International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 11 Issue 3 ǁ March 2023 ǁ PP. 82-86

Effect of Pineapple Skin Bioethanol on 92 Octane Fuel and Engine Speed on Gasoline Engine Performance

[1]Yuniarto AgusWinoko, [2]Ageng Ryan Firmansyah
[1]*Department of Mechanical Engineering, Malang State Polytechnic, Malang State Polytechnic, Indonesia*
[2]*Department of Mechanical Engineering, Malang State Polytechnic, Malang State Polytechnic, Indonesia*
Corresponding Author:[2]Ageng Ryan Firmansyah (ryanageng4789@gmail.com)

Abstract
Bioethanol is an alternative fuel processed from plants. Bioethanol has an octane number (RON/Research octane number) of 108. Because bioethanol has a fairly high octane rating, it is necessary to conduct research on a mixture of bioethanol and fuel in order to obtain the correct octane rating for vehicles.
The purpose of this study was to analyze the effect of the percentage of bioethanol and variations in engine speed on fuel on engine performance (power, torque, and bmep). The research method was carried out by an experimental method. In this study, the observed data were power, torque, and bmep on various bioethanol mixtures and engine speed. Research data will be processed into graphs to determine the effect.
The conclusion of this study is the effect of adding bioethanol to fuel on engine performance, the highest power is 8.79 Hp at 7000 rpm engine speed, the highest torque is 9.08 Nm at 3000 rpm engine speed, the highest bmep value is 899.93 Kpa at 7000 engine speed rpm on the E10 mixture.
Keywords:*engine speed, bioethanol mixture, power, torque, bmep*

Date of Submission: 25-02-2023 Date of acceptance: 06-03-2023

I. INTRODUCTION

Contains: The increasing number of transportation vehicles in Indonesia is the cause of the increasing use of fuel oil and the rapid decline in fuel oil reserves. This fuel oil comes from petroleum and is a non-renewable natural resource. Therefore the use of alternative fuels is urgently needed to overcome the increasing use of fossil fuels [1].

One alternative fuel that can be used is bioethanol. Bioethanol can be made through fermentation and distillation processes using basic ingredients of vegetable waste in the environment. One of the vegetable wastes that can be used to produce bioethanol is pineapple skin waste.According toLubalu, Sutrisno, and Anggono (2017)the glucose content found in pineapple skin is 8.53%. The high glucose content in pineapple skin allows it to be used as an ingredient in ethanol production [2, 3].

In addition to the basic ingredients that are easy to obtain, bioethanol also has the characteristics of a fuel with a high octane rating and is environmentally friendly, so that when mixed with fuel that has an octane rating of 92 there will be an increase in the octane rating which will impact on engine performance. For this reason, a study was conducted on "The Effect of Pineapple Peel Bioethanol and 92 Octane Fuel on Gasoline Engine Performance" [4, 5].

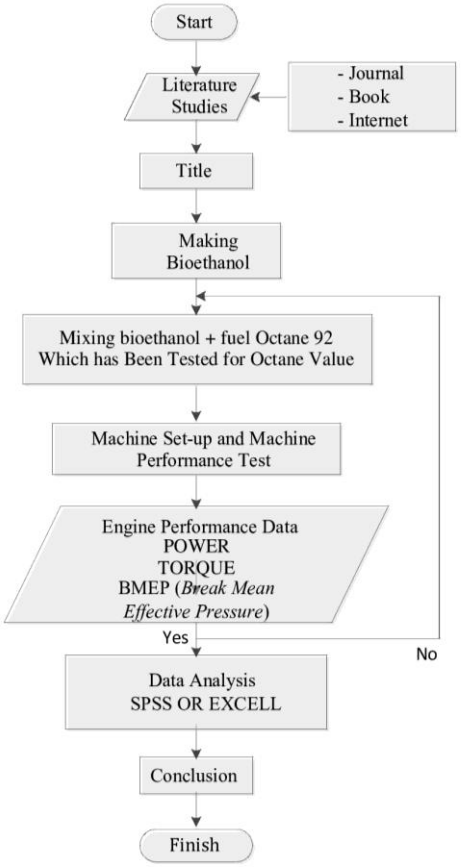
1.1Research variable

1. **Free Variables**
   The independent variable is the variable that affects the dependent variable, where the independent variable used in this study is a mixture of 10%, 15%, 20% bioethanol on 92 octane fuel and engine speed of 2000rpm, 3000rpm, 4000rpm, 5000rpm, 6000rpm and 7000rpm.
2. **Dependent variable**
   The dependent variables of this research are power, torque, and bmep (Break Mean Effective Pressure).

