ANALYSIS OF THE EFFECT OF TWO TURBO CYCLONES WITH SIX BLADES TOWARDS THE PERFORMANCE OF A 4-STROKE MOTORCYCLE

Compiled as one of the requirements of completing the undergraduate program at the Mechanical Engineering Department

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APPROVAL PAGE

The Final Project entitled **'Analysis of the Effect of two *Turbo Cyclones* with six Blades Towards the Performance of a 4-stroke Motorcycle'** has been approved by the Final Assignment Supervisor and accepted to fulfill some of the requirements to obtain a Bachelor's degree in the Mechanical Engineering Program, Universitas Muhammadiyah Surakarta.

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AFFIRMATION PAGE

Analysis of the Effect of two *Turbo Cyclones* with six Blades Towards the Performance of a 4-stroke Motorcycle

Final Project

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ANALYSIS OF THE EFFECT OF TWO *TURBO CYCLONES* WITH SIX BLADES TOWARDS THE PERFORMANCE OF A 4-STROKE MOTORCYCLE

(Case Study NINJA MOTORCYCLE 250cc with Pertamax & Pertalite)

ABSTRAK

Penelitian ini bertujuan untuk merancang perangkat turbo cyclone dengan 6 bilah pada kemiringan 40 °, untuk mengetahui hasil performa mesin sepeda motor 4 tak dengan penambahan turbo cyclone dengan bahan bakar pertamax dan pertalite serta untuk mengetahui alasan mengapa kurva tenaga, torsi dan akselerasi turun pada rpm tertentu. Penelitian ini menggunakan metode eksperimental, dimana penelitian ini memanfaatkan turbo cyclone yang telah dibuat dengan enam (6) jumlah bilah dan kemiringan menjadi pengujian untuk membandingkan performa motor bakar dimana udara dari filter diinjeksikan ke dalam karburator. Untuk mengetahui ada tidaknya perubahan atau peningkatan kerja pada motor bahan bakar, dilakukan pengujian performansi berupa torsi, tenaga, dan percepatan dalam kaitannya dengan jarak menggunakan bahan bakar pertalite dan pertamax. Variabel yang diamati dalam penelitian ini antara lain sebagai berikut: Variabel bebas: Variabel bebas adalah variabel yang ditentukan peneliti sebelum melakukan penelitian, variabel bebas yang digunakan adalah sebagai berikut: Variasi perlakuan dan putaran mesin. Prosedur yang dilakukan dalam penelitian ini meliputi perancangan alat untuk mendapatkan desain dan bentuk sesuai jumlah bilah dan kemiringan yang diinginkan, serta pengujian performansi pada sistem sepeda motor bensin. Pengujian kerja motor bakar berupa tenaga, torsi dan percepatan dilakukan dengan menggunakan mesin dyno-jet. Untuk setiap pengujian tenaga, torsi dan percepatan pada motor bahan bakar dilakukan dengan menambahkan turbo cyclone dengan bahan bakar pertalite dan pertamax dan tanpa penambahan perangkat turbo cyclone. Kemudian sesuai dengan prosedur yang telah dijelaskan sebelumnya diperoleh grafik yang secara otomatis akan muncul pada alat ukur monitor. Pengujian kinerja ini bertujuan untuk mengetahui peningkatan tenaga, torsi dan akselerasi sebelum dan sesudah penambahan turbo cyclone yang dipasang pada filter. Pada tabel 1, 2, 3 dan 4 menunjukkan hasil pengujian berupa tenaga, torsi, percepatan dan jarak yang dihasilkan oleh mesin bakar pada putaran mesin 5400 rpm hingga 13000 rpm. Kesimpulannya, Tenaga yang dihasilkan pada sepeda motor bahan bakar setelah dipasangi turbo cyclone mengalami peningkatan dengan tenaga maksimal pada pemasangan turbo cyclone dengan enam (6) bilah pada kemiringan 40 °. Oleh karena itu, sepeda motor 4 tak sebaiknya dioperasikan pada putaran mesin yang optimal antara 8000 rpm hingga 12000 rpm untuk mendapatkan performa motor bahan bakar yang ideal. Kata kunci: Putaran mesin, Tenaga, Torsi, Akselerasi, Pertamax, Pertalite.

ABSTRACT

The aim of this research includes designing a turbo cyclone device with 6 blades on a slope of 40 °, to know the results of the performance of the 4-stroke motorbike engine with the addition of a turbo cyclone with pertamax and pertalite fuel and to determine the reason why the curve for power, torque and acceleration falls at a certain rpm.

This research used experimental method, where this study utilizes the turbo cyclone that has been made with six (6) number of blades and slope into the test to compare the performance of the combustion motor where the air from the filter is injected inside the carburetor. To find out whether there is a change or increase in work on the fuel motor, a test is performed on performance in the form of torque, power, and acceleration in relation with distance using pertalite and pertamax fuels. The variables observed in this study include the following: Independent variable: The independent variable is the variable determined by the researcher before conducting the research, the independent variables used are as follows: Variation in treatment and Engine rotation. The procedure carried out in this study includes the design of tools to get the design and shape according to the number of blades and the desired slope, as well as testing the performance on the gasoline motorcycle system.

Testing for the work of this combustion motor in the form of power, torque and acceleration is carried out using dyno- jet machine. For each test the power, torque and acceleration on the fuel motor is done by adding a turbo cyclone with pertalite and pertamax fuel and without the addition of a turbo cyclone device. Then according to the procedure described previously, a graph is obtained which will automatically appear on the measuring instrument monitor. This performance test aims to determine the increase in power, torque and acceleration before and after the addition of the turbo cyclone installed in the filter. In tables 1, 2, 3 and 4 show the results of testing in the form of power, torque, acceleration and distance produced by the combustion engine at engine speed of 5400 rpm to 13000 rpm.

In conclusion, Power generated on a fuel motorcycle after being fitted with a turbo cyclone has increased with maximum power at the installation of turbo cyclone with six (6) blades on a slope of 40 °. Therefore, it is better to operate a 4-stroke motorcycle at an optimum engine speed of between 8000 rpm to 12000 rpm to get the ideal performance of a fuel motorcycle.

Keywords: Engine rotation, Power, Torque, Acceleration, Pertamax, Pertalite.

1. INTRODUCTION

In the development of automotive technology in Indonesia in recent years has increased so rapidly, various types of automotive technology are widely used in everyday life. The depletion of supplies and rising fuel prices have made many people try to find innovative fuel and increase combustion efficiency in motorcycle. Automotive technology is an interesting thing to be developed because of the increasingly advanced science of combustion engines about the effect on the performance of the combustion engine. Efforts to improve the efficiency of the fuel motor by improving the combustion process that occurs in the combustion chamber are also carried out by Sei Y Kim through his discovery tool called *Turbo Cyclone*. One of the automotive technologies that has developed until now is the use of turbo cyclone on motorcycles. *Turbo cyclone* is one of the compressing technologies of the air, by means of air passing through the *turbo cyclone*, a more focused vortex is made. This additional tool is used on the *internal combustion engine* which functions to make the air flow that will enter the carburetor and the combustion chamber cylinder to rotate or *swirling*. *Turbo cyclone* is like a *swirl fan* whose blades do not rotate and are placed in the intake air or intake manifold. (Ping Wang, 2005). So that the results of compressing the air can be compressed according to the number of *turbo cyclone* blades produced. *Turbo cyclone* installation causes a change in air flow characteristics, namely the emergence of a *pressure drops* in the combustion chamber and the air entering the *intake manifold* towards the combustion chamber will be formed turbulently. Research Objectives: The objectives of this study are as follows: Design a *turbo cyclone* device with 6 blades on a slope of 40 °, Know the results the performance of the 4-stroke motorbike engine with the addition of a *turbo cyclone* with pertamax and pertalite fuel and Determining the reason why the curve for power, torque and acceleration falls at a certain rpm.

Literature Review In Muhaji's research, et al. (2013) the testing of the effect of turbo cyclone blade angle variations on the performance of Honda Civic SR4 motorcycles, with an ideal ratio of air and fuel mixtures that had an influence on the work produced in each combustion process. From the results of testing that has been done, the use of turbo cyclone with variations of the turbo cyclone angle 30º, 45º, 60º provides increased torque and power at mid to high engine speed between 3500 rpm - 4500 rpm at intervals of 500 rpm at each test. In research by Kosjoko (2002) on the influence of Turbo Cyclone 6 Fin Without Hole on the intake manifold against shows off Work 4 stroke petrol motor 100 cc with Power Comparison. The standard manifold is effective against the turbo cyclone angle 45º, 55º, and 65º which results in greater torque and power at high speeds of 6250 rpm to 9000 rpm than standard conditions. The highest torque (T) is found in variations of the turbo cyclone with a slope angle of 650 which is equal to 3.10 Nm at 5500 rpm engine speed. The highest effective power (Ne) is found in variations of the turbo cyclone with a slope of 650 at 3.03 hp at 6750 rpm. On (Fc) Fuel Consumption the lowest average is obtained by p on variations of the turbo cyclone with a 550-tilt angle of 0.75429 kg / hour at 4000 rpm rotation.

