Jurnal Pendidikan Teknik Mesin Vol 24, No. 1, June 2024 (11-18)

JPTM
http://journal.unnes.ac.id

THE EFFECT OF VARIATIONS IN THE DIAMETER AND NUMBER OF GROUNDSTRAP WINDINGS ON THE PERFORMANCE OF A 150 CC ENGINE

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ABSTRACT

This study is a type of experimental research that aims to determine the effect of the use of variations in diameter and number of groundstrap windings on spark plug cables on power, torque, AFR and fuel consumption of 150 CC motorcycle engines. This research focuses on the use of groundstrap which aims to improve the combustion system on motorcycles. This research was carried out by an experimental method using a dynotest test tool to obtain valid data. Using the Pre-Experimental Designs method with One-Group Pretest-Posttest Design. Based on the results of the data analysis that has been carried out, it shows that there is a positive influence on engine performance by using the groundstrap on the motorcycle spark plug cable. The use of groundstrap on motorcycle spark plug cables is effective to improve engine performance, resulting in a higher increase in performance value compared to the value when without using a groundstrap. Based on the results of using the groundstrap, an increase in the average value of engine power of 0.49 K.w at engine torque of 0.80 N.m for the AFR of the engine remains within the normal value threshold at 11-13 and on fuel consumption is more economical.

Key words: Groundstrap, engine performance, 4 stroke engine, AFR, winding

INTRODUCTION

The increasingly rapid development and progress of technology has given rise to many innovations, especially in the automotive sector. Various information about motorbikes can be searched easily, from just general information to the latest innovations that can be made to motorbikes to improve their performance. Engine performance can be seen from the amount of torque, power, AFR and fuel consumption produced by the motorbike. To produce maximum performance in a vehicle, it is necessary to have a perfect combustion process in the vehicle engine combustion chamber.

According to Daryanto (2023), incomplete combustion is where the flame from this combustion does not spread regularly and evenly, causing problems or even damage to motor parts. If there is an incomplete combustion process in the vehicle engine, this will have an impact on decreasing the performance of a vehicle.

The combustion process in vehicles certainly requires sparks on the spark plugs to burn a mixture of fuel and air, while incomplete combustion is one of the influencing factors, namely sparks that are not good. According to Isnanto (2023), the high tension generated by the coil causes a magnetic field on the spark plug cable which will have an adverse impact on the ignition system. The solution to the land period is to stabilize the electric current through the spark plug cable.

According to Isnadi (2014) Groundstrap is a type of Ignition booster whose function is to stabilize the electric current produced by the coil so that the spark plug can be larger and more stable. Groundstrap is defined as one type of ignition booster to stabilize and focus the electric current obtained from the coil so that the spark spark of the spark plug is larger and constant. The constant current can produce a good fire, the result is a complete combustion explosion and almost no gasoline molecules are wasted.

This research aims to determine the effect of using variations in the diameter and number of groundstrap turns in the spark plug cable on power, torque, AFR and fuel consumption in a 150 CC motorbike engine.

LITERATURE REVIEW

Groundstrap

According to Utomo (2020), Groundstrap is an additional winding or coil that is installed on the out-side of the spark plug cable. Groundstrap is a type of Ignition booster to stabilize the electric current ob-tained from the coil so that the spark plug is larger and constant, Ignition booster is a tool that functions to improve the quality of ignition results, so that it can increase or increase power (energy), power (power), force (force), and performance or perfor-mance (performance) on the motor. The groundstrap makes the spark generated by the spark plug more focused. In the presence of a groundstrap the electric current that distortions out is refocused by the groundstrap which is drawn to the ground of the ca-ble.

Figure 1. Groundstrap on spark plug cable

Haslim (2010) said the way this tool works is to stabilize the wild current coming out of the coil to the spark plug so that ignition becomes more optimal, so that fuel combustion in the engine becomes more complete. This tool can also push the voltage gener-ated by the coil to the spark plug, so this tool can be a booster of ignition current. A stable current produces a good fire so that the combustion explosion becomes complete and no gasoline molecules are wasted, the combustion chamber becomes clean and the piston work becomes not heavy and the result can increase the performance of the motor engine.

Diameter Variations

Diameter variations are various diameters / sizes of wire that will be used in making groundstraps, diameter is a line segment that connects one other point on the circle and the line segment passes through the center point. The diameter to be used in making groundstrap is 0.3 mm, 0.6 mm and 0.9 mm diameter using a type of copper wire material.