Testing is carried out on the system diagram as shown in the image above. The amount of power is obtained from measuring the motorcycle using a dynometer, when the motorcycle is driving on a roller dynometer. Power and torque testing is carried out using the full throttle method to obtain power results at each engine speed, for Bmep (Break Mean Effective Pressure) testing using manual calculations via Microsoft excel,

power, torque and bmep calculation tests are carried out at engine speed of 2000 Rpm, 3000 Rpm , 4000 Rpm, 5000 Rpm, 6000 Rpm and 7000 Rpm.

1.2 Research Flow



1.3Production of Bioethanol

1. **Pineapple Peel Collection**
   The collection of pineapple skin is carried out in stages, for 14 days with an amount of 4 to 5 kilograms per day. The total amount of pineapple skin used after being weighed was 58 kilograms. Pineapple skin is chopped into small pieces using a knife to simplify the grinding and weighing process.
2. **Grinding using a blender plus water**
   Grinding is done using a blender and water is added with a ratio of pineapple skin and water of 1:2 or 1kg of pineapple skin per 2 liters of water to get a crushed and smooth texture. The next process is filtering, carried out to separate the juice from the pulp of the pineapple skin.
3. **Fermentation**
   The fermentation process is carried out using a vacuum container and then stored and tightly closed in a place with minimal direct sunlight. Baker's yeast 30 grams added for one kilogram of pineapple skin. Fermentation was carried out for 11 days with room temperature parameters. This process is carried out at a pH of 5 and utilizes the bacterium Saccharomyces cerevisiae.
4. **Distillation**
   Distillation is a process of separating water and alcohol. Where the fermented liquid is heated in a container with a temperature of approximately 80ºC so that the alcohol boils and turns into steam which is then channeled into the cooling channel for the condensation process or turning the alcohol vapor into liquid. This process is carried out 5 times to achieve the desired alcohol content with a distillation temperature of approximately 80ºC. This is done because bioethanol has a boiling point (volatility) at 80ºC. Due to the length of the distillation process the author uses two distillators which are operated

simultaneously, the distillation process is carried out for approximately 12 hours every day for 99 consecutive days to obtain 3 liters of bioethanol with 90% alcohol content.

5. Measurement of alcohol content

In the first distillation process it was measured to produce bioethanol with a content of 33%, the second distillation was measured to produce bioethanol with a content of 70%, the third distillation was measured to produce bioethanol with a content of 82%, the third distillation was measured to produce bioethanol with a content of 87%, and the fifth distillation was measured to produce bioethanol with a content of 90%.

II. RESULT AND DISCUSSION

The research parameters were engine performance including power, torque and average effective pressure (bmep) with treatment using a mixture of Bioethanol and Pertamax fuel with a ratio of 0%:100%, 10%:90%, 15%:85%, 20%:80 %.

1. Power Test Data

Table 1.Average Power Change

Engine Speed (RPM)	STD	BE10	BE15	BE20	BE10-std	BE15-std	BE20-std
2000	0.04	0.04	0.04	0.04	0.00	0.00	0.00
3000	1.44	1.51	1.47	1.37	0.07	0.03	-0.07
4000	2.51	3.05	2.57	2.41	0.54	0.06	-0.10
5000	4.62	4.87	4.37	4.06	0.25	-0.25	-0.56
6000	6.73	6.99	6.65	6.63	0.27	-0.08	-0.09
7000	8.41	8.79	8.68	8.60	0.38	0.26	0.18