In the study of Nely Ana M (2016) about analysis achievement of 4 stroke motorbike functioning with the use of turbo cyclone. This research was conducted to determine the work performance of the gasoline fuel motor analyzed, including torque, power, and performance at 4750rpm - 10000 rpm. From the results testing on standard intake manifolds with an average torque of 3,750 Nm while the turbo cyclone 65 ° angle increases amounting to 0.145 Nm to 3,895 Nm, or experience an increment of 3.866%. This shows that the existence of a turbo cyclone with 65° angle results (increase torque) in high rotation, above 5000 rpm. b. Average power in manifolds without fin amounting to 3.790 hp. In varying to 650 for 3.953 HP there was an increase to 4.30% or up 0.163 hp. This shows that the use of turbo cyclone with 65 ° angle positively affects the output power on rotation above 7000 rpm.

2. RESEARCH METHOD

This research is a type of design research. Designing is an activity that becomes the beginning of a business that is used to realize a product. In the design process, various reality constraints such as economic factors, security, reliability, aesthetics, ethics and social impact are things that need to be considered. (Rhapsody, 2011). However, most of this research uses the *experimental* method, where this study will utilize the *turbo cyclone* that has been made with six (6) number of blades and slope into the test to compare the performance of the combustion motor where the air from the filter is injected inside the carburetor. To find out whether there is a change or increase in work on the fuel motor, a test is performed on performance in the form of torque, power, and acceleration in relation with distance using pertalite and pertamax fuels.

2.1 Research variable

The variables observed in this study include the following: Independent variable:The independent variable is the variable determined by the researcher before conducting the research, the independent variables used are as follows:*Variation in treatment*: The treatment variations that will be carried out in this study are: Testing on the Ninja EX250T-A370 gasoline motorbike with a standard intake manifold. Testing on the Ninja EX250T-A370 motorbike uses 2 filters fitted with two turbo cyclones with six number of blades at a slope of 40º. Engine rotation: The tester wants fast changing turns according to engine capability from 5400 rpm - 13000 rpm. Fuel: The fuel that will be used in the research is pertalite fuel and pertamax fuel.

Dependent variable: Dependent variable is a variable whose size cannot be determined, but the amount depends on the independent variable. This study aims to obtain a comparison of engine performance before and after the *turbo cyclone is* installed by analyzing the data including: Torque (Nm) and Motor effective power (kW). Acceleration (Mph/s) in relation with distance (mi).

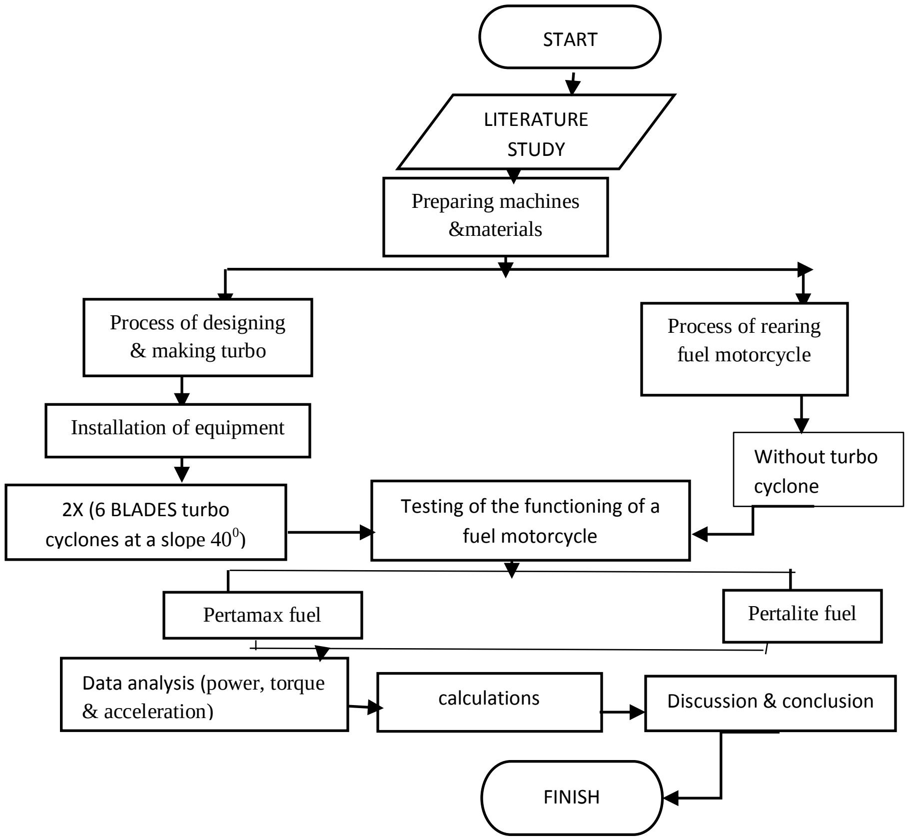

Figure 1. Research Flow Chart

2.2 Location and Time of Research

The location and time of the research conducted are presented as follows: The process of designing and making a *Turbo Cyclone* tool is carried out in June 2019 at the author's residence. Engine performance testing in the form of torque and combustion power was carried out on the 21st July 2019.

2.3 Analysis and discussion

The research carried out covers the design of *turbo cyclone* devices, based on the type of fuel and the number of turbo cyclones at a slope of 40 ° to find out the results of testing on fuel motorcycles in the form of power, torque and acceleration. This study as a whole aim to design a *turbo cyclone* device with six (6) blades on a slope of 40 ° which are then mounted on filters leading to the combustion chamber so that air passing through the *turbo cyclone* will form a more focused air vortex coupled with the ingredients from pertamax and pertalite in each test. When the *turbo cyclones are* installed, it will be known that there is an increase in the performance of the combustion motor because there is an increase in the centralized wind vortex so that the mixing of fuel and incoming wind in the combustion chamber can increase the initial combustion so that the engine rotation can produce power , torque and maximum acceleration in relation to distance covered.

2.4 Research Procedure

The procedure carried out in this study, which includes the design of tools to get the design and shape according to the number of blades and the desired slope, as well as testing the performance on the gasoline motorcycle system.

2.5 Design of tools

Turbo cyclone is a device that functions for compressing air technology, by way of air passing through the *turbo cyclone*, a more focused vortex is made. This additional tool is used on the *internal combustion engine* which functions to make the air flow that will enter the carburetor and the combustion chamber cylinder to be spinning or swirling. The design of this tool is made of *stainless steel* which has a thickness of 0.3 mm. This research will be carried out with 2 turbo cyclones of the number of blades and with the same slope of 40 °. The pictures of the *turbo cyclone* design before being attached to the filter are as follows:

Figure 2. Turbo Cyclone design

After the design process has been completed, the next steps must be taken, namely:

1. Cut the *turbo cyclone* material in the form of *a stainless-steel metal plate* with scissors or charter in accordance with the size of the design drawing that is made which is 105 mm X 30 mm.
2. Then make a groove sketch on top of the cut plate, according to the size that has been designed with A SLOPE OF 40^0.

3. Cut the part of the line that has been sketched on the plate with attachment of the white masking tape to help in seeing the design well drawn on the stainless steel.

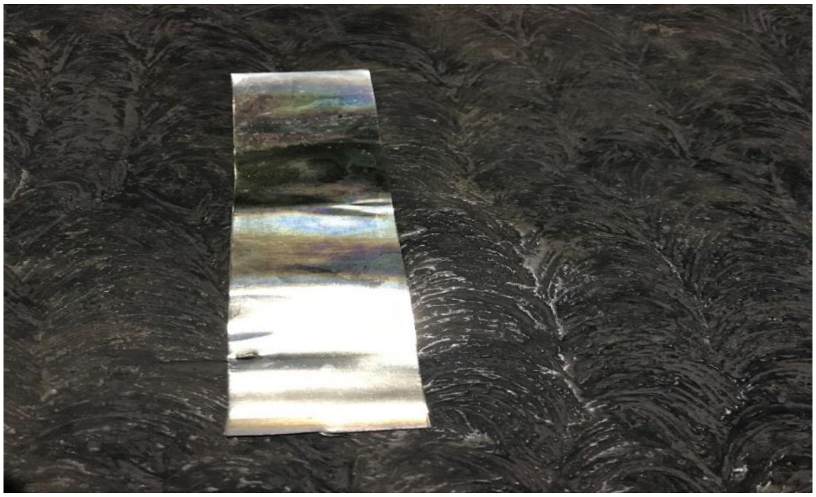

Figure 3. Stainless Steel Plate

4. Then the plate is bent with the help of the pipe and a nozzle to become hollow having a diameter of 33 mm.

Figure 4. Plate folds into circles

5. The final step is to bend the groove on the plate that was already cut by bending it into an angle of 90 °, where the blade functions as a whirlwind leading to the carburetor.

Figure 5. Groove formation

2.6 Motorbike Performance Testing

In this study two types of testing were carried out on the performance of the gasoline fuel motor, namely:

a. Testing to determine the performance of the engine in the form of Power and Torque.

b. Testing to determine the acceleration in relation to the distance covered.

