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Effect of Ron Increase in Molasses Gasoline-Bioethanol Mixture on 4-Stroke Gasoline Engine Performance

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***Abstract*— The development of technology in the 4.0 era has led to higher energy consumption. Meanwhile, Indonesia's energy consumption has been increasing every year. This requires the substitution of alternative energy vehicle fuels. One of them is bioethanol. Bioethanol can be obtained from plants, namely molasses. The use of RON enhancers can increase the octane rating so that low quality fuel can be used. By using high octane, the performance and fuel consumption will be optimal. The purpose of this study was to determine the performance of a 4-stroke petrol engine. This research uses an experimental approach where direct experiments are carried out on torque, power and fuel consumption. The data obtained is also presented graphically. In this study, the independent variables used were Ron enhancers with masses of 0ml, 5ml, 10ml, 15ml and molasses bioethanol percentages of 0%, 10%, 15%, 20%. Control variables engine speed 5500 rpm to 9000 rpm. The highest power results were obtained with a mixture of 0% bioethanol and 5ml RON enhancer, 7.90hp at 8000 rpm. The highest torque is achieved with a mixture of 0% bioethanol and 15ml RON enhancer 8.74 Nm at 6000 rpm. For fuel consumption, the 15% bioethanol mixture with the addition of 0ml RON enhancer is the lowest at 0.0804 kg/Hp.hour at 6000 rpm.**

Keywords : Power, Bioethanol, Torque, Fuel Consumption

I. INTRODUCTION

The rapid development of technology in the current era 4.0 has resulted in higher use of natural resources. Currently, fossil fuels are still used as an energy source. If exploitation continues, fossil resources will be depleted and energy scarcity is expected in the future[1]. With the number of vehicles expected to increase every year, this is associated with an increase in fuel demand. In terms of consumption, this shows that energy consumption in Indonesia has increased from year to year. final energy consumption increased by an annual average of 2.73%. Most of the energy sources used are fossil fuels[2]. This requires efforts to save or replace alternative energy vehicle fuels. Alternative energy that can be used today is bioethanol[3].

Bioethanol is a vehicle fuel blend used as an alternative energy source[4]. The use of bioethanol can improve the combustion process in petrol engines, resulting in environmentally friendly exhaust emissions[5]. Not only that, bioethanol also has some disadvantages, including difficulty starting the vehicle engine when it is cold. In addition, bioethanol can also react with metals[6]. Bioethanol is a biofuel containing starch such as corn, sugar cane, potato, cassava, and other biomass[7]. Among the raw materials for bioethanol production can be obtained from molasses. Sugarcane molasses is a by-product of the sugar processing industry that contains organic acids and sugars. Sugarcane plants contain about 70-88% sucrose, 2-4% glucose, 2-4% fructose, and 2-4% fructose. Because of the high glucose content, it can be used as a source of ethanol easily[9].

Additives are enhancements to the fuel of internal combustion vehicles, both diesel and petrol. These additives are often called RON enhancers. Additives are used to improve certain basic properties that the fuel already has, such as anti-knocking. In addition, they also increase the anti-oxidation ability[10]. The additive used was an octane booster.

Octane Booster is one of the compound components used as a fuel octane number enhancer and also as an anti-knock booster. In addition, it increases the octane value of the fuel, which can eliminate late combustion, restore engine power to the right level, and increase the octane number or improve the quality of the fuel[11].

With the shortcomings of bioethanol, efforts to improve the efficiency of the combustion process in the combustion chamber of a petrol engine are carried out in various ways. Among them is the use of additives. Additives can improve fuel quality and prevent corrosion in the fuel system[10]. Because additives can increase the octane number in fuel. So as to make the combustion rate more perfect, it affects engine performance and fuel consumption, because additives have the ability to clean the fuel line so as to control the combustion process in the engine[12].

Some previous studies on the use of 92 octane fuel mixed with molasses and additives were conducted by. According to [13] Adding additives to petrol-bioethanol fuel blends can increase specific fuel consumption. In addition, the use of additives in fuel blends also reduces

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the fuel consumption value of each blend. According to [3] The addition of bioethanol from molasses can increase effective power and torque especially at 15% blend. However, the fuel mixture with 15% bioethanol gives the highest fuel consumption. Meanwhile, according to [14] the use of octane boosters can increase power and also reduce fuel consumption compared to standard octane boosters.

The purpose of this study was to investigate the effectiveness of petrol-bioethanol blends and octane boosters on four-stroke petrol motorcycles through dynamometer tests. A motorbike was chosen as the research tool due to the high growth of this transport sector throughout the region. Many things were found in this study: power, torque, and fuel consumption.

1.1 Literature Review

1. Combustion Process

Combustion is a rapid reaction between air, fuel and a spark that produces heat. During combustion, chemical energy is converted into energy in the form of heat, and the combustion process produces residual gas[15]. There are two combustion processes, namely: Complete combustion is combustion caused when the mixture of air and fuel is exposed to sparks from the spark plug and does not emit toxic gases. Incomplete combustion is combustion caused by the fuel mixture burning by itself, not due to spark ignition. This phenomenon occurs because due to the combustion process, the flame does not spread[16]. The following combustion reactions in the combustion chamber of RON 92 (C_8H_{18}), bioethanol (C_2H_5OH) and octane booster ($C_5H_{12}O$) are as follows:

1) Complete combustion reaction RON 92 + bioethanol + octane booster
$C_8H_{18} + C_2H_5OH + C_5H_{12}O + 23\ O_2 \rightarrow 15\ CO_2 + 18\ H_2O$
2) Incomplete combustion reaction RON 92 + bioethanol + octane booster
$C_8H_{18} + C_2H_5OH + C_5H_{12}O + 16\ O_2 \rightarrow 15\ CO + 18\ H_2O$

2. Bioethanol

Bioethanol is a renewable fuel that can be produced from plants. Plants that have the potential to obtain bioethanol are plants with high carbohydrate content, for example corn, sugar cane, sweet potato, nira. Bioethanol fuel is also volatile, flammable, and colourless. The chemical composition of bioethanol is C_2H_5OH which is included in the single chain. Bioethanol has an octane value of 108 and a low calorific value[17]. Its technical specifications are liquid, colourless, volatile and the boiling point of bioethanol is 78.3°C at a pressure of 766 mmHg, and its specific gravity is 0.7939 g/ml, with a combustion heat of 7093.72 kcal [8].

2. Octane Booster

Octane Booster is a chemical compound made from organic additives that is used as a fuel octane number enhancer. This compound has tertiary methyl and butyl groups and the molecular formula $C_5H_{12}O$. MTBE octane number 116-118 RON, boiling point 55° C, molecular weight 88, combustion calorific value 8400 kcal / kg[18].

