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The Variation of Fuel Mixture of Pertalite and Corncob Bioethanol on Engine Performance

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Abstract

Year by year, fossil fuels start to run out due to the increasing marketing of fuel due to the increasing number of vehicles in Indonesia. It is proven by the increase in fuel prices in Indonesia, which means that the available oil is running low. To overcome the excessive use of fossil waste, researchers use alternative materials which are recycled from waste or commonly called bioethanol. The purpose of making a fuel mixture is that in addition to materials that are easily available, bioethanol does not damage the surrounding environment because it uses materials that do not contain harmful substances, which can be recycled such as fruit peels or plant waste. The study method used is experimental, using a Yamaha Force 115cc motorcycle. Data is obtained directly by observing the analysis of experimental results and then concluding in the form of graphs and tables. This test uses a dynamometer to determine the power and torque produced, while for testing the rate of fuel consumption using a measuring burette, then the calculation of fuel consumption is carried out. The results showed that there were differences in power, torque, Bmep and fuel consumption produced by variations in fuel. For maximum power produced on E15 fuel of 6.47 hp and a maximum torque of 5.16 Nm. For the lowest power produced on E20 fuel of 5.67 hp and the lowest torque of 4.39 Nm. The lowest fuel consumption was found in the use of E10 fuel of 0.000338 kg/hP while the highest fuel consumption was produced by E20 fuel of 0.0000406 kg/hP. For the highest Bmep on E15 fuel of 11.91 Psi and the lowest on E20 fuel of 11.39 Psi

Keywords: *bioethanol; BMEP; power; torque*

1. INTRODUCTION

Indonesia has abundant natural resources in terms of both renewable and non-renewable [1,2]. However, it is noted in terms of non-renewable natural resources such as petroleum, which are experiencing a dwindling availability. According to the Central Statistics Agency (BPS), the value of Indonesia's oil exports in May 2020 decreased by 75.76 percent to US$19 million from US$78.4 million in May 2019, this was due to the rapid increase in the number of transportation vehicles [3,4], so that the oil needed Indonesian society is increasing. To reduce the risk of unavailability of petroleum, it is necessary to have a solution. An example that the government has started to do in tackling it is bioethanol [5,6]. Bioethanol is a form of renewable energy that can be produced from plants such as starch-containing materials such as grains (wheat), potatoes, tapioca, corn and others. Pertalite fuel mixed with bioethanol greatly affects engine performance, power, torque, and fuel consumption [7]. Then the research conducted by M. Prayetno et al concluded, the highest torque value produced on fuel that has been mixed with bioethanol is at a composition of 12% is 9.61 Nm, at 1000 RPM engine speed. For Pertalite fuel mixed with 12% bioethanol, namely: 7.60 HP seen from the highest power results in pure partalite fuel and 12% bioethanol [8,9]. Corn (Zea Mays) is one of the carbohydrate-producing food crops which is a staple food in Indonesia, in

addition to wheat and rice. Based on data from the Central Statistics Agency in 2015, corn production in 2014 was 19,008,426 tons [10,11]. This figure increased by 496.57 thousand tons compared to 2013 [12,13]. Corn contains 80% carbohydrates and starch is generally in the form of a mixture of amylose and amylopectin [14]. In corn, most or all of the starch is amylopectin.

2. METHODS

In this study, a 4-stroke motor vehicle tested using bioethanol as fuel. Tools used for retrieval The data is dynotest with variable engine speed ranging from 2500 rpm to 9500 rpm. The data obtained after testing are power, torque, fuel consumption specifications, and BMEP. The following are the steps of the research carried out at the time of data collection.