For each of the above tests will be carried out in two testing mechanisms, namely when *standard* conditions or without the addition of tools and by the addition of a tool where using pertalite and pertamax Gas. Then the tests carried out with the addition of a *turbo cyclone* device are made with two turbo cyclones since the type of motorcycle used has two filters in it. Following are the testing steps to find out the engine performance in the form of torque and power of a gasoline motor with the *variable speed* method. The work steps in this test include:

1. Prepare *dyno jet 250i dynamometer* test *equipment.*
2. Installing a gasoline motor on a *dynamometer* by clamping the front wheel on the choke and adjusting the position of the rear wheel to contact the roller wheel *dynamometer* test equipment.
3. Put a container that has been given a hose in the carburetor so that it will be easier later in the fuel replacement, the first is to use pertamax fuel.
4. If the gasoline motor is in the right position, the next step is to turn on and heat the engine.

5. After the engine is considered stable, it starts the process of retrieving power and torque data at engine speed of 5400 - 13000 rpm by opening the *throttle*.
6. Observe the graph of power and torque produced on the *dynamometer* test monitor.
7. Then observe another graph of acceleration and distance on the monitor.

Figure 6. dynameter 250i dynamometer test

Then in the performance testing process using the addition of a *turbo cyclone* device with six (6) blades begins by inserting the two cyclones on the opening of the two filters that lead to the two carburetors on the combustion engine according to the installation scheme and then do the above for all types of testing with pertamax and with pertalite by replacing one type of fuel after the other .

3. RESEARCH RESULTS

Motorbike Fuel Performance Test Results: Motor performance testing in this study was carried out through several stages, namely as follows:

Testing the Power and Torque of a Fuel Motor: Testing for the work of this combustion motor in the form of power, torque and acceleration is carried out using dyno jet machine. For each test the power, torque and acceleration on the fuel motor is done by adding a *turbo cyclone* with pertalite and pertamax fuel and without the addition of a *turbo cyclone* device. Then according to the procedure described previously, a graph is obtained which will automatically appear on the measuring instrument monitor.

This performance test aims to determine the increase in power, torque and acceleration before and after the addition of the *turbo cyclone* installed in the filter. In tables 1, 2, 3 and 4 show the results of testing in the form of power, torque, acceleration and distance produced by the combustion engine at engine speed of 5400 rpm to 13000 rpm.

3.1 Discussion

Motorbike Performance: Power produced by motorcycle. Power is expressed in kilowatt (Kw) or in Horsepower (Hp).

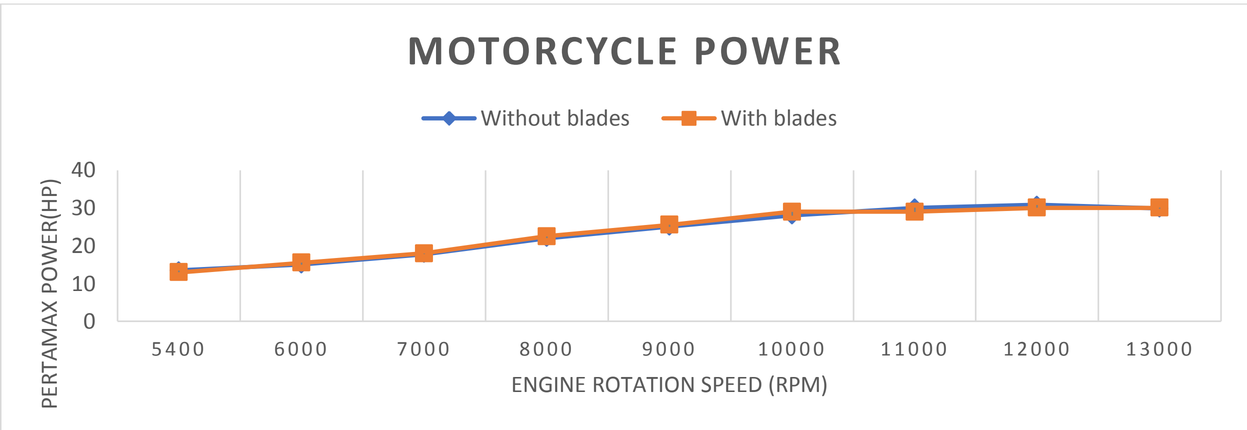

Figure 7. Comparison between motorcycle power with and without turbo cyclone using Pertamax fuel.

Power curve: In principle, power curve is not needed when there is a torque curve: it is just a matter of multiplying. But of course, it is easier when the multiplying has been done for the user. In most cases, the multiplying has been done for the user, when the technical specifications of a motorcycle are illustrated with the torque and power curve from measuring in a test. Where the torque curve is flat, the power curve climbs: with an increasing rpm and a constant torque, the power increases. Where the torque decreases, the power may still increase, but less than where the torque curve is flat. In the end, there will be a point where the power stops (probably where the red area of the rpm is). The next process is an analysis of the test results data and plotted on the graphs. From the figure 7,it can be seen that there is an increase in power in the motor because there is an addition of a tool in the form of a *turbo cyclone* with six (6) blades on a slope of 40 °. The highest increase in power occurs when the fuel motorcycle is at 12000 RPM. When the motorcycle is in a standard state without the addition of a *turbo cyclone*, pertamax fuel only capable of producing a maximum power of 22.0 hp at 8000 rpm rotation speed. Whereas when the combustion motor is given an additional turbo cyclone device with 6 blades on a slope of 40 ° the maximum power produced increases to 22.5 hp at a rotational speed of 8000 rpm.

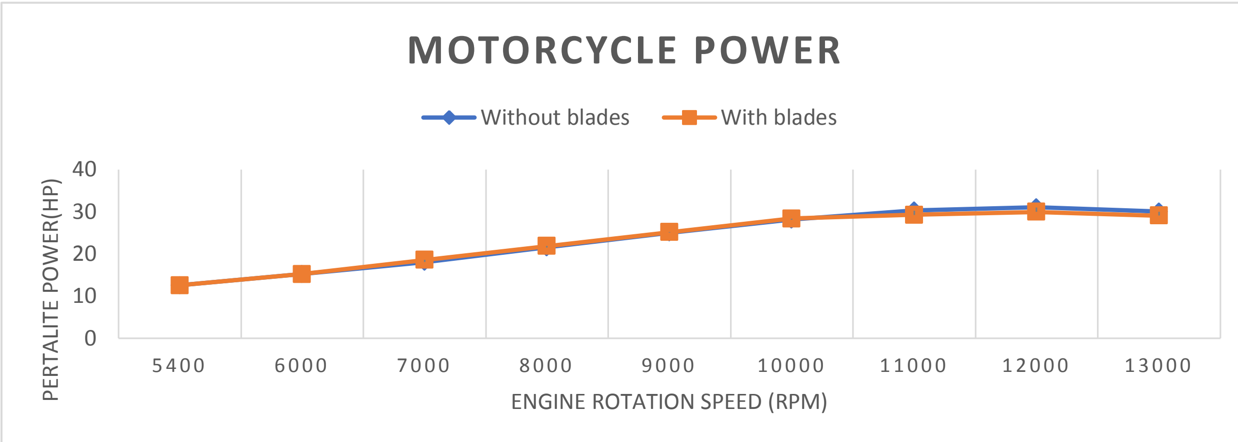

Figure 8. Comparison between motorcycle power with and without turbocyclone using Pertalite fuel.

The next process is an analysis of the test results data and plotted on the graphs. From figure 8, it can be seen that there is an increase in power in the motor because of the addition of a *turbo cyclone* with 6 blades on a slope of 40 ° using pertalite fuel. The most optimum power output is attained when the rpm of the motorcycle is within the range of 8000 to 10000 revolutions per minute with the addition of turbo cyclone. When you take a look at the table 4.1, it shows that with the use of pertalite fuel, the increase of power will be witnessed with the addition of the turbo cyclone. When the motorcycle is tested without the turbo cyclone of 6 blades, at 8000 rpm the power gotten was 21.5 hp. But after adding the turbo cyclone, the power increased to 21.8 hp.