3. Torque

Torque is the ability of an engine to perform work. Engine torque can be a useful measure of engine performance. Torque can be defined as the force exerted over a certain distance in Nm[19]. The torque formula is as follows:

$$\mathrm{T} = \frac{Ne \times 60 \times 746}{2\pi \times \mathrm{n}}$$

Description:
T : Torque (N.m)
Ne : Power (Hp)
n : Engine Speed (rpm)

2. Power

Power is the energy obtained by a machine per unit time during one process. The number of revolutions and the amount of rotation torque are related to the power produced by the engine[14]. The amount of power is

$$\mathrm{Ne} = \frac{2\pi \times \mathrm{n} \times T}{60 \times 746}$$

Description:
n : Engine Speed (rpm)
Ne : Power (Hp)
T : Torque (N.m)

3. Fuel consumption

Fuel consumption is the economic value of fuel use. Similarly, fuel consumption indicates how much fuel the engine needs at any one time[20]. The amount of specific fuel consumption is as follows.

$$Sfc = \frac{mf}{Ne}$$

Description:
mf : Fuel flow rate (kg/hour)
Ne : Power (Hp)
Sfc : Fuel Consumption (kg/Hp.hour)

The mass formula for fuel flow is,

$$mf = \frac{\rho f\ x\ vf}{t}$$

Description:
mf : Fuel flow rate (kg/hour)
ρf : Fuel density (kg/m^3)
t : Time (seconds)
*v*f : Fuel Volume (m^3)

II. METHOD

The materials consist of bioethanol from molasses with 96% content as much as 0ml, 100ml, 150ml, and 250ml, and 92 octane fuel as bioethanol blending material. Furthermore, the mixture will be added with RON enhancing liquid (octane booster) as much as 0ml, 5ml, 10ml, and 15ml per litre of fuel mixture. Engine testing is carried out using a dynamometer. The parameters measured in this test are engine torque and power at various percentage blends, while fuel consumption is measured with a burette, tachometer, and stopwatch. Measurements were made in the range of 5500 - 9000 rpm engine speed with an interval of 500 rpm.