Variation of the Number of Windings

The winding variation is the number of windings that will be used for the groundstrap. The purpose of varying the number of groundstrap windings is to change the amount of magnetic force of the groundstrap, the number of windings will affect electromagnetic induction depending on the number of windings used. If the winding used in large quantities then the induction to be produced increases / large and vice versa if the number of windings is small then the induction that will be produced decreases / small

Electromagnetic Induction

According to Gussow (2004) the current flowing through a piece of wire will produce concentric rings in the form of magnetic force lines surrounding the wire. Electromagnetic Induction is the event of the onset of electric current due to changes in magnetic flux. Magnetic flux is the number of magnetic lines of force that penetrate a field.

Ignition System

According to Wayan (2009) the ignition system is a system that exists in every gasoline motor, used to burn a mixture of fuel and air that has been compressed by the piston in the cylinder according to the ignition timing time, which is at the end of the compression stroke. The ignition system also functions to produce sparks on the spark plug electrode in order to ignite a mixture of fuel and air.

Principle and chronology of ignition electric current induction

Producing sparks on the spark plug electrode requires electricity that must jump the air gap between the two spark plug electrodes, while air is an insulator (poor conductor of electricity) so that high electricity is needed so that electricity can jump the air gap so that sparks form on the spark plug. The component in the ignition system that serves to raise the height of the battery is the ignition coil.

Motorcycle Engine Performance

Engine performance is an ability of the engine to convert thermal energy (heat) from combustion into mechanical energy so that it can produce useful power, in other words engine performance can be interpreted as performance performance performance in a vehicle engine where the achievement is closely related to the engine power produced and the usability of the engine. The performance of a vehicle engine is generally shown in three quantities, namely the power that can be produced, the torque produced, and the amount of fuel consumed. (Arismunandar, 2002).

The performance of a motorcycle can be judged by the amount of motor power produced against the fuel consumption used or specific fuel consumption. The higher the motor power that can be produced with a small amount of fuel consumed, it can be said that the performance of the motor is good. In addition to engine power, motor performance is also judged by the torque produced and fuel consumption. (Mafruddin, 2019)

According to Arismunandar (2002) Power is the amount of work that can be produced per unit time, in a machine the value of power is influenced by the amount of torque value and engine speed. Power is the amount of motor work at a certain period of time or also the working level of the engine.

According to Soedarmo (2008) Torque is the attraction of power in a motor engine. Torque is a measure of the ability of a machine to carry out a work process, where the amount of torque is a derivative amount commonly used to calculate the energy produced from an object rotating on its axis. This unit of torque is expressed in the form of Newton meters (N.m).

Air Fuel Ratio (AFR) is a comparison of the amount of air and fuel in the combustion process in units of mass or volume. Air fuel ratio is a factor that affects the perfection of the combustion process in the combustion chamber. (Angky Puspawan, 2023)

Arends (1980) says "Fuel consumption is the amount of fuel used during the combustion process". Another opinion expressed by Jelius Jama (2008) states "Fuel consumption is a number showing how many kilometers can be traveled by a motorcycle with 1 liter of gasoline".

RESEARCH METHODS

The research method used in this study is a type of experimental research. According to Arikunto (2006), experimentation is a way to find a causal relationship (causal relationship) between two factors deliberately caused by researchers. This research design uses Pre-Experimental Designs, namely by using the One-Group Pretest-Posttest Design model , which is a research design that contains pretest before treatment and postest after treatment. One-Group Pretest-Posttest Design is a research design that has a pretest so that it can be known more accurately, because it can compare research after and before treatment (Sugiyono, 2014)

Pretest	*Treatment*	*Posttest*
O_1 →	X →	O_2

Information:

O1: The researcher made an initial observation to determine the value of engine performance before receiving treatment

X : Researchers provide treatment of engine performance using variations in diameter and number of groundstrap windings

02: Researchers make final observations to determine the effect of engine performance values after treatment.

Research Variables

The independent variable is a variable that affects the dependent variable, in this study the independent variable is the diameter of the groundstrap, the number of groundstrap windings.

A dependent variable is a variable that is affected by an independent/treatment variable. In this study, the dependent variable is engine performance.