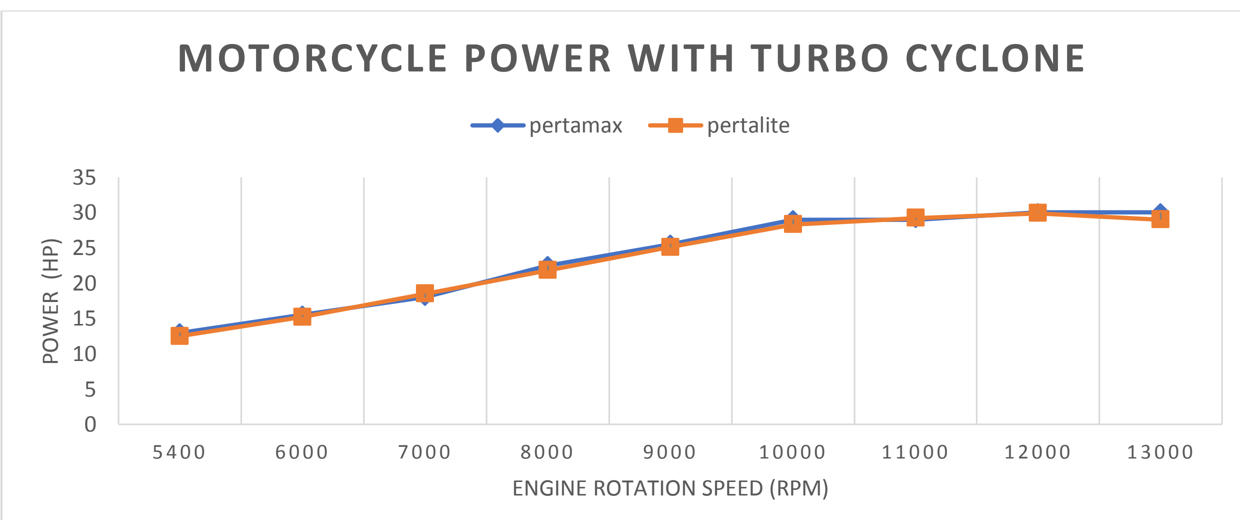

Figure 9. Comparison between motorcycle Power with Turbocyclone using Pertamax fuel and using Pertalite fuel.

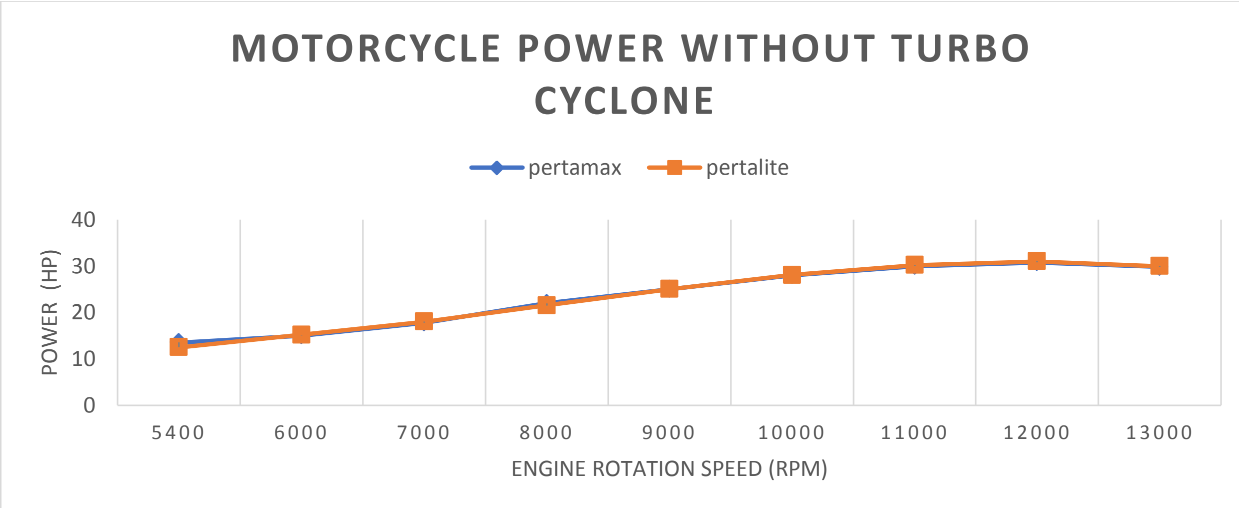

Figure 10. Comparison between motorcycle Power without Turbo cyclone using Pertamax fuel and using Pertalite fuel.

From figure 9, it can be seen that there is an increase in power in the motor because there is an addition of a tool in the form of a *turbo cyclone* with six (6) blades on a slope of 40 ° using pertamax fuel. The highest increase in power occurs when the fuel motorcycle is at 12000 RPM. When the motorcycle is in a standard state without the addition of a *turbo cyclone*, pertamax fuel only capable of producing a maximum power of 22.0 hp at 8000 rpm rotation speed. Whereas when the combustion motor is given an additional turbo cyclone device with 6 blades on a slope of 40 ° the maximum power produced increases to 22.5 at a rotational speed of 8000 rpm. From figure 10 it can be seen that there is an increase in power in the motor because of the addition of a *turbo cyclone* with 6 blades on a slope of 40 ° using pertalite fuel. The most optimum power output is attained when the rpm of the motorcycle is within the range of 8000 to 10000 revolutions per minute with the addition of turbo cyclone. The results show that with the use of pertalite fuel, the increase of power will be witnessed with the addition of the turbo cyclone. This is evidence in the figure 9when the motorcycle is tested without the turbo cyclone of 6 blades, at 8000 rpm the power gotten was 21.5 hp. But after adding the turbo cyclone, the power increased to 21.8 hp. From the figures, it can clearly show that the motorcycle attains the maximum power which is 30.05hp at 12000rpm while using pertamax fuel. This shows that pertamax fuel is better in production of motorcycle power than pertalite fuel which has maximum power of 29.98hp at the same rpm.

Torque Produced by a Fuel Motor: The torque at a certain rpm is the average torque that the piston delivers during the revolution stroke. Thus, motorcycle has more than one cylinder, the torque of the individual pistons adds up. The rpm where the maximum torque is delivered, is the rpm where the fuel is burned most efficiently: it is at that rpm that the piston delivers the maximum torque on the crank.

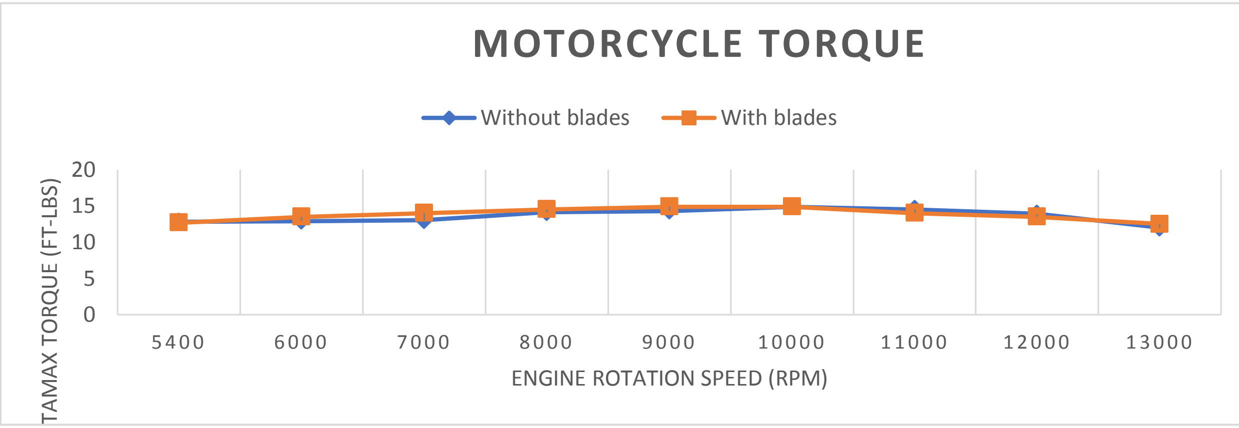

Figure 11. Comparison between motorcycle Torque with and without turbocyclone using Pertamax fuel.

Torque curve: The torque curve shows an x and y axle and a line. The height of that line shows the amount of torque. The place on the x-axle shows at which rpm that torque is delivered. So, from left to right, its the rpm, and from down to top, its the torque. Based on testing the performance of the combustion engine the data plotted on the graphs. The data is then analyzed and a graph of torque comparison is obtained from the tests that have been carried out with different variables. The test was carried out to analyze the effect of the addition of a *turbo cyclone* device on the increase in torque from the fuel motorcycle. From Figure 11 it can be seen that there is an increase in torque when adding a *turbo cyclone* device and the use of fuel added to the engine in the fuel motor. The increase in torque can be seen when the combustion motor is given an additional *turbo cyclone* device which uses pertamax fuel. This is evident when the fuel motor with standard pertamax fuel produces a torque of 14.1 ft-lbs. at engine speed of 8000 rpm. Whereas when adding a *turbo cyclone* device of 6 blades with a slope of 40 ° the torque increased to 14.5 ft-lbs. at the same engine speed.