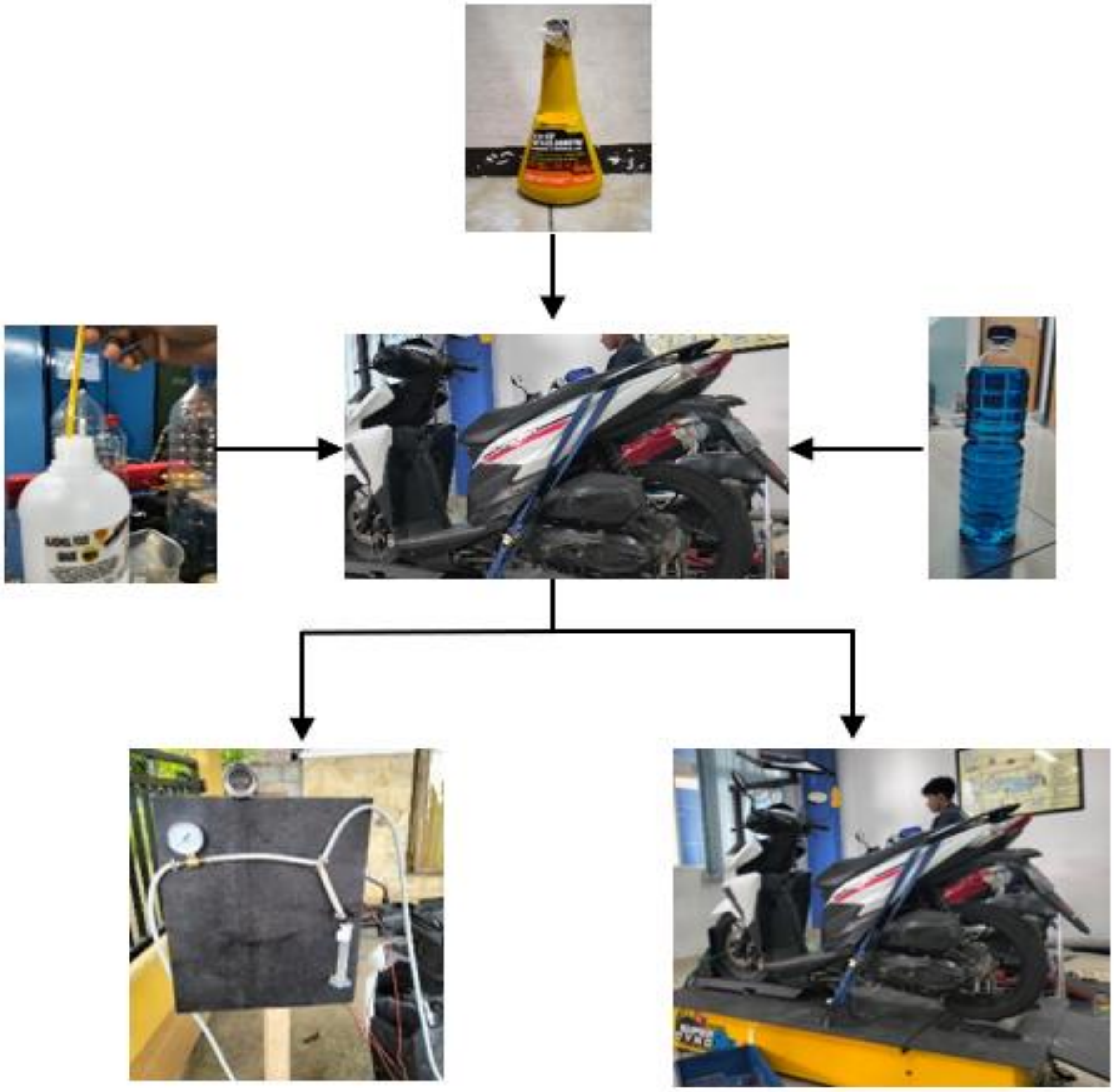

Figure 1. Test Schematic

III. Results and Discussion

1. Power

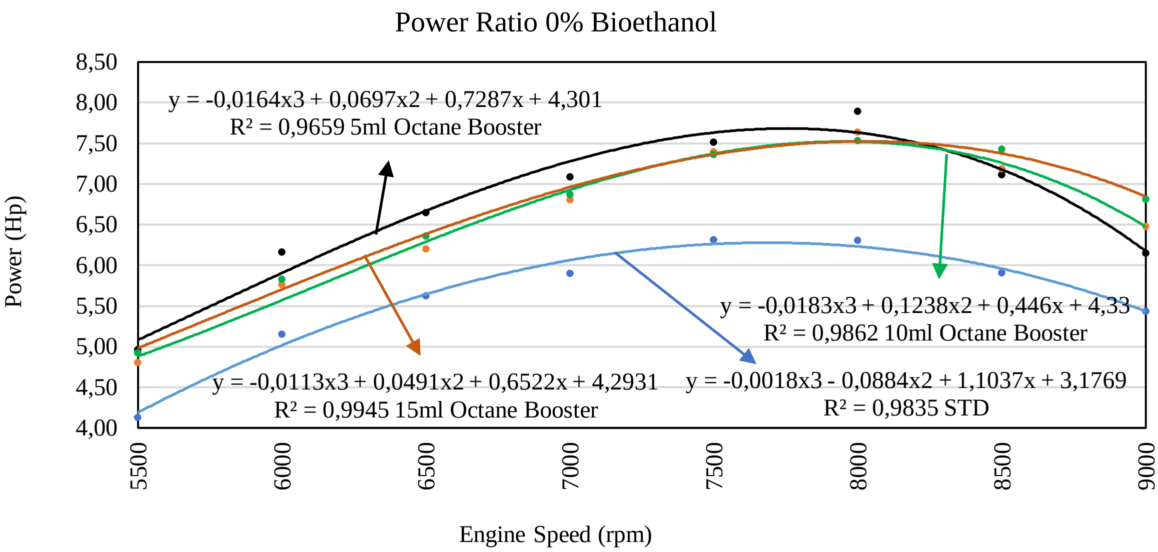

Figure 2. Power at Blend of Octane 92 with 0% Bioethanol

The relationship of power generated at variations of rotation starting from 5500 rpm to 9000 rpm range of rotation every 500 rpm. Based on Figure 2, it can be seen that the standard fuel produces a minimum power of 4.13 Hp and a maximum power of 6.32 Hp. As for the addition of 5ml octane booster produces a minimum power of 4.97 Hp and a minimum power of 7.90 Hp. The addition of 10ml octane booster gets a minimum power of 4.18 Hp and a maximum power of 7.64 Hp. In addition, the addition of 15ml octane booster produces a minimum power of 4.93 Hp and a maximum of 7.54 Hp.

The highest power gets 7.90 Hp at 8000 rpm with the addition of 5ml octane booster. Adding the right amount of octane booster will help the combustion process become more complete. Since octane boosters contain oxygen, they help maximise the performance of the engine. According to [13] Because of the high levels of oxygen in the fuel, the combustion process can produce more oxygen and generate significant power. Conversely, adding too much octane booster will change the chemical composition of the fuel, possibly leading to undesirable chemical reactions. This destabilises the combustion process and results in lower power. According to [21] Excessive use of octane boosters can cause slow combustion and inhibit the combustion process, which in turn reduces the maximum pressure generated in the engine cylinder.

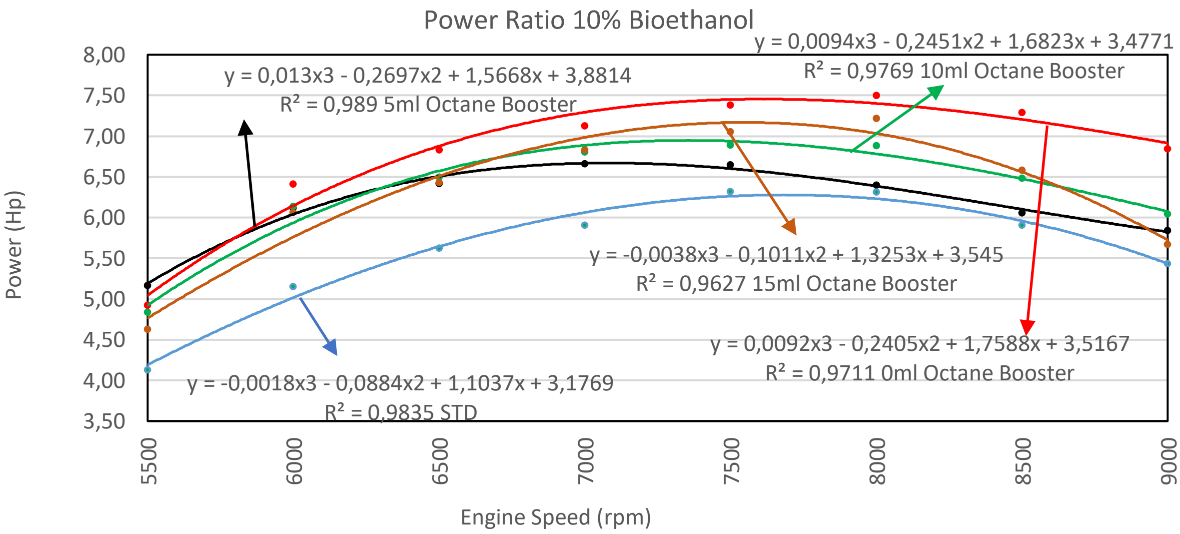

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Figure 3. Power at Blend of Octane 92 with 10% Bioethanol

The relationship of power generated at variations of rotation starts from 5500 rpm to 9000 rpm with a range of rotation every 500 rpm. Based on Figure 3, it can be seen that the standard fuel produces a minimum power of 4.13

Hp and a maximum power of 6.32 Hp. While without octane booster mixture produces a minimum power of 4.92 Hp and a maximum power of 7.50 Hp. For the addition of 5ml octane booster produces a minimum power of 5.17 Hp and a maximum power of 6.66 Hp. The addition of 10ml octane booster gets a minimum power of 4.84 Hp and a maximum power of 6.89 Hp. In addition, the addition of 15ml octane booster produces a minimum power of 4.63 Hp and a maximum of 7.22 Hp.

The highest power gets 7.50 Hp at 8000 rpm with the addition of 0ml octane booster. This is because bioethanol contains oxygen, which helps in more complete and efficient combustion. A blend with 10% bioethanol increases the availability of oxygen within the combustion chamber, which helps maximise the performance resulting from the combustion of the fuel. According to [22] Bioethanol in fuel can increase the oxygen concentration to achieve complete combustion reaction.

Adding an octane booster will change the chemical composition of the fuel, potentially causing unwanted chemical reactions, leading to decreased power and lower combustion stability. According to [21] Excessive use of octane boosters can cause slow combustion and inhibit the combustion process, which in turn reduces the maximum pressure generated in the engine cylinder.