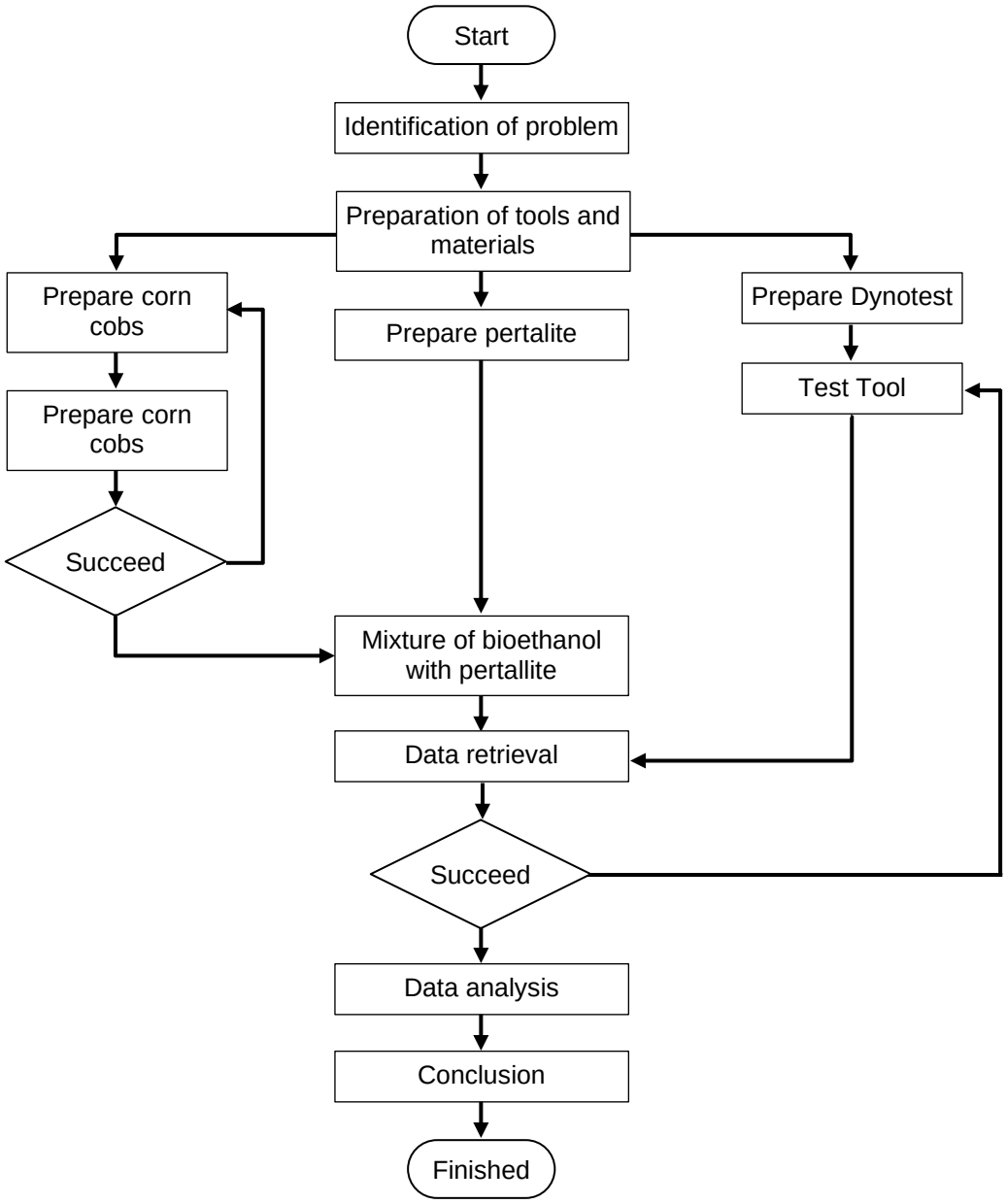


Figure 1. Research Procedure

The basic material used for the manufacture of bioethanol is corn cobs. The corncobs are then mashed, and the water is taken for fermentation for ±7 days. After doing the fermentation, do the distillation to take the ethanol.

Figure 2. Corncob

Figure 3. Corncob fermentation after being mashed and filtered

Figure 4. Corncob fermented distillation

Figure 5. Ethanol from corncobs

The tools used for data collection are dynotest and fuel consumption specification tools.

Figure 6. Mixing fuel and ethanol

Figure 7. Dynotest tool

Figure 8. Perform power and torque tests

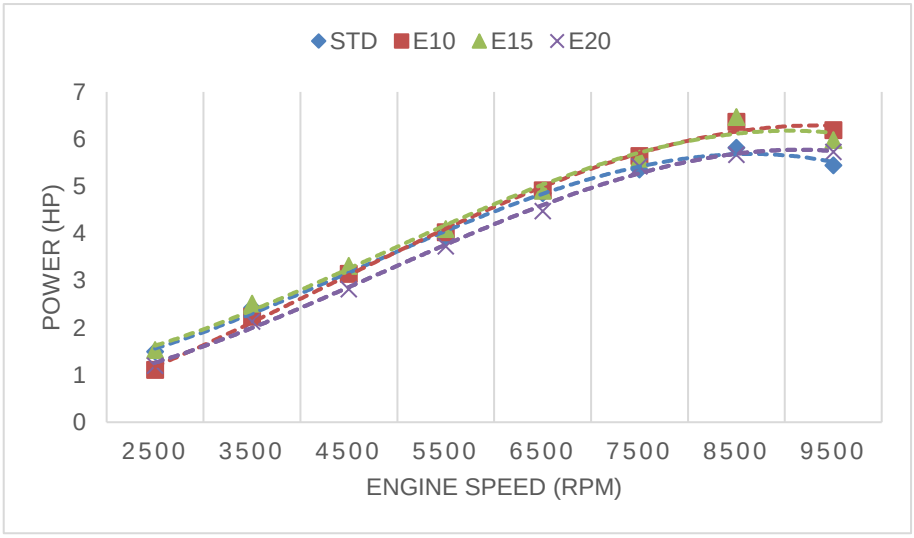
3. RESULT AND DISCUSSION

Data collection is carried out according to predetermined variables.