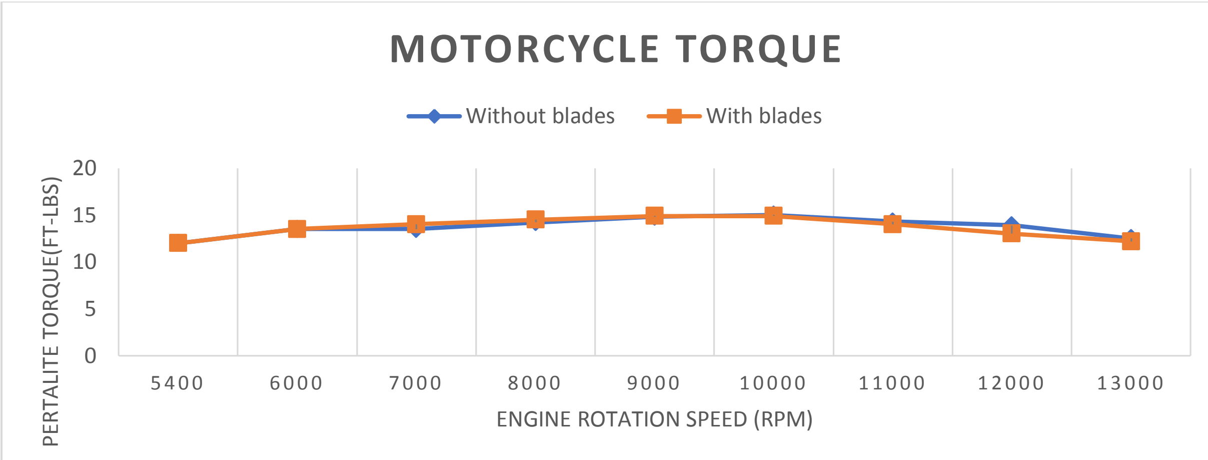

Figure 12. Comparison between motorcycle Torque with and without turbo cyclone using Pertalite fuel.

Based on testing the performance of the combustion engine the data plotted on the graphs. The data is then analyzed and a graph of torque comparison is obtained from the tests that have been carried out with different variables. The test was carried out to determine the effect of the addition of a *turbo cyclone* device to the increase in torque from the fuel motor. From Figure 12, it can be seen that there is an increase in torque when adding a *turbo cyclone* device and the use of fuel added to the engine in the fuel motor. The increase in torque can be seen when the combustion motor is given an additional *turbo cyclone* device which uses pertalite fuel. This is evident when the fuel motor with standard pertalite fuel produces a ma torque of 14.2 ft-lbs. at engine speed of 8000 rpm. Whereas when adding a *turbo cyclone* device of 6 blades with a slope of 40 ° the torque increased to 14.5 ft-lbs. at the same engine speed.

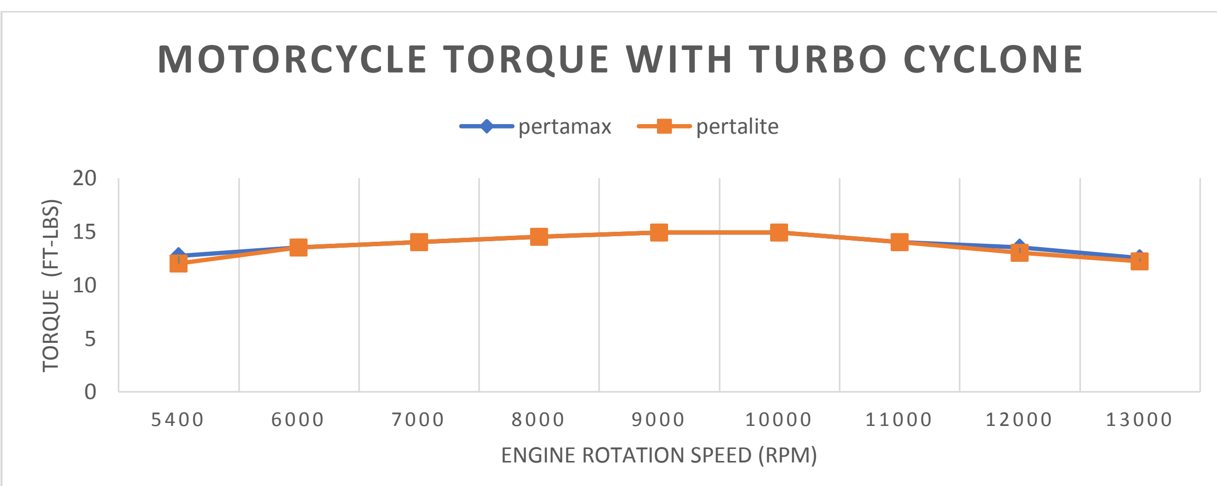

Figure 13. Comparison between motorcycle Torque with Turbo cyclone using Pertamax fuel and using Pertalite fuel.

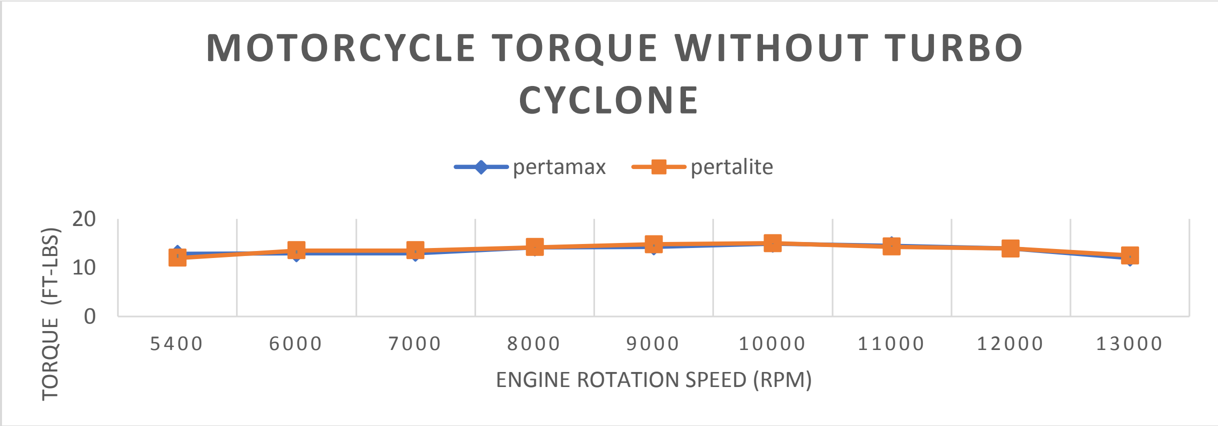

Figure 14. Comparison between motorcycle Torque without Turbo cyclone using Pertamax fuel and using Pertalite fuel.

Based on testing the performance of the combustion engine the data plotted on the graphs. The data is then analyzed and a graph of torque comparison is obtained from the tests that have been carried out with different variables. The test was carried out to analyze the effect of the addition of a *turbo cyclone* device on the increase in torque from the fuel motorcycle. From Figure 13, it can be seen that there is an increase in torque when adding a *turbo cyclone* device and the use of fuel added to the engine in the fuel motor. The increase in torque can be seen when the combustion motor is given an additional *turbo cyclone* device which uses pertamax fuel. This is evident when the fuel motor with standard pertamax fuel produces a ma torque of 14.1 ft-lbs. at engine speed of 8000 rpm. Whereas when adding a *turbo cyclone* device of 6 blades with a slope of 40 ° the torque increased to 14.5 ft-lbs. at the same engine speed. Based on testing the performance of the combustion engine the data plotted on the graphs. The data is then analyzed and a graph of torque comparison is obtained from the tests that have been carried out with different variables. The test was carried out to determine the effect of the addition of a *turbo cyclone* device to the increase in torque from the fuel motor. From Figure 14, it can be seen that there is an increase in torque when adding a *turbo cyclone* device and the use of fuel added to the engine in the fuel motor. The increase in torque can be seen when the combustion motor is given an additional *turbo cyclone* device which uses pertalite fuel. This is evident when the fuel motor with standard pertalite fuel produces a ma torque of 14.2 ft-lbs. at engine speed of 8000 rpm. Whereas when adding a *turbo cyclone* device of 6 blades with a slope of 40 ° the torque increased to 14.5 ft-lbs. at the same engine speed. Torque has a close relationship with power. This is because, power is gotten from torque multiplied by the rpm.

Where the torque curve is flat, the power curve climbs: with an increasing rpm and a constant torque, the power increases.

Acceleration Produced by a fuel motorcycle: Acceleration which is a vector quantity, is the rate at which an object changes its velocity. The most obvious way that the fuel motorcycle could accelerate would be to change the speed from 30 miles per hour to 40 miles per hour. However, acceleration would be experienced if the motorcycle changed direction without changing speed, like driving around a bend in the road at a constant 30 miles per hour. In a large bend where the motorcycle direction was changing slowly, it would experience a lower acceleration than if it was to take a sharp turn, since its direction would change more rapidly. We can feel the difference in acceleration when we go around a corner on a motorcycle as a sensation that we're being pulled or pushed to one side or the other.