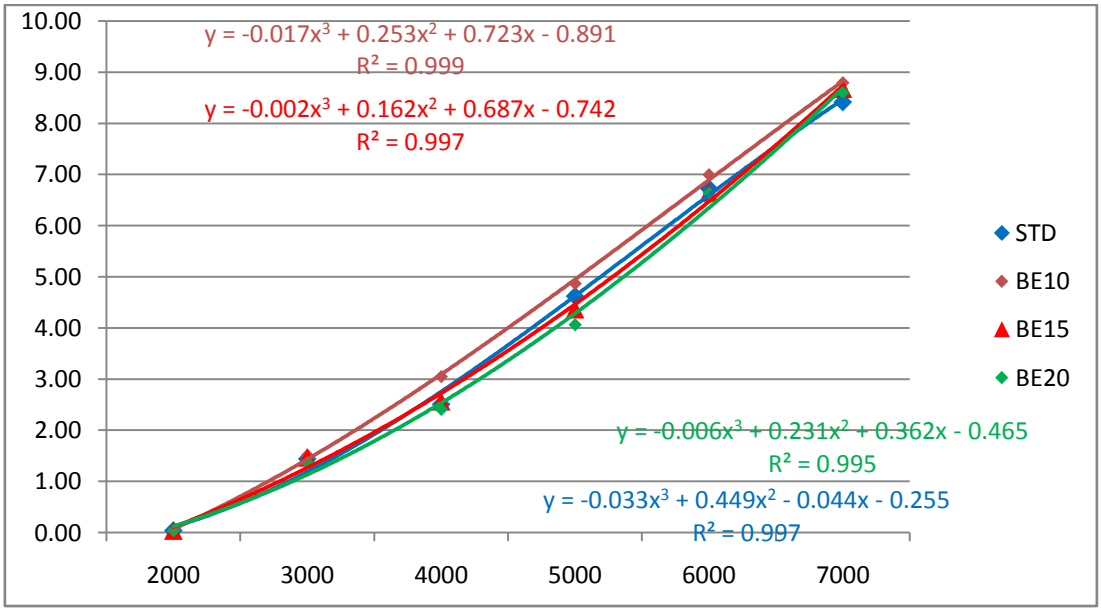


Figure 1. Graph of STD, BE10, BE15, and BE20 Average Power Data

Based on Figure 1 it can be seen that all the use of fuel with a mixture of bioethanol results in an increase in maximum power at 7000 rpm compared to the use of standard fuel. This shows that mixing bioethanol in fuel can increase the maximum power of the engine.

Of all the fuel testing data the best and produces the highest power is the BE10 mixture. As can be seen from the table and graph above, the BE10 fuel mixture has a steady increase in power from 2000 rpm to 7000 rpm and the highest power among other fuel mixtures is 8.79 Hp at 7000 rpm.

When using the BE15 fuel mixture, there was only an increase in power at 3000 rpm, 4000 rpm and 7000 rpm with a maximum power of 8.68 hp. When using the BE20 fuel mixture, there is only an increase in power at 7000 rpm which has a value of 8.6 hp. The lowest maximum power occurs when using 92 octane standard fuel without bioethanol mixture, namely 8.41 Hp at 7000 rpm.

2. Torque Test Data

Table 2. Changes in Average Torque

Engine Speed (RPM)	STD	BE10	BE15	BE20	BE10-STD	BE15-STD	BE20-STD
2000	0.12	0.24	0.16	0.12	0.12	0.04	0.00
3000	1.40	1.49	1.49	1.26	0.10	0.09	-0.14
4000	3.73	3.87	3.83	3.37	0.14	0.10	-0.36
5000	4.86	5.60	4.56	4.59	0.75	-0.29	-0.26
6000	8.02	8.19	7.86	7.77	0.16	-0.17	-0.26
7000	8.77	9.08	8.85	8.76	0.31	0.08	-0.01