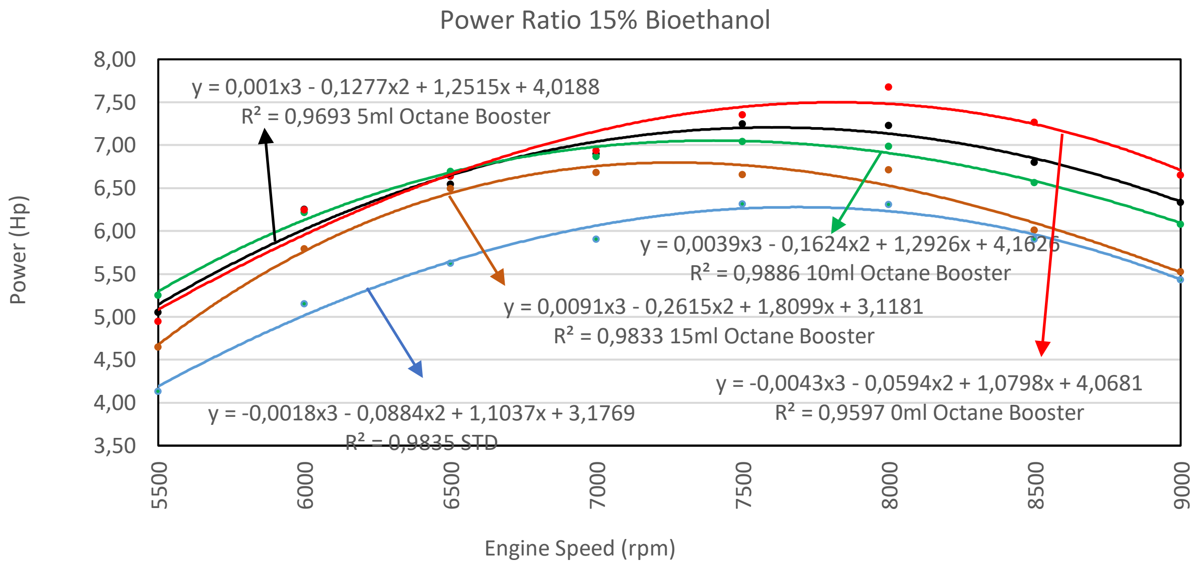

Figure 4. Power at Blend of Octane 92 with 15% Bioethanol

The relationship of power generated at variations of rotation starts from 5500 rpm to 9000 rpm range of rotation every 500 rpm. Based on Figure 4, it can be seen that the standard fuel produces a minimum power of 4.13 Hp and a maximum power of 6.32 Hp. While without octane booster mixture produces a minimum power of 4.95 Hp and a maximum power of 7.68 Hp. For the addition of 5ml octane booster produces a minimum power of 5.05 Hp and a maximum power of 7.25 Hp. The addition of 10ml octane booster gets a minimum power of 5.25 Hp and a maximum power of 7.04 Hp. In addition, the addition of 15ml octane booster produces a minimum power of 4.65 Hp and a maximum of 6.71 Hp.

The highest power gets 7.68 Hp at 8000 rpm with the addition of 0ml octane booster. This is because bioethanol contains oxygen, which helps in more complete and efficient combustion. A blend with 15% bioethanol increases the availability of oxygen within the combustion chamber, which helps maximise the performance resulting from the combustion of the fuel. According to [22] Bioethanol in fuel can increase the oxygen concentration to achieve complete combustion reaction.

Conversely, adding an octane booster will change the chemical composition of the fuel, potentially causing undesirable chemical reactions, leading to decreased power and lower combustion stability. According to [21] Excessive use of octane boosters can cause slow combustion and inhibit the combustion process, which in turn reduces the maximum pressure generated in the engine cylinder.

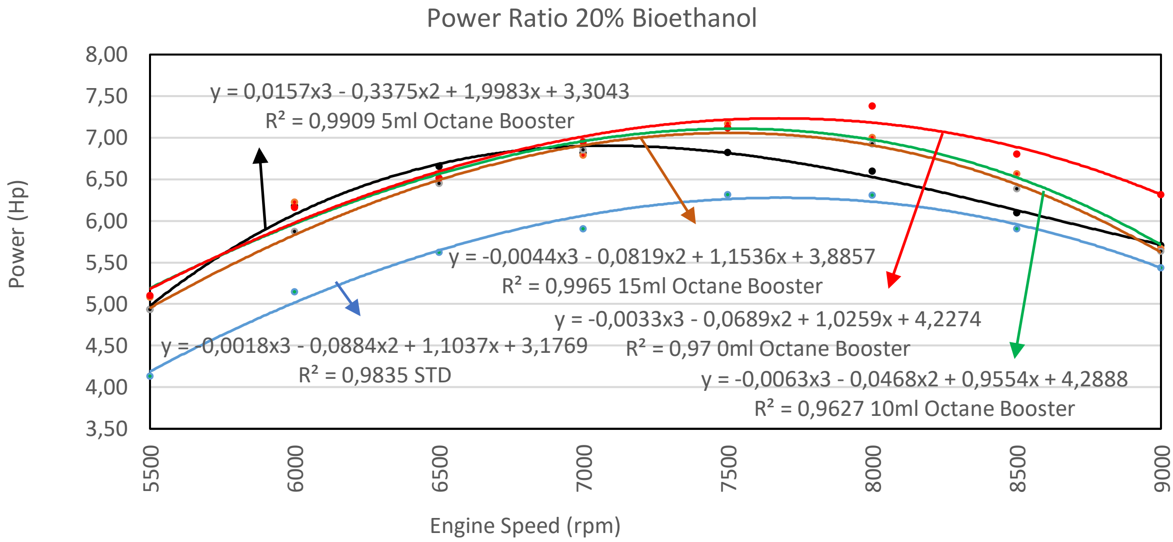

Figure 5. Power at Blend of Octane 92 with 20% Bioethanol

The relationship of power generated at variations of rotation starts from 5500 rpm to 9000 rpm range of rotation every 500 rpm. Based on Figure 5, it can be seen that the standard fuel produces a minimum power of 4.13 Hp and a maximum power of 6.32 Hp. While without octane booster mixture produces a minimum power of 5.11 Hp and a maximum power of 7.38 Hp. For the addition of 5ml octane booster produces a minimum power of 4.94 Hp and a maximum power of 6.82 Hp. The addition of 10ml octane booster gets a minimum power of 5.08 Hp and a maximum power of 7.17 Hp. In addition, the addition of 15ml octane booster produces a minimum power of 4.95 Hp and a maximum of 7.12 Hp.

The highest power gets 7.38 Hp at 8000 rpm with the addition of 0ml octane booster. Because Bioethanol has a chemical structure that contains oxygen atoms. So it plays a role in the oxidation process during fuel combustion in the engine combustion chamber. When bioethanol is mixed with 92 octane, the additional oxygen from bioethanol helps the combustion process to be more perfect. According to [22] Bioethanol in fuel can increase the oxygen concentration to achieve complete combustion reaction.

However, the mixture containing 20% bioethanol is the mixture with the lowest potential value compared to other mixtures. Because bioethanol produces too much oxygen, it slows down the combustion process and causes incomplete combustion. According to [23] increasing the proportion of bioethanol in the fuel leads to a decrease in the energy content of the petrol-ethanol blend, as the calorific value of ethanol is about 35% lower than that of petrol.