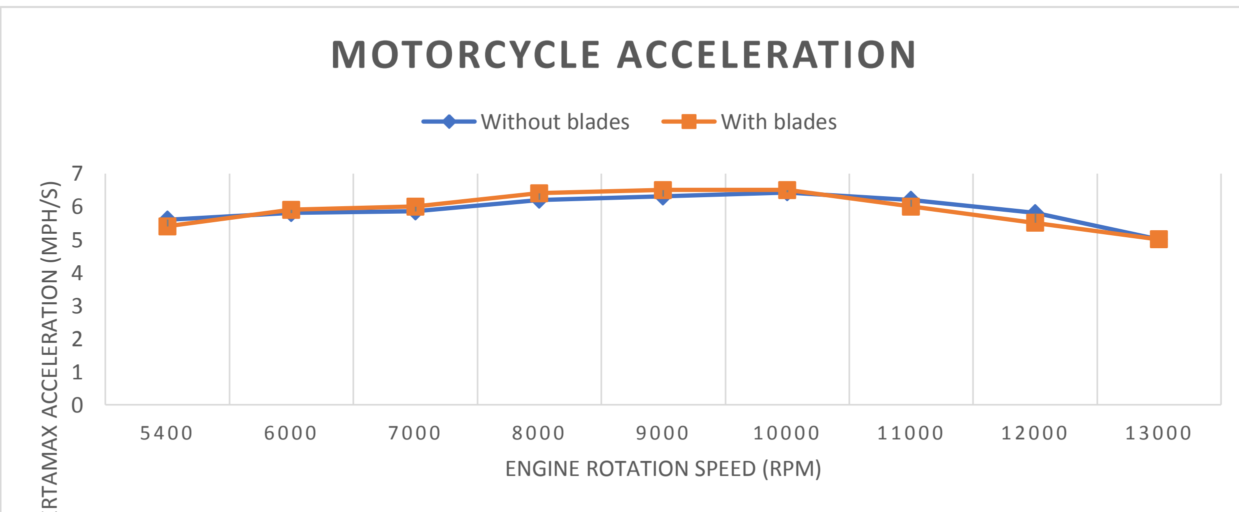

Figure 15. Comparison between motorcycle Acceleration with and without turbocyclone using Pertamax fuel

Based on testing the performance of the combustion engine the data plotted on the graphs. The data is then analyzed and a graph of acceleration in relation with distance comparison is obtained from the tests that have been carried out with different variables. The test was carried out to determine the effect of the addition of a *turbo cyclone* device to the increase in acceleration from the fuel motor. From Figure 15, it can be seen that there is an increase in acceleration when adding a *turbo cyclone* device and the use of fuel added to the engine in the fuel motor. The increase in acceleration can be seen when the combustion motor is given an additional *turbo cyclone* device which uses pertamax fuel. This is evident when the fuel motorcycle with standard pertamax fuel produces acceleration of 6.2mph/s at engine speed of 8000 rpm. Whereas when adding a *turbo cyclone* device of 6 blades with a slope of 40 ° the acceleration increased to 6.4mph/s at the same engine speed.

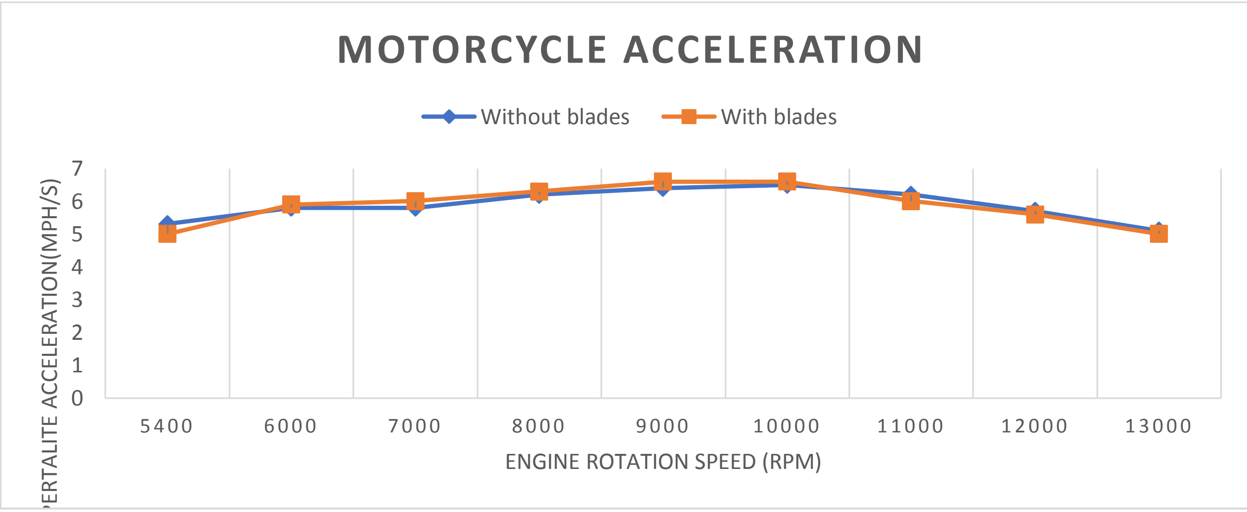

Figure 16. Comparison between motorcycle Acceleration with and without turbocyclone using Pertalite fuel.

Based on testing the performance of the combustion engine the data plotted on the graphs. The data is then analyzed and a graph of acceleration in relation with distance comparison is obtained from the tests that have been carried out with different variables. The test was carried out to determine the effect of the addition of a *turbo cyclone* device to the increase in acceleration from the fuel motor. From Figure 16, it can be seen that there is an increase in acceleration when adding a *turbo cyclone* device and the use of fuel added to the engine in the fuel motor. The increase in acceleration can be seen when the combustion motor is given an additional *turbo cyclone* device which uses pertalite fuel. This is evident when the fuel motorcycle with standard pertalite fuel produces acceleration of 6.2mph/s at engine speed of 8000 rpm. Whereas when adding a *turbo cyclone* device of 6 blades with a slope of 40 ° the acceleration increased to 6.3mph/s at the same engine speed.

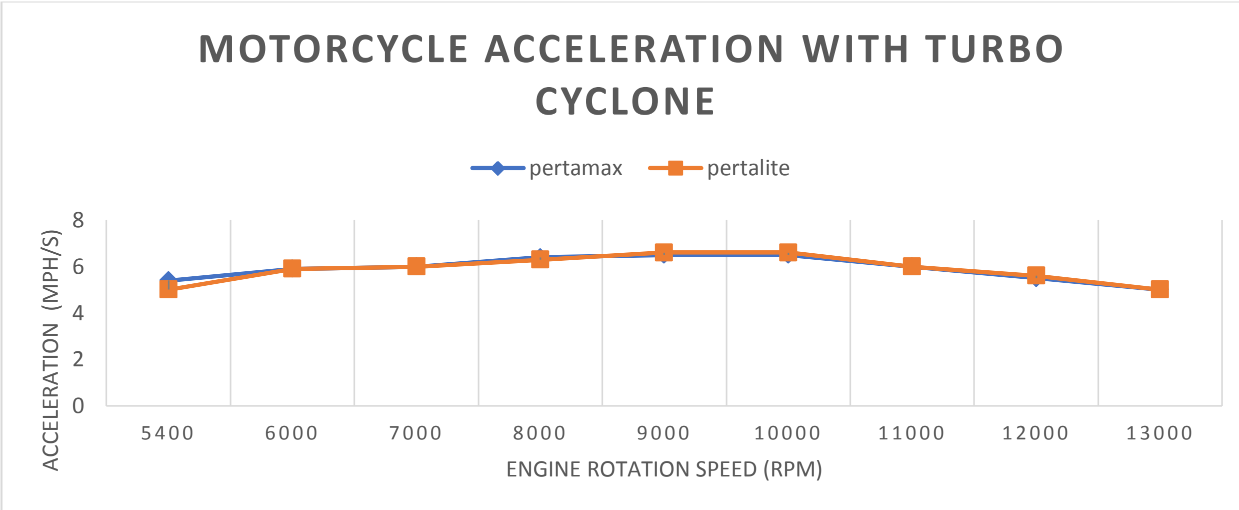

Figure 17. Comparison between motorcycle Acceleration with Turbocyclone using Pertamax fuel and using Pertalite fuel.

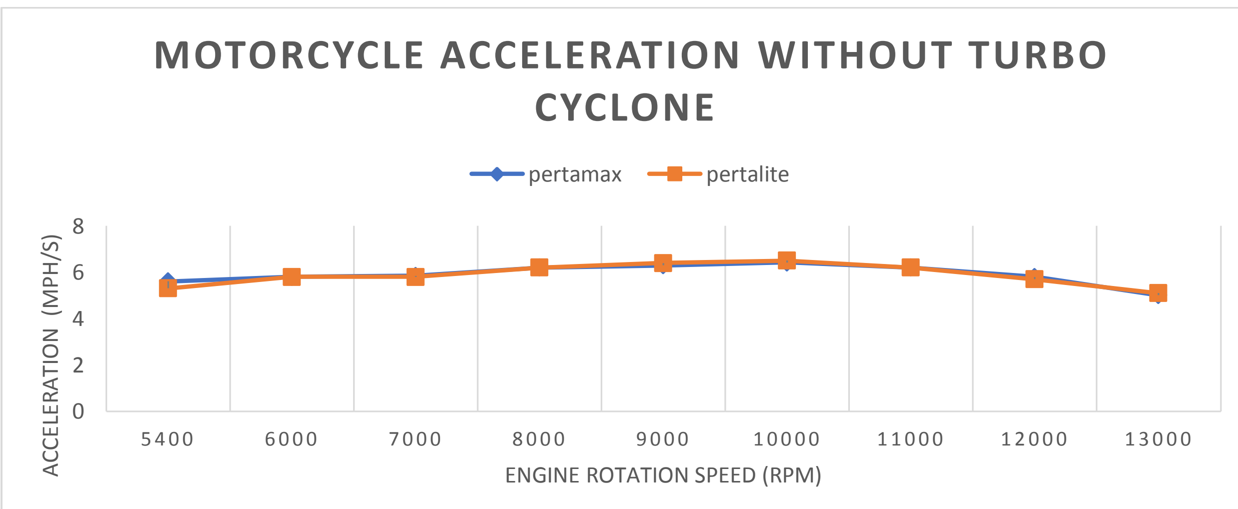

Figure 18. Comparison between motorcycle Acceleration without Turbocyclone using Pertamax fuel and using Pertalite fuel.

