Emissions Test on a Honda Tiger 2000 motorcycle is presented in **Figure 2.**

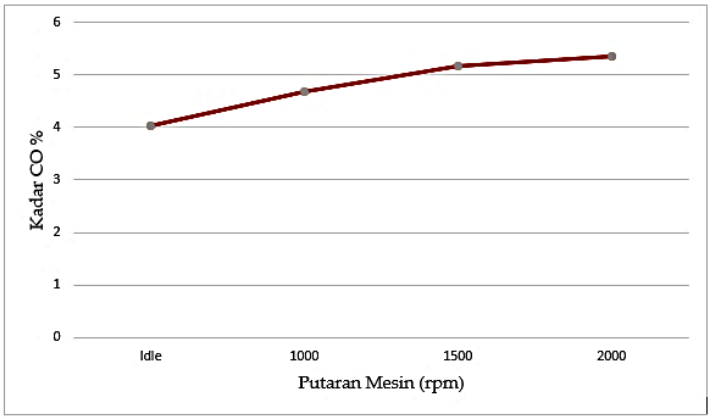

Figure 2. CO. Emission Test Results

In Figure 2 it is known that at idle rotation CO = 4.01%, 1000 rpm = 4.67%, 1500 rpm = 5.26%, and 2000 rpm = 5.42%. Based on the data in Figure 2, it can be concluded that the higher the engine speed, the higher the CO emission. CO emissions increase because there is a tendency that the higher the engine speed, the greater the CO emissions produced [12]. Based on the results of emission tests on motorcycles in manufacture 2010, it can be seen that CO emissions exceed the specified threshold value. The comparison table of allowable threshold values is presented in **Table 5.**

Table 5. Comparison of CO Threshold Values

Category	Parameter CO %	Test Result	Description
4 Stroke Motorcycle Year of Manufacture ≤ 2010	5,5	CO idle rotation = 4,01% 1000 rpm = 4,67% 1500 rpm = 5,26 2000 rpm = 5,42%	Exceeding Threshold Value

3.2 HC Emission Test

HC emissions arise because the fuel is not burned and comes out with the rest of the combustion [13] [14]. The HC emission test on a Honda Tiger 2000 motorcycle is presented in **Figure 3.**

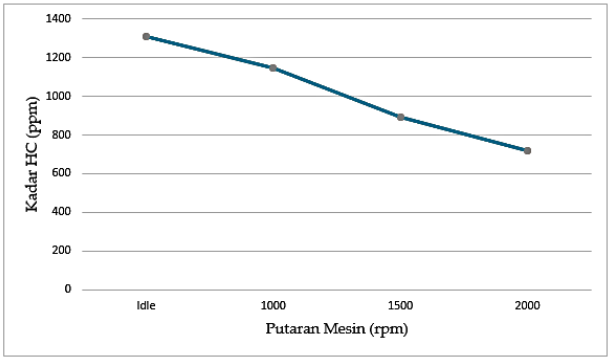

Figure 3. HC Emission Test Results

In Figure 3 it is known that at idle speed HC = 1300ppm, 1000 rpm = 1103ppm, 1500 rpm = 856ppm, and 2000 rpm = 725ppm. Based on the data in Figure 3, it can be concluded that the higher the engine speed, the lower the HC emission. HC emission decreases because there is a tendency that as the engine speed increases, the resulting HC emission decreases [15]. Based on the results of emission tests on motorcycles in the year of manufacture 2010, it can be seen that HC emissions are less than the specified threshold value. The comparison table of allowable threshold values is presented in **Table 6.**

Table 6. Comparison of HC. Threshold Values

Category	Parameter HC ppm	Test Result	Description
4 Stroke Motorcycle Year of Manufacture ≤ 2010	2400	HC idle = 1300ppm 1000 rpm = 1103ppm 1500 rpm = 856ppm 2000 rpm = 725ppm	Less Than Threshold Value