Research instrument

1. Ingredients
a. Copper wire 0.3 mm 0.6 mm 0.9 mm
b. Motorcycle engine capacity 150 CC
2. Tools
a. Dynotest

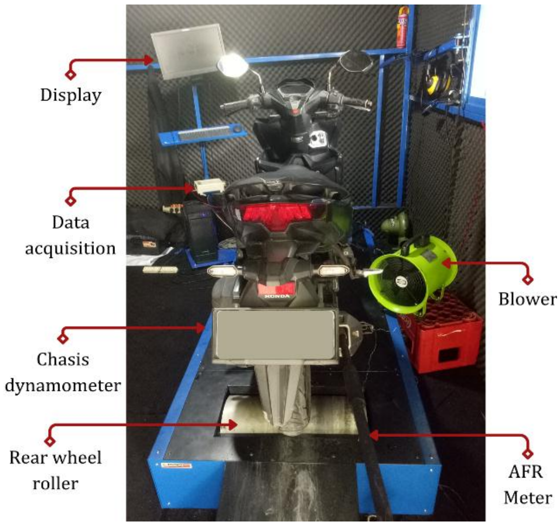

Figure 2. Dynotest equipment specifications

b. Control panel (indicators: power, torque, AFR and fuel consumption)
c. Stopwatch
d. T Key 10
e. Tang Lock

Testing Implementation

The first step that must be carried out before carrying out the test is to prepare a motorbike with an engine capacity of 150 CC which will be tested. After that, the vehicle is mounted on the dynotest test equipment and a tracking rope is installed on the front wheel so that the motorbike remains safe and stable during the test. Install the blower. on the side of the vehicle to maintain the engine temperature so that excessive heat does not occur. After that, install the AFR meter in the motorbike exhaust pipe and finally make sure the monitor is connected to the dynotest test equipment and is ready to be used.

Make sure all the tools are installed correctly, then test the vehicle to find the power, torque, AFR and fuel consumption values without using the groundstrap first. Specifically for fuel consumption, the value that is recorded first is the average value of kilometers per hour which can be seen on the vehicle speedometer, then the calculation is carried out using the following formula:

$$Mf = \frac{t}{Km} \cdot \frac{3600}{1000} \cdot Pbb\ Kg/hour$$

$$Mf = \frac{12{,}61}{43{,}7} \cdot \frac{3600}{1000} \cdot 0{,}770\ Kg/hour$$

$$Mf = 0{,}799\ Kg/hour$$

Where:
Mf = amount of fuel unity time (kg/h)
Pbb = specific gravity of fuel used
Km = distance traveled
T = time required for fuel consumption

The next step is that the vehicle is treated by attaching a groundstrap to the spark plug cable with a predetermined variation in diameter and number of turns of copper wire. For each variation of copper wire, the test is carried out three times so that the value obtained can be maximized. After all the series of tests have been carried out, the next step is to carry out data analysis to find the effect of using groundstraps on motorbikes

DATA ANALYSIS TECHNIQUES

Descriptive Statistical Analysis

According to Sugiyono (2013), descriptive statistics are statistics used to analyze data by describing or describing the data that has been collected as it is. Descriptive statistics describe a summary of data such as mean, standard deviation, variance, minimum value, maximum value and others. Descriptive statistics is a process of transforming research data in quantitative form so that it is easy to understand and interpret. The goal is to find out a general picture of the data and the relationship between the variables used is the average, maximum, minimum, standard deviation to describe the research variables.

Multivariate Dependency Analysis

Analysis of multivariate dependency data using the MANOVA multivariate analysis type with the help of IBM SPSS statistical analysis 25. Manova is a statistical test used to measure the influence of independent variables on a categorical scale on several dependent variables at the same time on a quantitative data scale (Ghozali, 2013). Criteria for testing statistical hypotheses if where the significance value (sig) ≥ an error level of 5% (0.05) then Ho is accepted and Ha is rejected or there is no significant effect. The dependency method of multivariate analysis is a multivariate analysis method in which a variable or set of variables identified as a dependent variable or dependent variable can be predicted or described by another variable that is an independent variable. Dependency analysis serves to explain or predict dependent variables using two or more independent variables.