Based on testing the performance of the combustion engine the data plotted on the graphs. The data is then analyzed and a graph of acceleration in relation with distance comparison is obtained from the tests that have been carried out with different variables. The test was carried out to determine the effect of the addition of a *turbo cyclone* device to the increase in acceleration from the fuel motor. From Figure 17, it can be seen that there is an increase in acceleration when adding a *turbo cyclone* device and the use of fuel added to the engine in the fuel motor. The increase in acceleration can be seen when the combustion motor is given an additional *turbo cyclone* device which uses pertamax fuel. This is evident when the fuel motorcycle with standard pertamax fuel produces acceleration of 6.2mph/s at engine speed of 8000 rpm. Whereas when adding a *turbo cyclone* device of 6 blades with a slope of 40 ° the acceleration increased to 6.4mph/s at the same engine speed. From Figure 17, it can be seen that there is an increase in acceleration when adding a *turbo cyclone* device and the use of fuel added to the engine in the fuel motor. The increase in acceleration can be seen when the combustion motor is given an additional *turbo cyclone* device which uses pertalite fuel. This is evident when the fuel motorcycle with standard pertalite fuel produces acceleration of 6.2mph/s at engine speed of 8000 rpm. Whereas when adding a *turbo cyclone* device of 6 blades with a slope of 40 ° the acceleration increased to 6.3mph/s at the same engine speed. In comparison of the two fuels based on the data, with the addition of the 6 blade turbo cyclones, it shows that pertalite fuel is better in producing a higher acceleration than pertamax fuel.

Distance covered by the motorcycle: Distance is a numerical measurement of how far apart objects or points are. In this case, how far apart are the motorcycles using different fuel types and using turbo cyclones. Both distance and displacement measure the movement of an object. Distance cannot be negative, and never decreases. Distance is a scalar quantity, or a magnitude. Whereas displacement is a vector quantity with both magnitude and direction. It can be negative, zero, or positive. Directed distance does not measure movement, it measures the separation of two points, and can be a positive, zero, or negative vector. The distance covered by a vehicle or a motorcycle, person, animal, or object along a curved path from a point *A* to a point *B* should be distinguished from the straight-line distance from *A* to *B*. For example, whatever the distance covered during a round trip from *A* to *B* and back to *A*, the displacement is zero as start and end points coincide. In general the straight-line distance does not equal distance travelled, except for journeys in a straight line. In this research, the distance covered is between two motorcycles having different conditions. For example, one motorcycle using pertalite fuel and the other using pertamax fuel. And one motorcycle turbo cyclone blades while the other without blades. This means that if two motorcycles start moving, they will be side by side without one or the other overtaking the other with the same engine rotation speed, or one motorcycle will overtake the other given the conditions provided.

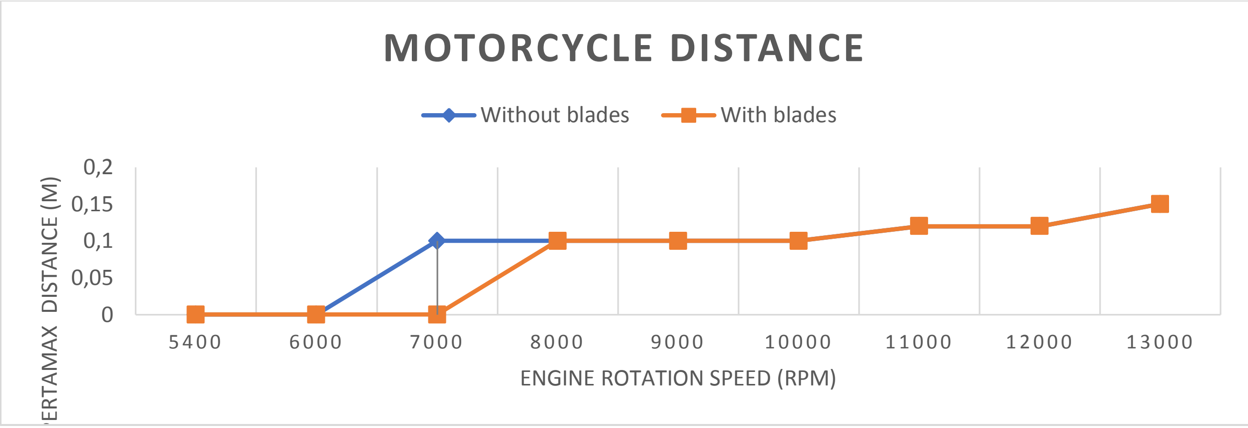

Figure 19. Comparison between motorcycle Distance with and without turbocyclone using Pertamax fuel.

Based on testing the performance of the combustion engine the data plotted on the graphs. The data is then analyzed and a graph of distance in relation with engine rotation speed comparison is obtained from the tests that have been carried out with different variables. The test was carried out to determine the effect of the addition of a *turbo cyclone* device to the increase in distance covered by the motorcycle. From Figure 19, it can be seen that there is an increase in distance covered when adding a *turbo cyclone* device and the use of fuel added to the engine in the motorcycle. The increase in distance coverage can be seen when the combustion motor is given an additional *turbo cyclone* device which uses pertamax fuel. This is evident when the fuel motorcycle with standard pertamax fuel increases the distance coverage from 0-0.1m at engine speed of 6000 rpm. Whereas when adding a *turbo cyclone* device of 6 blades with a slope of 40 ° the distance covered increased at 7000 rpm.

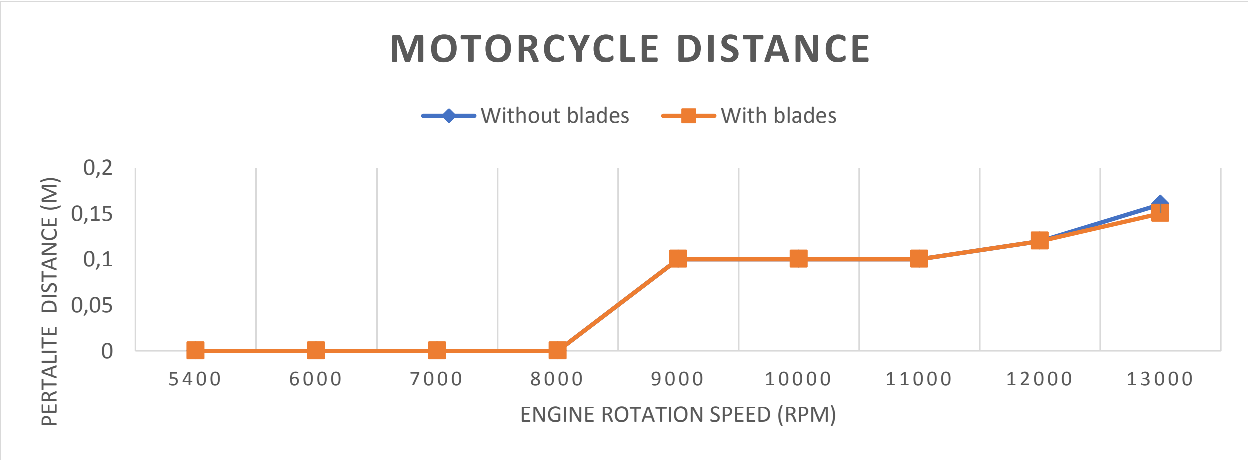

Figure 20. Comparison between motorcycle Distance with and without turbocyclone using Pertalite fuel.

Based on testing the performance of the combustion engine the data plotted on the graphs. The data is then analyzed and a graph of distance in relation with engine rotation speed comparison is obtained from the tests that have been carried out with different variables. The test was carried out to determine the effect of the addition of a *turbo cyclone* device to the increase in distance covered by the motorcycle. From Figure 40, it can be seen that there with the use of pertalite fuel, both motorcycles one using turbo cyclone blades and the other without the blades, the cover the same distance. This means that if two motorcycles start moving, they will be side by side without one or the other overtaking the other with the same engine rotation speed.