Table 1. Power test results

ACTUAL SPIN (RPM)	Power (hP)			
	E0	E10	E15	20
2500	1.5	1.11	1.53	1.2
3500	2.43	2.24	2.52	2.14
4500	3.18	3.15	3.32	2.82
5500	3.94	4.03	4.1	3.73
6500	4.86	4.92	4.91	4.48
7500	5.36	5.64	5.59	5.43
8500	**5.82**	**6.37**	**6.47**	**5.67**
9500	5.45	6.19	5.98	5.73

The use of E15 fuel produces the highest power than other fuels of 6.47 hP at 8500 rpm engine speed while the lowest power is found on E20 fuel of 5.67 hP at 8500 rpm engine speed.



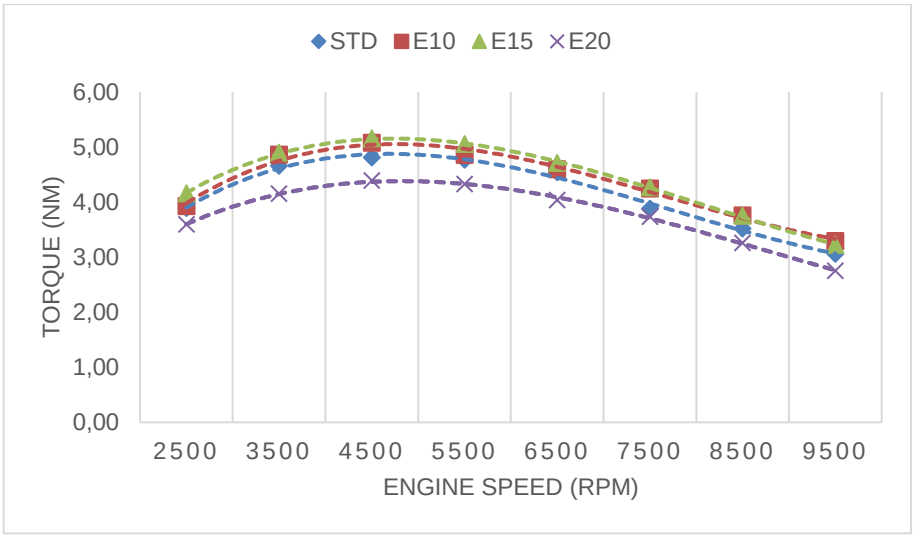
Graphic 1. Power comparison

In graphic 1, the average results of the four conditions E0, E10, E15, and E20 both have increased power at 2500 rpm engine speed to 8500 rpm rotation, this happens because the throttle valve opens wide as the speed increases. engine so that a lot of fuel and air enters. But at 9500 rpm the power produced decreases because the piston works very fast so that there is a mixture of fuel that has not been burned and the piston friction is getting bigger. E10, E15, and E20 fuels contain more oxygen than E0. Oxygen itself helps the fuel mixture become denser and combustion is complete. The increase in engine performance is because ethanol fuel has a higher-octane value compared to gasoline because it has around 30% oxygen molecules so that the combustion speed becomes faster (Nazaruddin Sinaga et al, 2017). However, in E20 fuel the power produced decreases due to the increasing water content. As a result, the engine temperature becomes lower and premature combustion occurs (knocking). Ethanol has a high heat of vaporization. This means that when the ethanol evaporates, it will require greater heat, where this heat will be absorbed from the cylinder so it is feared that the peak temperature will be low. In fact, for combustion to occur efficiently, the engine temperature should not be too low (Tunas Aditya, 2017: 22).

Table 2. Torque test results

ACTUAL SPIN (RPM)	Torque (Nm)			
	E0	E10	E15	E20
2500	3.89	3.92	4.16	3.59
3500	4.66	4.86	4.90	4.15
4500	**4.81**	**5.08**	**5.16**	**4.39**
5500	4.77	4.85	5.06	4.33
6500	4.54	4.60	4.71	4.04
7500	3.88	4.25	4.27	3.74
8500	3.52	3.79	3.75	3.26
9500	3.06	3.29	3.22	2.75

The use of E15 fuel produces the highest torque of 5.16 Nm and the lowest torque is obtained 4.39 Nm on E20 fuel at each engine speed of 4500 rpm.