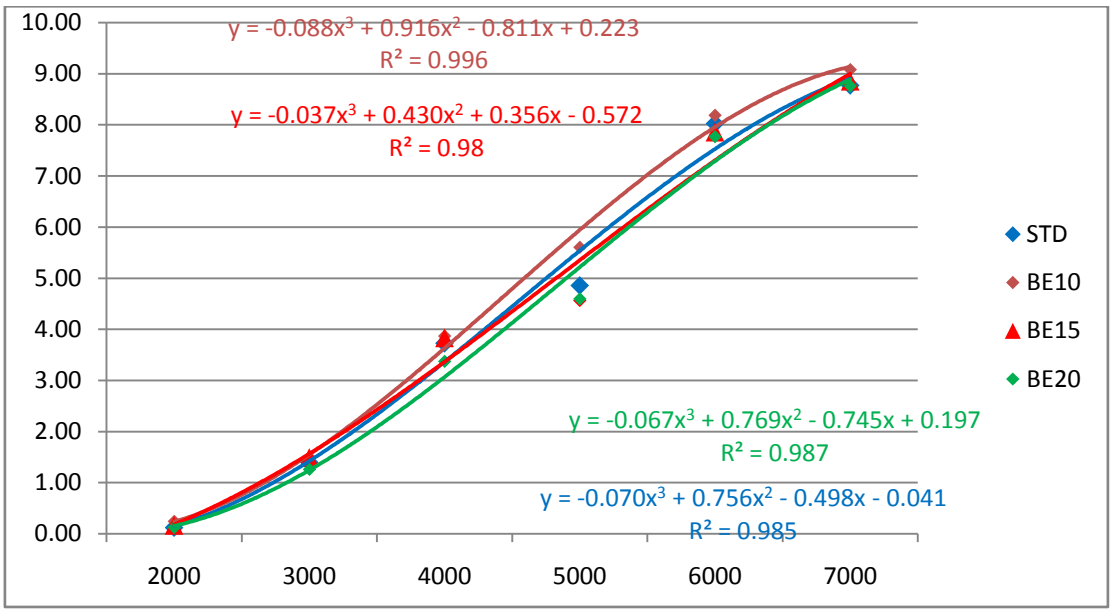


Figure 2. Graph of STD, BE10, BE15, and BE20 Average Torque Data

Based on Figure 4.2 it can be seen that the use of fuel with a mixture of BE10 and BE15 bioethanol results in an increase in torque compared to the use of standard fuel. In contrast to the use of BE20 fuel, which experienced a decrease in torque at each engine speed.

Of all the test data, the fuel that is the best and produces the highest torque is the BE10 mixture. As can be seen from the table and graph above, the BE10 fuel mixture has a stable torque increase from 2000 rpm to 7000 rpm and the highest torque among other fuel mixtures is 9.08 Nm at 7000 rpm.

When using the BE15 fuel mixture, there is only an increase in torque at 2000 rpm, 3000 rpm, 4000 rpm and 7000 rpm with a maximum torque of 8.85 Nm at 7000 rpm. When using the BE20 fuel mixture, there is a decrease in torque at each engine speed with a maximum torque of 8.76 Nm at 7000 rpm. The maximum torque when using standard 92 octane fuel without the bioethanol mixture is 8.77 Nm at 7000 rpm.

3. Bmep Test Data

Table 3. Changes in Average Bmep

Engine Speed (RPM)	STD	BE10	BE15	BE20	BE10-STD	BE15-STD	BE20-STD
2000	14.33	14.33	14.33	14.33	0.00	0.00	0.00
3000	344.00	361.52	351.17	327.28	17.52	7.17	-16.72
4000	449.11	546.46	459.86	431.79	97.35	10.75	-17.32
5000	662.20	697.56	625.89	582.41	35.36	-36.31	-79.79
6000	803.46	835.32	793.91	792.32	31.85	-9.56	-11.15
7000	861.37	899.93	888.33	880.14	38.56	26.96	18.77