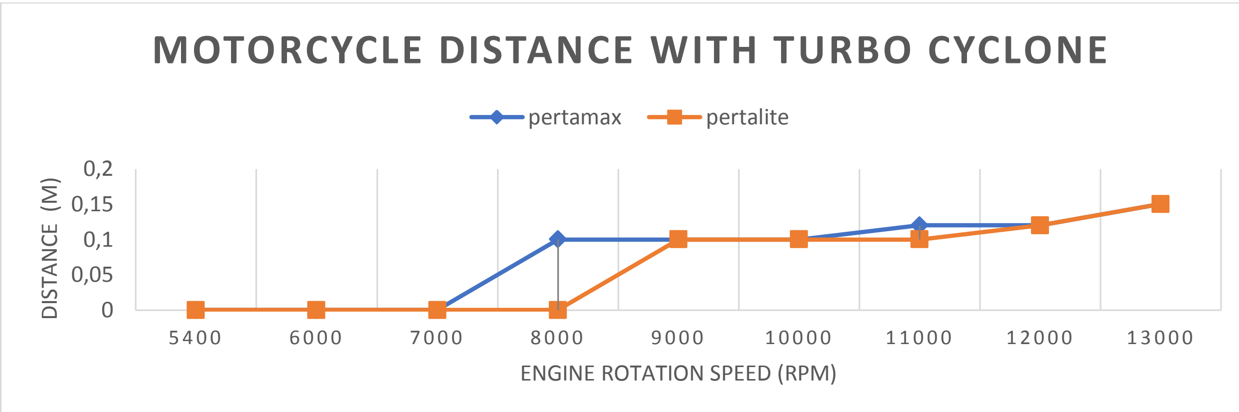

Figure 21. Comparison between motorcycle Distance with Turbo cyclone using Pertamax fuel and using Pertalite fuel.

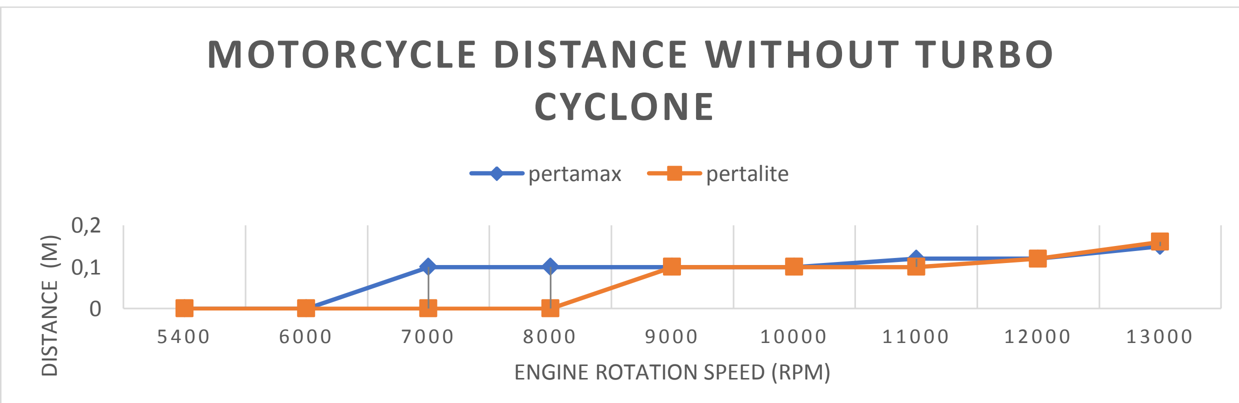

Figure 22. Comparison between motorcycle Distance without Turbo cyclone using Pertamax fuel and using Pertalite fuel.

Based on testing the performance of the combustion engine the data plotted on the graphs. The data is then analyzed and a graph of distance in relation with engine rotation speed comparison is obtained from the tests that have been carried out with different variables. The test was carried out to determine the effect of the addition of a *turbo cyclone* device to the increase in distance covered by the motorcycle. From Figure 21, it can be seen that there is an increase in distance covered when adding a *turbo cyclone* device and the use of fuel added to the engine in the motorcycle. The increase in distance coverage can be seen when the combustion motor is given an additional *turbo cyclone* device which uses pertamax fuel. This is evident when the fuel motorcycle with standard pertamax fuel increases the distance coverage from 0-0.1m at engine speed of 6000 rpm. Whereas when adding a *turbo cyclone* device of 6 blades with a slope of 40 ° the distance covered increased at 7000 rpm. From Figure 22, it can be seen that there with the use of pertalite fuel, both motorcycles one using turbo cyclone blades and the other without the blades, the cover the same distance. This means that if two motorcycles start moving, they will be side by side without one or the other overtaking the other with the same engine rotation speed. In comparison of the two fuels based on the data, with the addition of the 6 blade turbo cyclones, it shows that there is no significant difference in distance coverage, although a motorcycle is slightly faster while using pertamax fuel with the addition of the blades.

Why does power, torque and acceleration fall after 13000 rpm. From the graphs above, we can see that the power, torque and acceleration all fall after a certain **rpm**. Here, we are going to explain the reason behind that occurrence: The engine is the heart of an automobile. An Internal Combustion engine consists of a combustion chamber, Inlet valves (Only air enters through it in case of diesel engine, and air-fuel mixture in case of Petrol/Gasoline engine), Exhaust valves, spark plug/ fuel injector, piston and cylinder.Now, from chapter II we already discussed the working of a 2-stroke or a 4-stroke engine.

The valves are pushed open and closed by the rotation of the cam shaft, at a certain angle of the camshaft. The period by which the valves open and close differ with the RPM at which the crankshaft is rotating. At lower RPMs, or to a certain RPM range the valves are open for sufficient amount of time to allow the air/ air-fuel mixture (charge) to be sucked inside the combustion chamber, therefore making the maximum utilization of the swept volume.

This goes on till a certain RPM of the crankshaft and in our case, this RPM is 13000. Now, the reason why the torque, power and acceleration fall down after a certain RPM is because at very high RPMs the valves open for a very less duration, a fraction of a second, and the volume of air/air-fuel mixture sucked into the combustion chamber is very less. In other words, the engine runs out of breath. The combustion of this charge does not return the desired output. Hence, there is a sudden drop in power, torque and acceleration as seen in the power, acceleration and torque curves in the above figure (in the question).

4. CONCLUSIONS

4.1 *Turbo cyclone is* made using a type of *Stainless-Steel* plate with dimensions of 105 mm × 50 mm as many as 2 pieces with grooves of 25 mm × 12 mm, and 0.3 mm thick. The design of the tool is made with 40 ° blade slope with six (6) blades.

4.2 Power generated on a fuel motorcycle after being fitted with a *turbo cyclone* has increased with maximum power at the installation of *turbo cyclone* with six (6) blades on a slope of 40 °. When the motorcycle is in a standard state without the addition of a *turbo cyclone*, pertamax fuel only capable of producing a maximum power of 22.0 hp at 8000 rpm rotation speed. Whereas when the combustion motor is given an additional turbo cyclone device with 6 blades on a slope of 40 ° the maximum power produced increases to 22.5 hp at a rotational speed of 8000 rpm. The results show that with the use of pertalite fuel, the increase of power will be witnessed with the addition of the turbo cyclone. This is from the data when the motorcycle is tested without the turbo cyclone of 6 blades, at 8000 rpm the power gotten was 21.5 hp. But after adding the turbo cyclone, the power increased to 21.8 hp. So, the fuel motor power produced has a slight increase under the given conditions in testing on a dyno jet when given the turbo cyclone of 6 blades at a slope of 40^0. From the test results obtained, the performance of the motorcycle using *turbo cyclone* with pertamax and pertalite fuels analyzed and concludes as; the maximum performance of the fuel motorcycle is obtained using the addition of a *turbo cyclone* with a number of 6 tilt blades of 40° slope, pertamax fuel for power produces the highest power of 30.05hp at 12000 rpm whereas for torque and acceleration, pertalite fuel produces the highest torque of 14.68 ft-lb at 8000 rpm. Therefore, the motorcycle achieves better results in performance on a low rpm with pertalite fuel as compared to pertamax fuel.

4.3 At a certain RPM range the valves are open for sufficient amount of time to allow the air/ air-fuel mixture (charge) to be sucked inside the combustion chamber, therefore making the maximum utilization of the swept volume. This goes on till a certain RPM of the crankshaft and in our case, this RPM is 13000. The deduction is that, ***torque, power and acceleration fall down*** after a certain RPM because at very high RPMs the valves open for a very less duration, a fraction of a second, and the volume of air/air-fuel mixture sucked into the combustion chamber is very less. In other words, the engine runs out of breath. The combustion of this charge does not return the desired output. Hence, there is a sudden drop in power, torque and acceleration as seen in the power, acceleration and torque curves as seen in the graphs in the last chapters. The motorcycle delivers power by the combination of torque and rpm. So, when there is a need to learn something about the character of a motorcycle and only look at the power, it is difficult to predict its behavior. Anyone would need the power curve of another motorcycle to compare, because power curves always go up, and in the end collapse. It is the torque curve that tells you the character of the motorcycle. The rpm where the maximum torque is delivered, is the rpm where the fuel is burned most efficiently: it is at that rpm that the piston delivers the maximum torque on the crank. Therefore, it is better to operate a 4-stroke motorcycle at an optimum engine speed of between 8000 rpm to 12000 rpm to get the ideal performance of a fuel motorcycle.

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