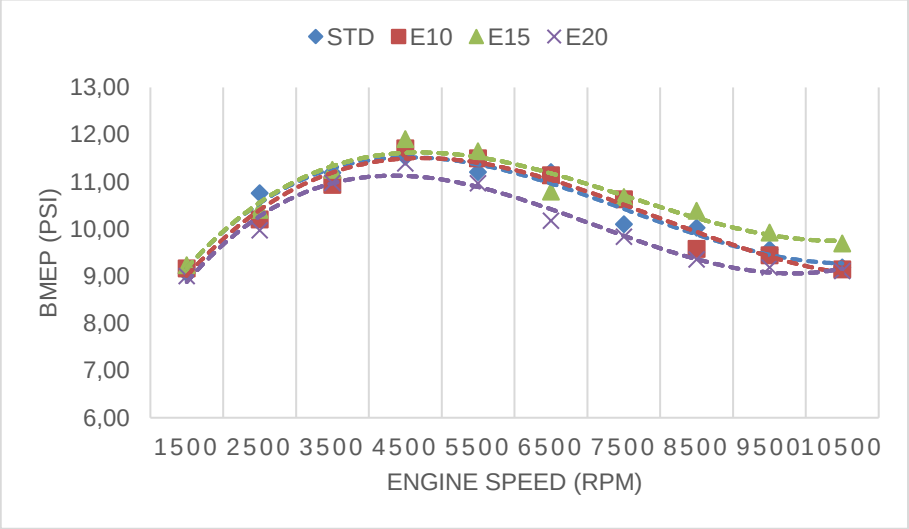


Graphic 2. Torque comparison chart

Graphic 2 shows the average results of the four conditions E0, E10, E15, and E20 both have increased torque from 2500 rpm to 4500 rpm, then decreased relatively significantly to 9500 rpm high speed. The torque at E0 and E10 has increased where the torque obtained is respectively 4.81 Nm for E0 and 5.08 Nm for E10 fuel, this is because the E10 fuel contains oxygen rather than E0. Oxygen itself can help the fuel mixture to become denser and the combustion to be complete. The increase in engine performance is because ethanol fuel has a higher-octane value compared to E0 with an oxygen content of about 30% so that the combustion speed becomes faster (Nazaruddin Sinaga, 2017). The increase in torque is caused by an increase in the octane number of the fuel. With this increase in octane number, the combustion pressure and temperature are higher so that the combustion energy produced will also be greater and the combustion process more complete so that the energy from combustion can be utilized optimally to produce torque (Mulyono, 2019). However, on E20 fuel, the torque produced decreases due to the increasing water content. As a result, the engine temperature becomes lower and premature combustion occurs (knocking). Ethanol has a high heat of vaporization. This means that when the ethanol evaporates, it will require greater heat, where this heat will be absorbed from the cylinder so it is feared that the peak temperature will be low. In fact, in order for combustion to occur efficiently, the engine temperature should not be too low (Tunas Aditya, 2017: 22).

Table 3. BMEP test results

ACTUAL SPIN (rpm)	Bmep (Psi)			
	E0	E10	E15	E20
2500	10.76	10.21	10.41	9.98
3500	11.20	10.94	11.25	10.98
4500	11.54	11.71	11.91	11.39
5500	11.21	11.50	11.65	10.97
6500	11.21	11.14	10.80	10.18
7500	10.10	10.63	10.68	9.84
8500	10.03	9.58	10.39	9.36
9500	9.57	9.45	9.92	9.19



Graphic 3. BMEP variation

In the graph above, it can be concluded that the fuel mixture variation has a network output of constant pressure with the highest result being E15 fuel of 11.91 Psi at 4500 rpm engine speed and the lowest being E20 fuel of 11.39 Psi at 4500 rpm engine speed. For low engine speed up to 4500 rpm engine speed, the resulting output starts to rise, this happens because the piston performance is still not fast so that the friction that occurs is still small. For the graph from medium to high rpm, it slowly decreases because the net output performance of the piston is getting faster, resulting in large friction.

4. CONCLUSION

Reviewing the results of research on the effect of bioethanol on engine performance to answer the research objectives, the following conclusions have been obtained.

1. There is an effect of adding corncob bioethanol in fuel on the performance of the 115cc engine, namely increasing and decreasing power and torque. For power the resulting changes are not significant and for torque changes significantly.
2. There is an effect of bioethanol on power where at each engine speed of 8500 the highest power is obtained at 6.47 hp on E15 fuel and the lowest power of 5.67 hp on E20 fuel.
3. There is an effect of bioethanol on torque where at each engine speed of 4500 the highest torque is 5.16 Nm on E15 fuel and the lowest torque is 4.39 Nm on E20 fuel.
4. For the highest Bmep on E15 fuel of 11.91 Psi and the lowest on E20 fuel of 11.39 Psi

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