2. Torsi

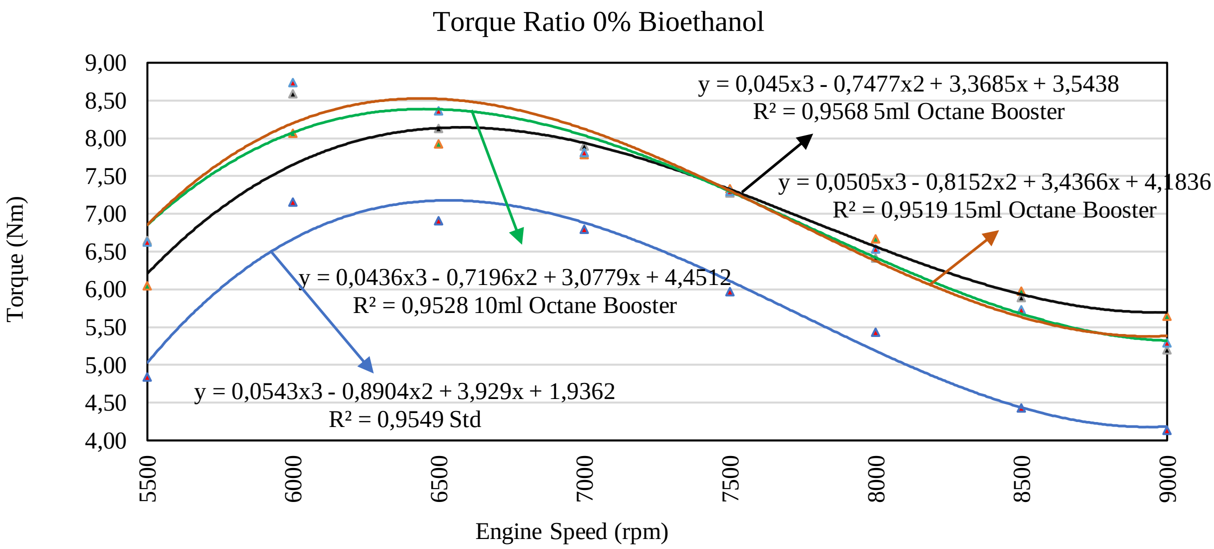

Figure 6. Torque at Blend of Octane 92 with 0% Bioethanol

The torque relationship produced at variations in rotation ranging from 5500 rpm to 9000 rpm ranges every 500 rpm. Based on Figure 6, it can be seen that the standard fuel produces a minimum torque of 4.41 Nm and a maximum torque of 7.16 Nm. As for the addition of 5ml octane booster produces a maximum torque of 8.07 Nm and a minimum torque of 5.65 Nm. The addition of 10ml octane booster gets a minimum torque of 5.20 Nm and a maximum torque of 8.59 Nm. In addition, the addition of 15ml octane booster produces a minimum torque of 5.29 Nm and a maximum torque of 8.74 Nm.

The highest torque gets 8.74 Nm at 6000 rpm with the addition of 15ml octane booster. This happens because in the use of high-octane fuel as much as 15ml, the combustion pressure is relatively greater thanks to the support of compression pressure and proper ignition timing so that the accumulation of torque is also more leverage.

According to [24] The torque of the engine is strongly influenced by the compression coefficient due to the combustion process (F) and the radius of the engine crankshaft. With the radius of the crankshaft on the engine has a fixed coefficient, so the biggest influence is the compression force (F). The compression force created by the combustion process will reach a maximum when the amount of air and fuel mixture injected is large, the compression pressure is maximum and the ignition time is accurate with a large spark.

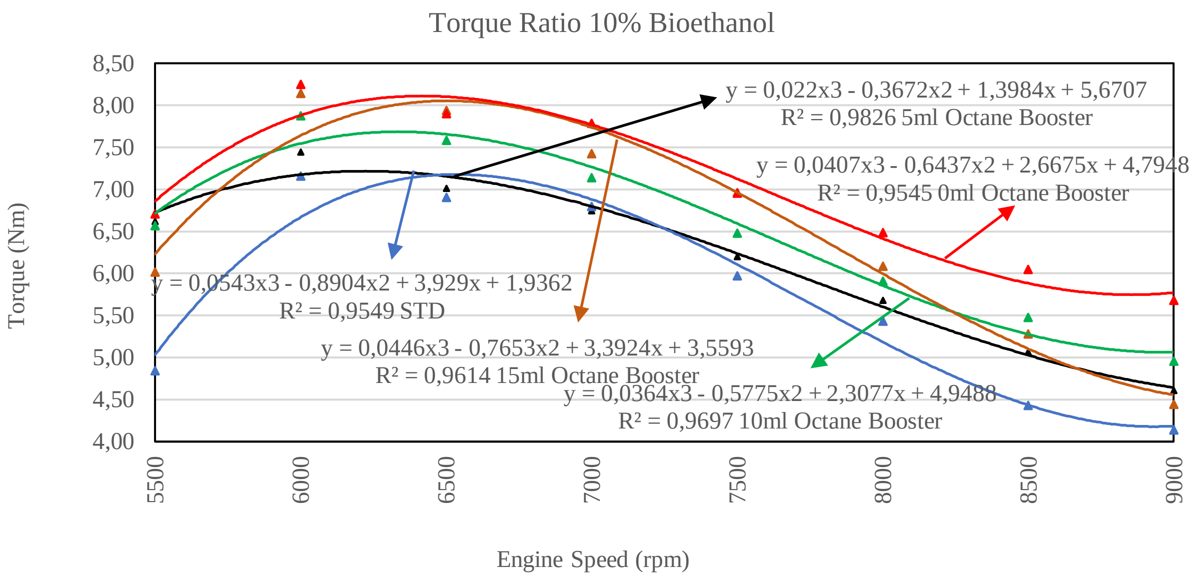

Figure 7. Torque at Blend of Octane 92 with 10% Bioethanol

The torque relationship produced at variations in rotation ranging from 5500 rpm to 9000 rpm ranges every 500 rpm. Based on Figure 7, it can be seen that the standard fuel produces a minimum torque of 4.14 Nm and a maximum torque of 7.16 Nm. While without octane booster mixture produces a minimum torque of 5.68 Nm and a maximum torque of 8.25 Nm. For the addition of 5ml octane booster produces a minimum torque of 4.61 Nm and a maximum torque of 7.44 Nm. The addition of 10ml octane booster gets a minimum torque of 4.95 Nm and a maximum torque of 7.87 Nm. In addition, the addition of 15ml octane booster produces a minimum torque of 4.44 Nm and a maximum torque of 8.14 Nm.

The highest torque is produced 8.25 Nm at 6000 rpm engine speed with the addition of 0ml octane booster. Because bioethanol already contains oxygen, so the octane number is already high enough to prevent knocking without the need for additional additives. This allows the engine to operate at optimum conditions with efficient combustion. The addition of an octane booster changes the chemical composition of the fuel, which can lead to undesirable chemical interactions. This reduces combustion stability and results in lower torque.