3.3 Fuel Consumption Test

Modification of Honda Tiger 2000 motorcycle affects fuel consumption (kh/L). The fuel used is Pertamax Turbo and Petalite. Pertamax Turbo is used in research because powers that have high octane values are resistant to high temperatures [16]. The effect of the modification is presented in **Figure 4.**

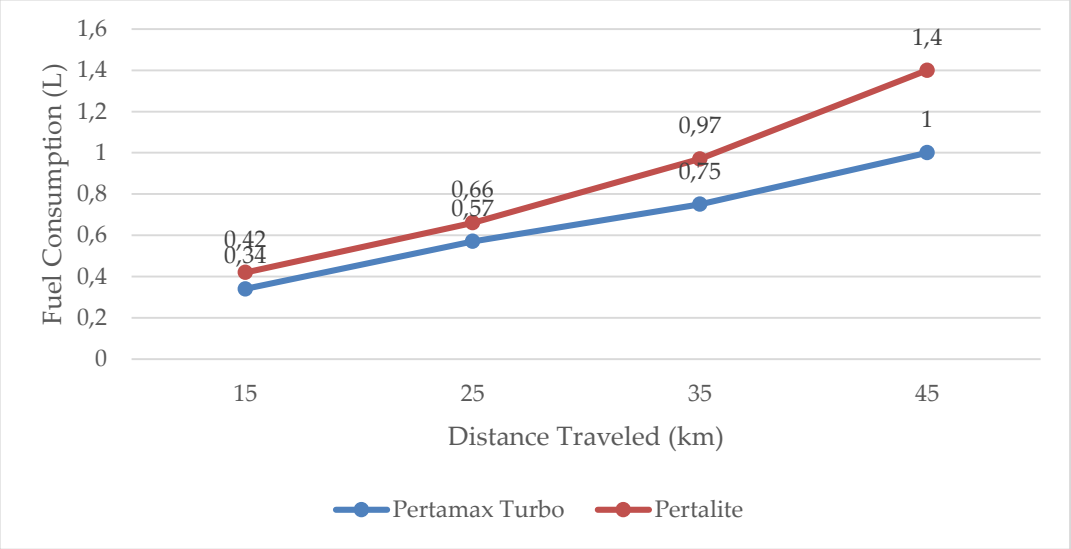

Figure 4. Average Fuel Consumption

In Figure 4, it is known that the Pertamax Turbo fuel consumption required at a distance of 15 km = 0.34 L, a distance of 25 km = 0.57 L, a distance of 35 km = 0.75 L, and a distance of 45 km = 1 L. required at a distance of 15 km = 0.42 L, a distance of 25 km = 0.66 L, a distance of 35

km = 0.97 L, and a distance of 45 km = 1.4 L. Based on the data in Figure 4, it can be concluded that the fuel consumption of Pertamax Turbo lower than the Pertalite used for the Honda Tiger 2000 motorcycle modification.

4. Conclusion

Based on data analysis on CO and HC emission tests, it can be concluded:

a. Honda Tiger 2000 motorcycle modification affects the amount of CO emissions. CO emissions increase at engine idle speed, 1000 rpm, 1500 rpm, and 2000 rpm.

b. Honda Tiger 2000 motorcycle modification affects the amount of HC emissions. HC emissions decrease at engine idle speed, 1000 rpm, 1500 rpm, and 2000 rpm.

c. Comparison of modifications of Honda Tiger 2000 motorcycles on the threshold value of motorcycles in the year of manufacture 2010, namely CO emissions are exceeding 5.5% and HC emissions less than 2400 ppm at engine idle speed, 1000 rpm, 1500 rpm, and 2000 rpm.

d. The fuel consumption of the Honda Tiger 2000 motorcycle modification is more efficient using Pertamax Turbo when compared to Petalite. A distance of 45 km requires fuel Pertamax Turbo 1L and Pertalite 1.4L.

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