RESULTS AND DISCUSSION

a. Engine power before and after using Groundstrap

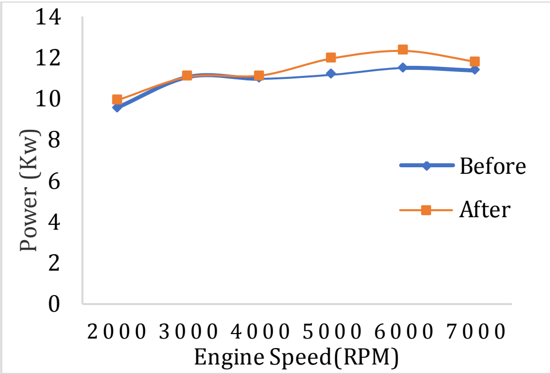

Figure 3. Engine Power Using 0.3 Groundstrap with 260 Winding

Based on figure 1 of the test results with the state of the standard spark plug cable and using a copper wire diameter of 0.3 mm with a winding of 260 times, the average value of power before and after using the groundstrap at 2,000 – 7,000 rpm rotation, shows an increase in power value in the use of groundstrap variations The diameter of 0.3 mm with the number of windings of 260 at each engine speed is positive and significant, this is in accordance with the literature which states that the size of the diameter and number of windings of copper wire will affect the amount of magnetic force to be generated. By using a smaller diameter and a considerable number of windings, it makes the results of using the groundstrap more optimal. From the graph above, the highest average power value before using the groundstrap is obtained at 6,000 rpm at 11.50 Kw and after using the groundstrap the highest average power value is obtained at 6,000 rpm, which is 12.33 Kw.

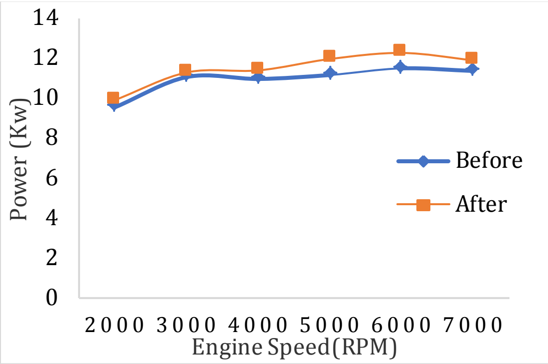

Figure 4. Engine Power Using Groundstrap 0.6 with 155 windings

Based on figure 2 of the test results with the standard spark plug cable condition and using a copper wire diameter of 0.6 mm with a winding of 155 times, the average value of power before and after using the groundstrap at 2,000 – 7,000 rpm rotation, shows an increase in power value in the use of groundstrap variations 0.6 mm diameter with 155 windings at each positive and significant engine speed, in the use of this variation the power value obtained is not much different from the use of previous variations because the number of windings is still fairly large so that the results of using the groundstrap are still maximum. From the graph above, the highest average power value before using the groundstrap is at 6,000 rpm of 11.50 Kw and after using the groundstrap the highest average power value is obtained at 6,000 rpm, which is 12.27 Kw.

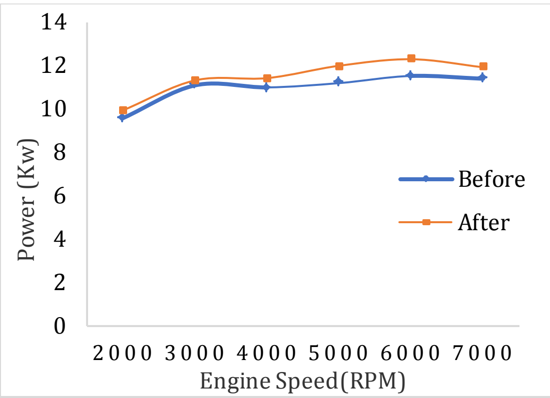

Figure 5. Engine Power Using Groundstrap 0.9 with Winding 103

Based on figure 3 of the test results with the state of the standard spark plug cable and using a copper wire diameter of 0.9 mm with a winding of 103 times, the average value of power before and after using the groundstrap at 2,000 – 7,000 rpm rotation, shows an increase in the power value in the use of groundstrap variations 0.9 mm diameter with 103 windings at each engine speed which is positive but not significant, in the use of this variation the power value obtained still shows an increase in each engine speed but the value obtained is not maximum enough, this is because the diameter used is getting bigger and as the number of windings used is also getting less then this will affect the results obtained. From the comparison graph above, it shows that the highest average power value is obtained before using the groundstrap at 6,000 rpm of 11.50 Kw and after using the groundstrap the highest average power value is obtained at 6,000 rpm, which is 12.33 Kw.