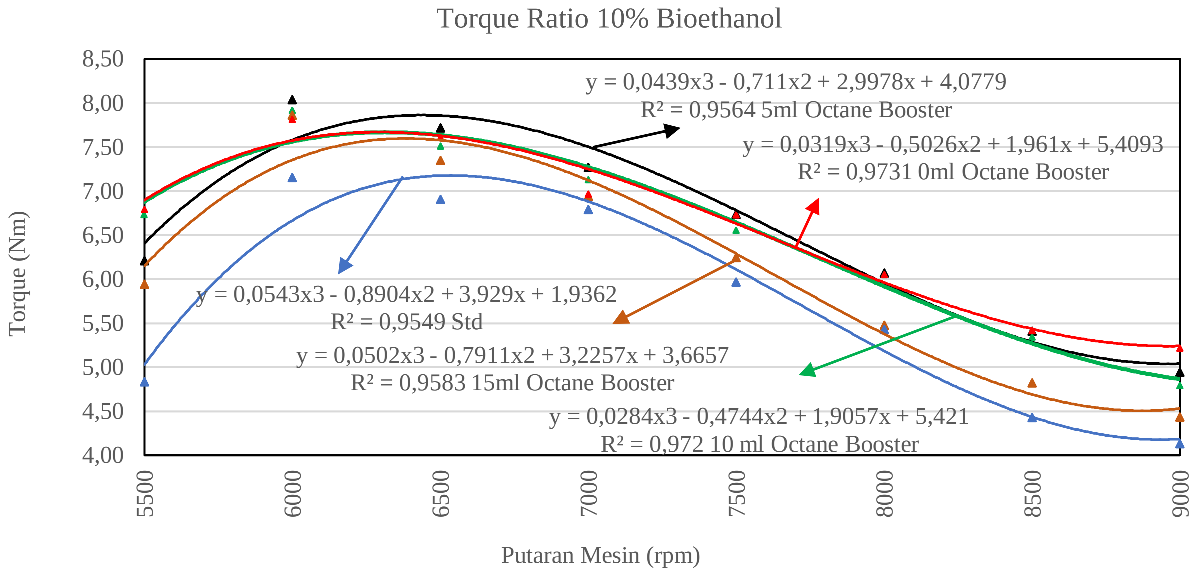

Figure 8. Torque at Blend of Octane 92 with 15% Bioethanol

The torque relationship produced at variations in rotation ranging from 5500 rpm to 9000 rpm ranges every 500 rpm. Based on Figure 8, it can be seen that the standard fuel produces a minimum torque of 4.14 Nm and a maximum torque of 7.16 Nm. While without octane booster mixture produces a minimum torque of 5.22 Nm and a maximum torque of 7.82 Nm. For the addition of 5ml octane booster produces a minimum torque of 4.95 Nm and a maximum torque of 8.04 Nm. The addition of 10ml octane booster gets a minimum torque of 4.80 Nm and a maximum torque of 7.92 Nm. In addition, the addition of 15ml octane booster produces a minimum torque of 4.44 Nm and a maximum torque of 7.87 Nm.

The highest torque was 8.04 Nm at 6000 rpm with the addition of 5ml octane booster. Due to the low ethanol concentration, the oxygen content is also low. With the addition of 5ml octane booster, oxygen levels rise, increasing the octane number so that the engine operates at a higher temperature without knocking. Optimal combustion temperature increases the thermal efficiency of the engine. So as to produce higher torque. Whereas without the addition of octane booster, the combustion temperature becomes less optimal. This reduces thermal efficiency and torque. So the combustion temperature becomes too high or too low due to changes in combustion characteristics, reducing thermal efficiency and torque.

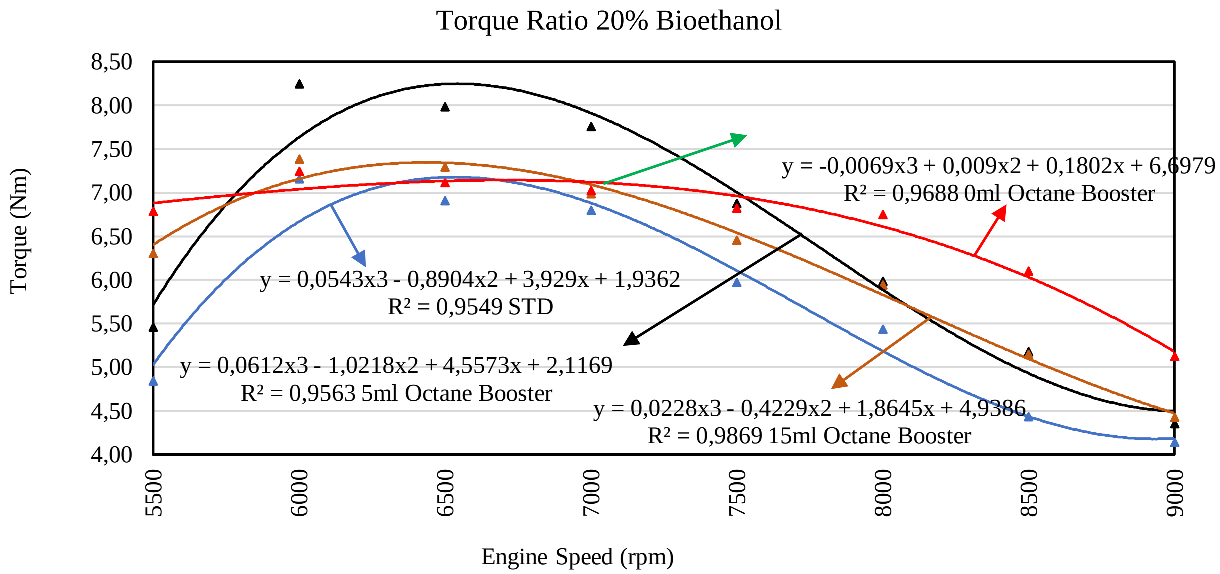

Figure 9. Torque at Blend of Octane 92 with 20% Bioethanol

The torque relationship produced at variations in rotation ranging from 5500 rpm to 9000 rpm ranges every 500 rpm. Based on Figure 9, it can be seen that the standard fuel produces a minimum torque of 4.14 Nm and a maximum torque of 7.16 Nm. While without octane booster mixture produces a minimum torque of 5.12 Nm and a maximum torque of 7.24 Nm. For the addition of 5ml octane booster produces a minimum torque of 4.35 Nm and a maximum torque of 8.25 Nm. The addition of 10ml octane booster gets a minimum torque of 4.42 Nm and a maximum torque of 7.93 Nm. In addition, the addition of 15ml octane booster produces a minimum torque of 4.42 Nm and a maximum torque of 7.38 Nm.

The highest torque was 8.25 Nm at 6000 rpm with the addition of 5ml octane booster. Due to the low concentration of ethanol, so that oxygen levels are also low. The addition of 5ml of octane booster makes oxygen levels rise thereby increasing the octane number and the engine operates at a higher temperature without knocking. Optimal combustion temperature increases the thermal efficiency of the engine. So as to produce higher torque. Whereas without the addition of octane booster, the combustion temperature is less than optimal, as the risk of knocking increases. This reduces thermal efficiency and torque. So the combustion temperature can be too high or too low due to changes in combustion characteristics, reducing thermal efficiency and torque. Whereas excessive addition of octane booster can cause a chemical reaction that produces more deposits, reducing combustion efficiency and torque.