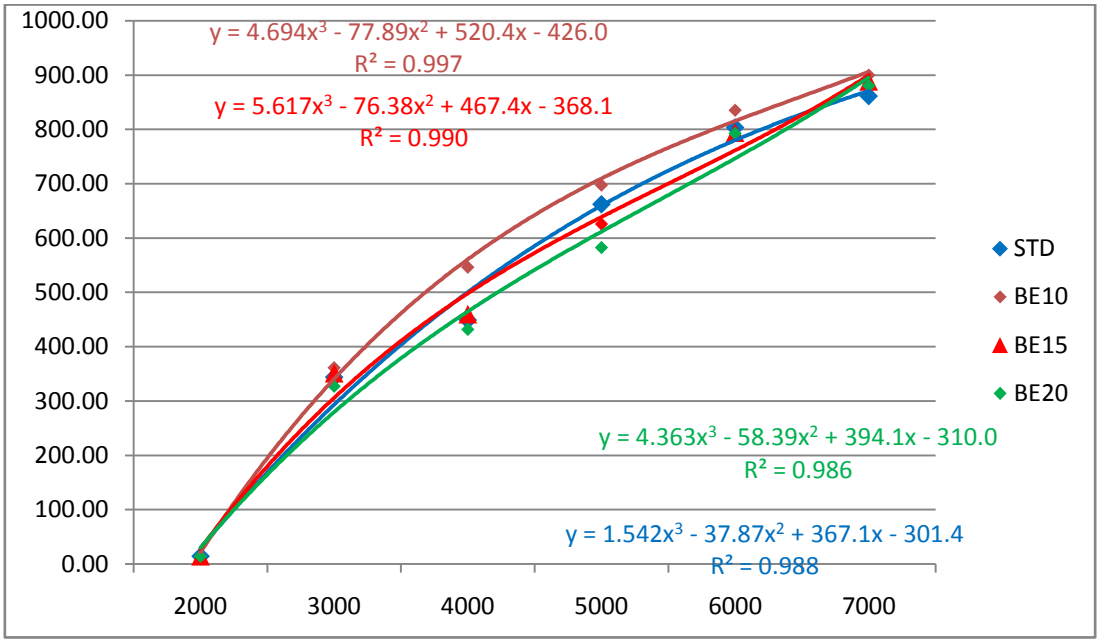


Figure 3. Graph of average Bmep data for STD, BE10, BE15, and BE20

Based on Figure 3 it can be seen that all the use of fuel with a mixture of bioethanol results in an increase in the bmep value at 7000 rpm compared to the use of standard fuel.

Of all the calculation data, the fuel that is the best and produces the highest power is the BE10 mixture. It can be seen from the table and graph above, the BE10 fuel mixture has a stable increase in bmep value from 2000 rpm to 7000 rpm and the highest bmep value among other fuel mixtures is 899.93 Kpa at 7000 rpm.

When using the BE15 fuel mixture, there was only an increase in bmep values at 3000 rpm, 4000 rpm and 7000 rpm with the highest bmep value of 888.33 Kpa at 7000 rpm. When using the BE20 fuel mixture, there was only an increase in bmep at 7000 rpm which has a value of 880.14 Kpa. The lowest maximum bmep value occurred when using 92 octane standard fuel without bioethanol mixture, namely 861.37 Kpa at 7000 rpm.

From the graph above, it can be concluded that the change in bmep or the average effective pressure on the engine increases significantly with an increase in power. The value of bmep or average effective pressure is generated from the power calculation, where the greater the power produced by the engine, the greater the resulting bmep value.

III. CONCLUSION

Based on the data from the tests that have been carried out, several conclusions can be drawn regarding the use of a mixture of pineapple peel bioethanol with 92 octane fuel as follows:

1. Mixing bioethanol with 92 octane fuel can increase power, torque, and bmep reaching a maximum point on the BE10 fuel mixture, but mixing bioethanol on top tends to have decreased power, torque and bmep values.
2. There is a significant change in power at each increase in engine speed, while torque and bmep tend to increase at engine speed of 2000 rpm to 6000 rpm and then decrease at above rotation. Mixing BE10 bioethanol with 92 octane fuel can increase power at 2000 rpm to 7000 rpm, but BE15 and BE20 mixtures tend to experience a decrease in power at each engine speed. Likewise the torque and bmep values produced for the BE10 mixture tend to be greater than 92 octane fuel without the bioethanol mixture at every engine speed. The BE15 and BE20 bioethanol mixtures experienced a decrease due to the ratio of fuel and air that was too low and the presence of water in the bioethanol.

REFERENCES

[1]. Kadi Arlianti, L. (2018). Bioethanol as a potential alternative green energy source in Indonesia. UNISTEK Journal of Science and Engineering Applications 5(1): 16-22.
[2]. Lubalu, Antonius Fernando, Teng Sutrisno, and Willyanto Anggono. (2017). Manufacture and Utilization of Pineapple Peel Bioethanol as a Mixture of RON 90 Fuel to Improve the Performance of the Supra X 125 FI Gasoline Motor Engine. Mechanova, 6.
[3]. Susanti, AD, et al. (2013). Making bioethanol from pineapple peel through hydrolysis with acid.EQUILIBRIUM ,10(2): 81-86.
[4]. Kurniati, Yuni, Iis Elfy Khasanah, and Kurniawati Firdaus. (2021). Study of Making Bioethanol from Pineapple Skin Waste (Ananas comosus. L). USU Journal of Chemical Engineering, 10: 95-101.
[5]. Susilo, Sugeng Hadi, and Angga Muhammad Sabudin. (2018). The Effect of Bioethanol–Pertamax 92 Mixture on Otto Motor Performance. Journal of Energy and Manufacturing Technology (JETM), 1: 21-26.