b. Engine torque before and after using Groundstrap

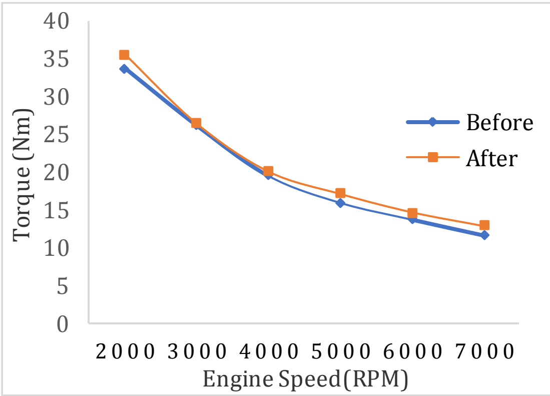

Figure 6. Engine Torque Using Groundstrap 0.3 with 260 Windings

Based on figure 4 of the test results with the state of the standard spark plug cable and using a copper wire diameter of 0.3 mm with a winding of 260 times, the average torque value before and after using the groundstrap at 2,000 – 7,000 rpm was obtained, the average value at 2,000 rotation in standard conditions was 33.66 Nm and after using the groundstrap with a diameter of 0.3 mm there was an increase in the average value at the 2,000 revolution of 35.48 Nm, the difference in the increase in the 2,000 rotation was 1.82 Nm, the increase in the average value occurred at each engine speed and the difference value at each revolution before and after use was 1.03 Nm. It can be concluded that the use of groundstrap 0.3 mm with a winding of 260 has a positive effect, the increase in torque value is due to an increase in positive and significant engine power with the use of a variation in diameter of 0.3 mm with a considerable number of windings that is 260 times so that the results of using the groundstrap become maximum.

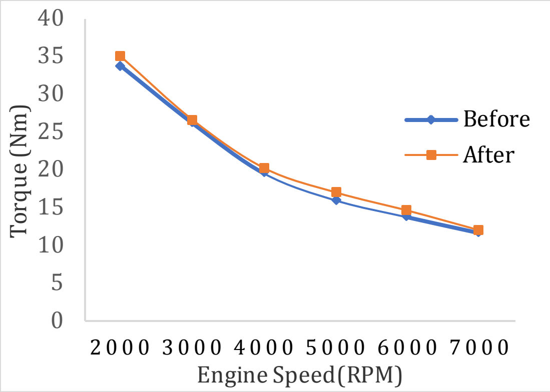

Figure 7. Engine Torque Using Groundstrap 0.6 with 155 Windings

Based on figure 5 of the test results with the state of the standard spark plug cable and using a copper wire diameter of 0.6 mm with a winding of 155 times, the average torque value before and after using the groundstrap at 2,000 – 7,000 rpm was obtained, the average value at 2,000 rotation in standard conditions was 33.66 Nm and after using the groundstrap with a diameter of 0.6 mm there was an increase in the average value at the 2,000 revolution of 34.91 Nm, the difference in the increase in the 2,000 rotation was 1.25 Nm, the increase in the average value occurred at each engine speed and the difference value at each rotation before and after use was 0.63 Nm. It can be concluded that the use of groundstrap 0.6 mm with a winding of 155 has a positive effect, the increase in torque value is due to an increase in positive and significant engine power with the use of 0.6 mm diameter variations with a fairly large number of windings that are still quite a lot, which is 155 times so that the results of using this groundstrap are not much different from the use of previous variations.