3. Fuel Consumption

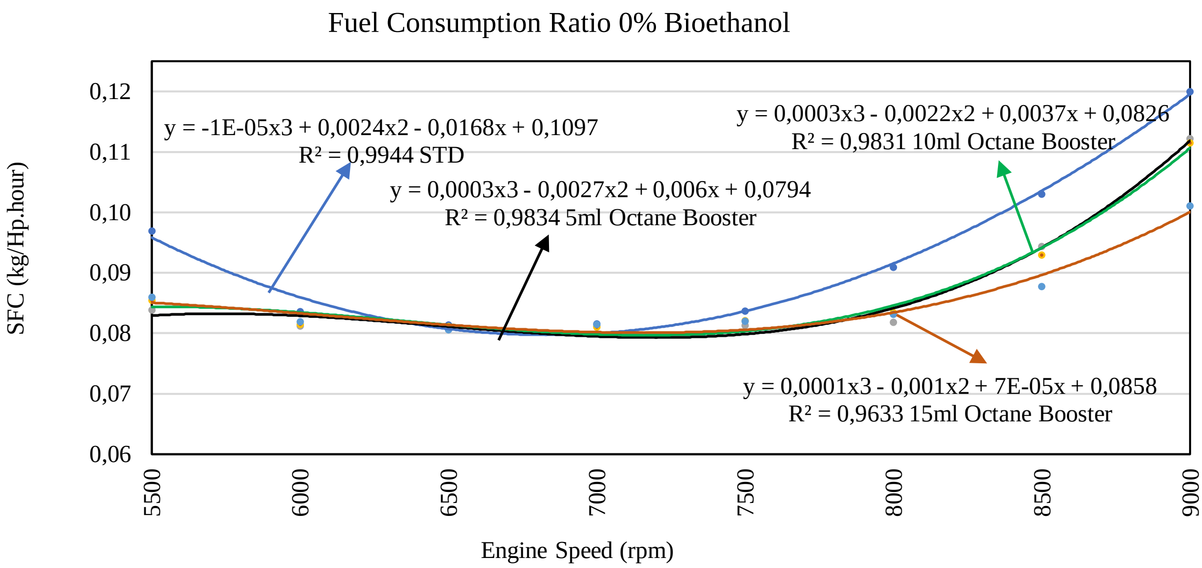

Figure 10. Fuel Consumption at Blend of Octane 92 with 0% Bioethanol

The relationship of fuel consumption obtained in the variation of rotation starts from 5500 rpm to 9000 rpm range of rotation every 500 rpm. Based on Figure 10, it can be seen that the standard fuel produces a minimum fuel consumption of 0.0813 kg/Hp.hour and a maximum fuel consumption of 0.1200 kg/Hp.hour. While for the addition of 5ml octane booster produces a minimum fuel consumption of 0.0806 kg/Hp.hour and a maximum fuel consumption of 0.1122 kg/Hp.hour. The addition of 10ml octane booster results in a minimum fuel consumption of 0.0815 kg/Hp.hour and a maximum fuel consumption of 0.1115 kg/Hp.hour. In addition, the addition of 15ml octane booster resulted in a minimum fuel consumption of 0.0806 kg/Hp.hour and a maximum fuel consumption of 0.1011 kg/Hp.hour.

The lowest fuel consumption is produced by adding 15ml of octane booster at 0.0806 kg/Hp.hour. Because increasing the octane number of fuel optimises combustion to achieve higher efficiency. With an optimised octane rating, the fuel burns more easily, thus getting more power from every drop of fuel, and effectively reducing fuel consumption.

The addition of an octane booster helps maintain an optimal air-fuel mixture ratio (stoichiometric ratio), which is important for efficient combustion. This contributes to optimal and efficient fuel combustion and reduced fuel consumption. Due to the high oxygen content in the fuel, the combustion process can produce more oxygen and result in low fuel consumption [13].

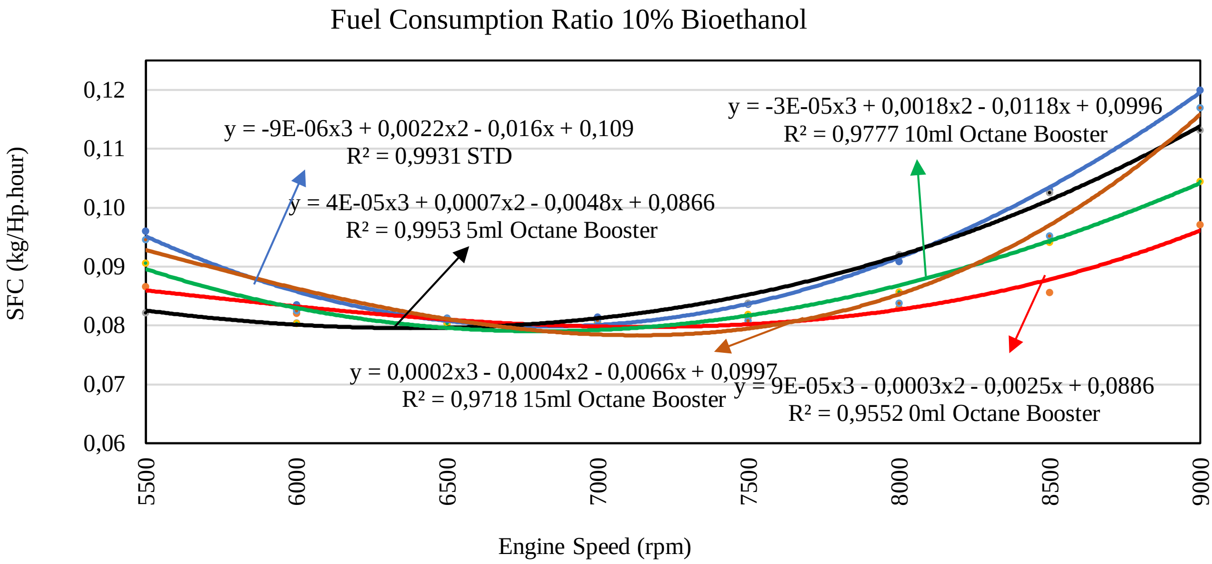

Figure 11. Fuel Consumption at Blend of Octane 92 with 10% Bioethanol

The relationship of fuel consumption generated at variations of rotation ranging from 5500 rpm to 9000 rpm range of rotation every 500 rpm. Based on Figure 11, it can be seen that the standard fuel gets a minimum fuel consumption of 0.0813 kg/Hp.hour and a maximum fuel consumption of 0.1200 kg/Hp.hour. While without octane booster mixture, the minimum fuel consumption is 0.0804 kg/Hp.hour and the maximum fuel consumption is 0.0971 kg/Hp.hour. For the addition of 5ml octane booster produces a minimum fuel consumption of 0.0804 kg/Hp.hour and a maximum fuel consumption of 0.1132 kg/Hp.hour. The addition of 10ml octane booster results in a minimum fuel consumption of 0.0804 kg/Hp.hour and a maximum fuel consumption of 0.1045 kg/hp. hour. In addition, the addition of 15ml octane booster resulted in a minimum fuel consumption of 0.0808 kg/Hp.hour and a maximum fuel consumption of 0.1170 kg/Hp. hour.

The lowest fuel consumption is produced without the addition of octane booster at 0.0804 kg/Hp.hour. This is because a higher power value will result in a decrease in fuel consumption, which leads to lower fuel consumption. This is in accordance with the fuel consumption formula, the higher the power value, the lower the fuel consumption value.