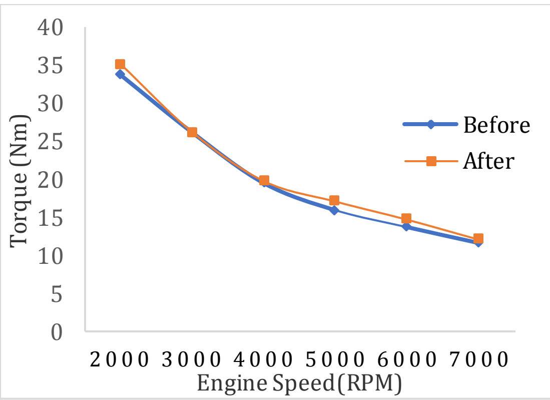

Figure 8. Engine Torque Using 0.9 mm Groundstrap With 103 Windings

Based on figure 6 of the test results with the state of the standard spark plug cable and using a copper wire diameter of 0.9 mm with a winding of 103 times, the average torque value before and after using the groundstrap at 2,000 – 7,000 rpm was obtained, the average value at 2,000 rotation in standard conditions was 33.66 Nm and after using the groundstrap with a diameter of 0.9 mm there was an increase in the average value at the 2,000 revolution of 35.09 Nm, the difference in the increase in the 2,000 rotation of 1.43 Nm, the increase in the average value occurred at each engine speed and the difference value at each revolution before and after use was 0.71 Nm. It can be concluded that the use of groundstrap 0.9 mm with a winding of 103 has a positive effect, at every engine speed of this type of variation there is an increase in the average torque value that is higher than the use of a variation of 0.6 with a winding of 155 because the average value of the power of use of this variation is lower so that the average value of torque increases.

c. AFR machine before and after using groundstrap

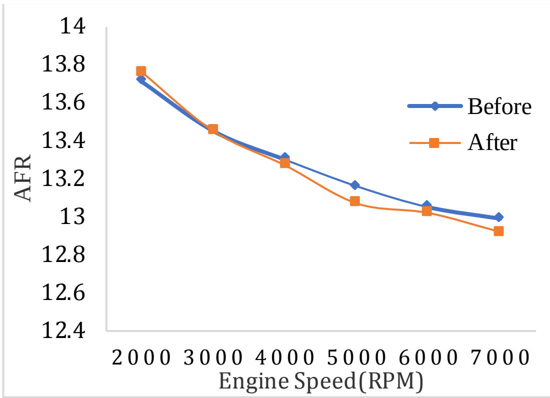

Figure 9. AFR Uses a 0.3 Groundstrap with a Winding of 260

Based on figure 7. from the test results with the standard spark plug cable condition and using a copper wire diameter of 0.3 mm with a number of windings of 260 times, the average AFR value before and after using the groundstrap at 2,000 – 7,000 rpm rotation, that the highest average AFR value was obtained before using the groundstrap at 2,000 rpm which is 13.71 along with the increase in engine speed makes the value of AFR smaller to 12.99 and after using the groundstrap the highest average AFR value is obtained at low revs at 2,000 rpm which is 13.76.

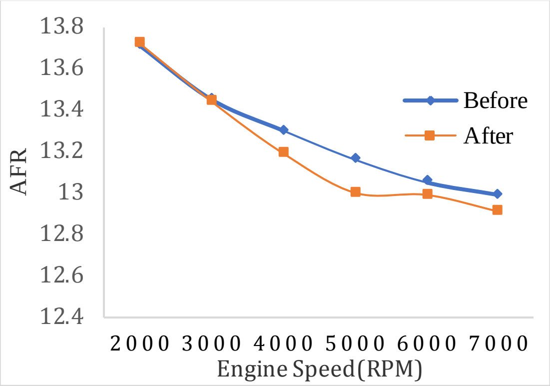

Figure 10. AFR uses a 0.6 groundstrap with a winding of 155

Based on figure 8 of the test results with the state of the standard spark plug cable and using a copper wire diameter of 0.6 mm with a winding of 155 times, the average AFR value before and after using the groundstrap at 2,000 – 7,000 rpm is obtained, that the highest average AFR value is obtained before using the groundstrap at 2,000 rpm, namely 13.71 along with the increase in engine speed makes the value of AFR smaller to 12.99 and after using the groundstrap the highest average AFR value is obtained at low revs at 2,000 rpm which is 13.72.