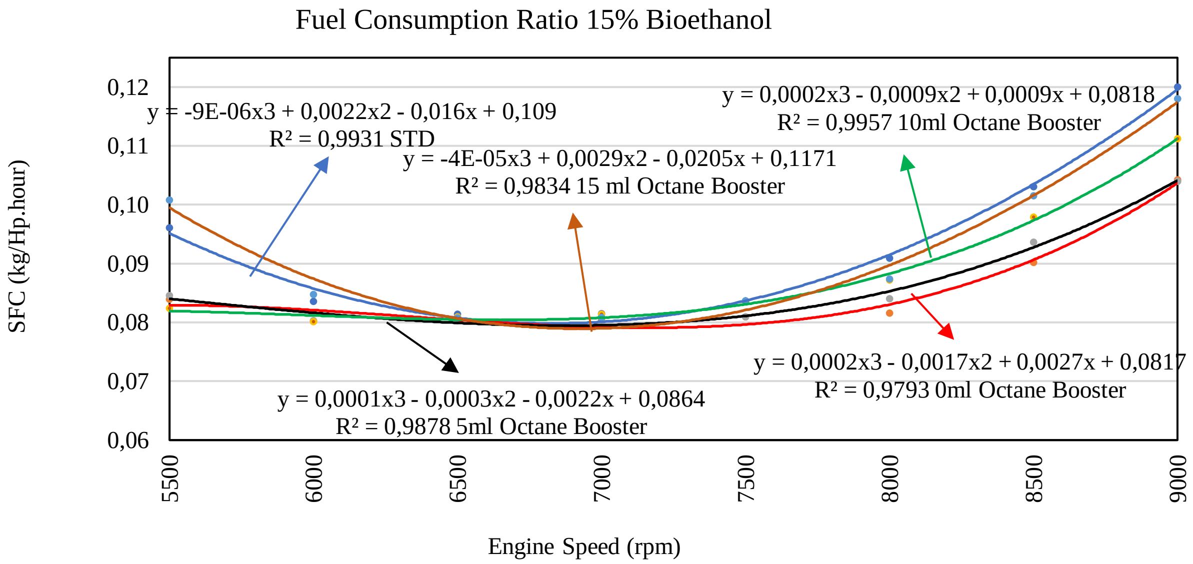

Figure 12. Fuel Consumption at Blend of Octane 92 with 15% Bioethanol

The relationship of fuel consumption obtained at variations of rotation ranging from 5500 rpm to 9000 rpm range of rotation every 500 rpm. Based on Figure 12, it can be seen that the standard fuel produces a minimum fuel consumption of 0.0813 and a maximum fuel consumption of 0.1200 kg/Hp.hour. While without octane booster mixture produces a minimum fuel consumption of 0.0802 kg/Hp.hour and a maximum fuel consumption of 0.1042 kg/Hp.hour. For the addition of 5ml octane booster produces a minimum fuel consumption of 0.0803 kg/Hp.hour and a maximum fuel consumption of 0.1040 kg/Hp.hour. The addition of 10ml octane booster results in a minimum fuel consumption of 0.0801 kg/Hp.hour and a maximum fuel consumption of 0.1112 kg/Hp.hour. In addition, the addition of 15ml octane booster obtained a minimum fuel consumption of 0.807 kg/Hp.hour and a maximum fuel consumption of 0.1180 kg/Hp.hour.

The lowest fuel consumption was produced by 0ml octane booster at 0.0802 kg/Hp.hour This is because a higher power value will result in a decrease in fuel consumption, which leads to lower fuel consumption. This is in accordance with the fuel consumption formula, the higher the power value, the lower the fuel consumption value.

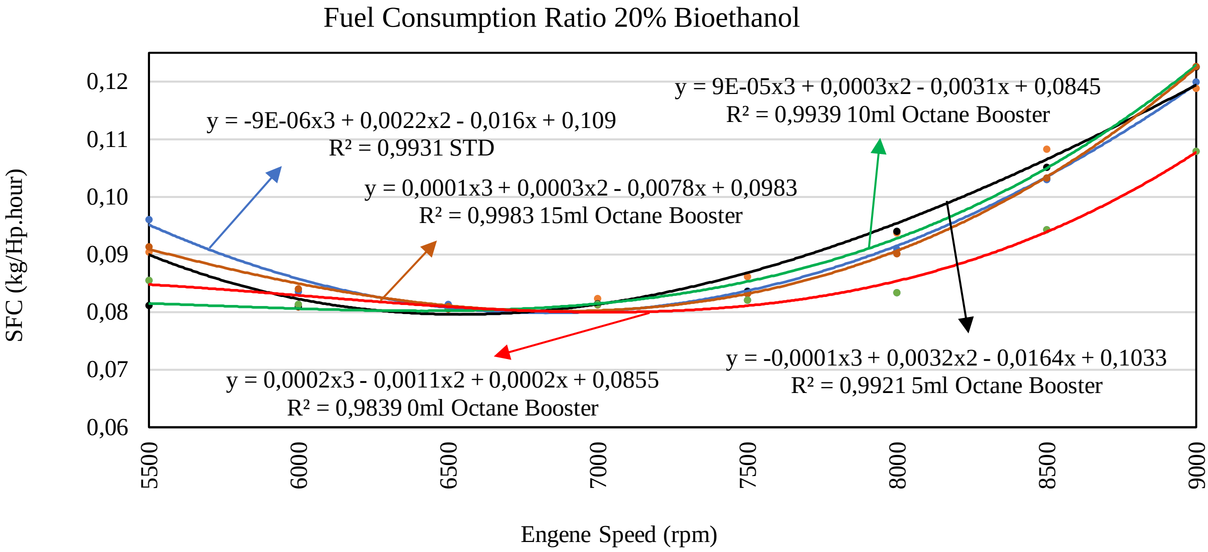

Figure 10. Fuel Consumption at Blend of Octane 92 with 20% Bioethanol

The relationship of fuel consumption generated at variations of rotation ranging from 5500 rpm to 9000 rpm range of rotation every 500 rpm. Based on Figure 13, it can be seen that the standard fuel gets a minimum fuel consumption of 0.08013 and a maximum fuel consumption of 0.1200 kg/Hp.hour. Whereas without octane booster mixture, the minimum fuel consumption is 0.0808 kg/Hp.hour and the maximum fuel consumption is 0.1079 kg/Hp.hour. For the addition of 5ml octane booster produces a minimum fuel consumption of 0.0805 kg/Hp.hour and a maximum fuel consumption of 0.1189 kg/Hp.hour. The addition of 10ml octane booster results in a minimum fuel consumption of 0.0806 kg/Hp.hour and a maximum fuel consumption of 0.1226 kg/Hp.hour. In addition, the addition of 15ml octane booster obtained a minimum fuel consumption of 0.0810 kg/Hp.hour and a maximum fuel consumption of 0.1226 kg/Hp.hour.

The lowest fuel consumption is obtained without the addition of octane booster at 0.0808 kg/Hp.hour. The reason is that a higher power value will result in a decrease in fuel consumption, leading to lower fuel consumption. This is in accordance with the fuel consumption formula, the greater the power value, the lower the fuel consumption value.

However, the use of 20% bioethanol will increase fuel consumption due to the higher percentage of bioethanol, this is due to too much oxygen entering the combustion chamber, slowing down the combustion process and causing incomplete combustion. According to [22] as the bioethanol mixture increases in a fuel, the need for fuel consumption in the combustion chamber also increases.

IV. Conclusion

The use of standard fuel obtained the highest power of 6.32 Hp at 7500 rpm while the use of 0% molasses with 5ml octane booster obtained the highest power results compared to other variations of molasses and octane booster which is 7.90 Hp at 8000 rpm. For standard fuel torque obtained 7.16 N.m at 6000 rpm while the use of 0% bioethanol with 15ml octane booster produces the highest torque compared to other variations which is 8.74 Nm at 6000 rpm. As for fuel consumption using standard fuel obtained the lowest fuel consumption of 0.0813 kg/Hp.hour at 6500 rpm While the use of 15% bioethanol with the addition of 0ml octane booster booster get the lowest consumption of 0.0804 kg/Hp.hour at 6000 rpm engine speed.

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