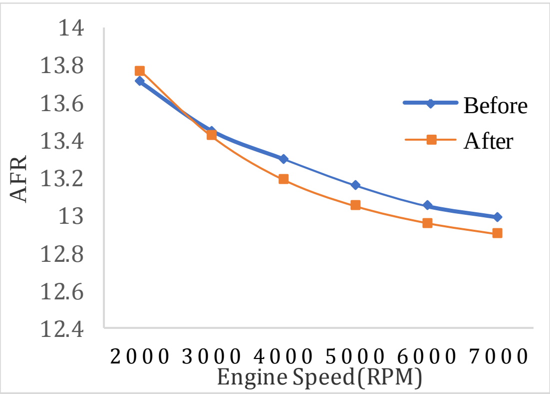

Figure 11. AFR engine uses groundstrap 0.9 with winding 103

Based on figure 9 of the test results with the state of the standard spark plug cable and using a copper wire diameter of 0.6 mm with a number of windings of 260 times, the average AFR value before and after using the groundstrap at 2,000 – 7,000 rpm rotation, that the highest average AFR value was obtained before using the groundstrap at 2,000 rpm which is 13.71 along with the increase in engine speed makes the value of AFR smaller to 12.99 and after using the groundstrap the highest average AFR value is obtained at low revs at 2,000 rpm which is 13.77.

Fuel Consumption Test Results

Table 1. Fuel Consumption

Groundstrap Variations	Test	Time (seconds)	Fuel Consumption (Kg/hour)
Standard conditions	1 2 3	10,01 11,31 11,47	0,730 Kg/h 0,787 Kg/h 0,843 Kg/h
Groundstrap 0,3	1 2 3	12,61 12,03 12,38	0,799 Kg/h 0,741 Kg/h 0,760 Kg/h
Groundstrap 0,6	1 2 3	12,34 11.98 12,86	0,804 Kg/h 0,744 Kg/h 0,812 Kg/h
Groundstrap 0,9	1 2 3	12,61 12,21 13,01	0,860 Kg/h 0,803 Kg/h 0,827 Kg/h

Based on table 10 obtained the results of testing the value of fuel consumption used in a certain unit of time, it can be seen that there is a significant average increase in the value of fuel consumption that can be reached in kilometers per liter. This is in accordance with the literature that has been described that the occurrence of a good combustion process will improve the performance of the vehicle so that the fuel can burn properly. To calculate the amount of fuel unity time can be calculated by the following formula:

The results of the comparison of the total average fuel consumption system per engine speed

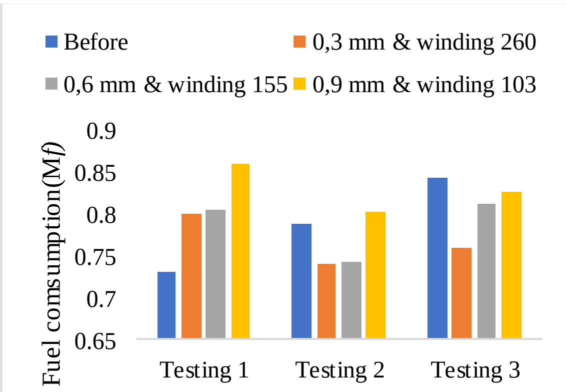

Figure 12. Average Test Results Fuel Consumption

Based on the graph above, the total average fuel consumption before and after using the Groundstrap in three tests shows that in test 1 it can be seen that fuel consumption is higher when after using the groundstrap this is influenced by the condition of the engine has not reached the ideal heat and in test 2 it can be seen that the most influential fuel consumption is the use with the type diameter variations of 0.3 mm and 0.6 mm. In test 3, fuel consumption with all three types of variation was lower than the state without using a groundstrap.

CONCLUSION

Based on the results of the research that has been described previously, it can be concluded that there is an effect of the use of variations in the diameter and number of groundstrap windings on power, torque, AFR and fuel consumption in the 150CC engine. . Based on the results of using the groundstrap on engine performance, it shows that there is a higher value increase compared to before using the groundstrap.

The types of variations that have an impact are variations in the diameter of 0.3 mm winding 260 and 0.6 mm winding 155. An increase in the average value of engine power of 0.49 Kw was obtained, a value of 0.80 Nm was obtained, then at AFR, the engine remained in normal condition at 11-13, while on fuel consumption, the effect obtained became more economical. So it can be concluded that the use of groundstrap on motorcycles is able to increase the performance of the vehicle.

SUGGESTION

From the results of the tests and analyses that have been carried out, there are several suggestions that need to be put forward, namely the need to conduct further research on the influence of variations in diameter and the number of *groundstrap* windings so that it can produce maximum power, torque, AFR, and fuel consumption. It is recommended to research the type of wire diameter to be used in order to get better results. Further research is needed to measure the voltage value of the spark plug cable before and after using *the groundstrap.* Further research can make variations in the length of wire windings more varied in the manufacture of *Groundstrap* and choose types of wire other than copper.

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