Analysis of the use bioethanol-pertalite mixtures in motorcycles on fuel consumption efficiency

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Abstract Indonesia is one of the countries in the world that depend on fossil fuels. Fossil fuels are non-renewable fuels. The increasing use of fossil fuels causes fossil fuel reserves to dwindle, there is a need for alternative fuels, the use of alternative fuels is the right solution, alternative fuels that have been developed include bioethanol. The research method used in this study used pure pertalite data as a comparison, then continued with a mixture of bioethanol and pertalite with a variety of bioethanol and pertalite mixtures used were 10ml bioethanol 90ml pertalite, 20ml bioethanol 80ml pertalite, and 30ml bioethanol 70ml pertalite. variations of engine speed used 1000, 2000, and 3000 RPM. Then the fuel consumption data analysis was carried out on the engine. The results of the research conducted will get results for RPM 1000 with 10 ml bioethanol content, there will be less fuel consumption than pure pertalite as well as 20 ml. In the 3000 RPM Round with 10 ml bioethanol content, the fuel consumption is more efficient than pure pertalite, the same thing with bioethanol with 20 ml levels, the fuel consumption is less than pertalite.

1. Introduction
Indonesia is one of the countries in the world that is dependent on fossil fuels which are used for industrial equipment and transportation, especially motorbikes. Fossil fuels are non-renewable fuels that take millions of years to renew these fuels. The decline in air quality, depletion of petroleum reserves, and the impact of global warming are the results of the increasing use of fossil fuels. the use of alternative fuels is the right solution to address the use of fossil fuels. Alternative fuels that have been developed include bioethanol. Various types of alternative fuels have been developed in recent times, including biomass [1], biofuel [2], biogas [3], and bioethanol. [4] Bioethanol is one of the easiest alternative fuels to manufacture. Bioethanol can be produced from various types of materials such as glucose, starch, and other materials. The ease of finding bioethanol raw materials has led to the popularity of bioethanol compared to other alternative fuels. However, the ingredients for making bioethanol are generally the main food ingredients or fruits which are also food ingredients. To avoid competition between food and energy materials, in recent years many bioethanol products made from agricultural waste have been developed such as durian seeds [5], banana peels [6], bagasse [1], Cempedak [7], pineapple peels [8], and others. Suprapto [9] explain that ability of the combustion engine is influenced by several factors, one of which is the quality of the fuel used.
in the combustion process. The use of fuel of poor quality can result in the performance of the combustion engine, the use of low-quality fuel causes more fuel consumption because the energy produced in one combustion process is very small. One way to improve the quality of the fuel is by mixing the fuel with bioethanol.

2. Materials and Methods
This research was carried out in March-June 2021 at the Mechanical Engineering Laboratory and Chemical Laboratory, Bangka Belitung University.

2.1 Materials
Cherries fruit and pineapple peels from Bangka, Indonesia, sulfuric acid (H\textsubscript{2}SO\textsubscript{4}, Merck, 99%), sodium hydroxide (NaOH, Merck), distilled water, \textit{Saccharomyces cerevisiae} (Saf-Instant), standard ethanol (7.9%), Pertalite from PT Pertamina Indonesia.

2.2 Equipment and Instrumentation
The equipment used in this research are: digital scales, blender, glassware, magnetic stirrer, pH meter, furnace, pycnometer, a set of distillation apparatus, centrifuge, Oswald viscometer, alcohol refractometer. The instruments used for bioethanol analysis is Gas Chromatography (GC).

The equipment used for testing the consumption of a mixture of pertalite and bioethanol fuels is the Jupiter Z1 115cc engine stand (Yamaha), air pressure system fuel pump, fuel measuring cup, stopwatch, tachometer, and thermometer.

![Figure 1. Fuel consumption test equipment](image)

2.3 Method
2.3.1 Bioethanol Productions
150 grams each cherries fruit and pineapple peels were cleaned. 600 mL of water was added and blended. The mixed slurry to 100 mL of 3% H\textsubscript{2}SO\textsubscript{4} then heated at the temperature of 100\(^\circ\)C and stirred. After that, the solution was cooled to room temperature. To condition the pH 4-5, NaOH was added. Add 10% yeast solution and sugar as nutrients, then put the solution in a closed container. Ethanol that use in this study was prepared by basic concept of ethanol production [10] as follows Fig. 2.
2.3.2 Fuel consumption test

This research was conducted with pure pertalite, a mixture of bioethanol and pertalite, with three variations of 10%, 20%, and 30% bioethanol. Tests were carried out on engine variations with 1000, 2000, and 3000 RPM in 10 minutes.

3. Results and Discussion

Bioethanol production from cherry fruit and pineapple peel is carried out through four main stages, namely the preparation of raw materials, fermentation, as well as purification and testing of bioethanol. The hydrolysis stage aims to increase the glucose levels present in the material before the fermentation process is carried out. Hydrolysis is a reaction between water and reactants to break down carbohydrate/starch polymer chains into glucose monomers [11]. Glucose from hydrolysis will be converted into ethanol in the fermentation process. The better the hydrolysis process is carried out at the preparation stage, the higher the ethanol content produced at the fermentation stage. Hydrolysis was carried out with the addition of a 3% sulfuric acid catalyst. Acid catalyst in the hydrolysis process serves as a reaction accelerator because the hydrolysis reaction with water is slow[11]. Fermentation aims to convert glucose into ethanol. Incubation was carried out with variations in time for 3 days, the results obtained as shown in Table 1.
Bioethanol from the production is then used in fuel consumption test. The test of the mixture of pertalite and bioethanol fuel in this study using a 115cc Jupiter Z1 engine stand. This research was conducted to determine whether the fuel mixture of bioethanol and pertalite affect the efficiency of fuel consumption. Based on the study of the effect of a mixture of pertalite and bioethanol with three comparisons of variation, the following results:

### Table 1. Physical properties of bioethanol produced

| Ethanol content | Physical properties |
|----------------|--------------------|
| 68.807%        | Density (g.cm\(^{-1}\)) 0.938 | Viscosity (cps) 1.664 |

### Table 2. Fuel consumption of 100% pertalite

| Engine speed (RPM) | Fuel consumption (liter/hour) | starting temperature (°C) | Final temperature (°C) |
|--------------------|------------------------------|----------------------------|------------------------|
| 1000               | 0.420                        | 38                         | 90                     |
| 2000               | 0.432                        | 37                         | 115                    |
| 3000               | 0.474                        | 38                         | 128                    |

### Table 3. Fuel consumption of 90% pertalite and 10% bioethanol

| Engine speed (RPM) | Fuel consumption (liter/hour) | starting temperature (°C) | Final temperature (°C) |
|--------------------|------------------------------|----------------------------|------------------------|
| 1000               | 0.422                        | 39                         | 91                     |
| 2000               | 0.430                        | 38                         | 117                    |
| 3000               | 0.474                        | 38                         | 128                    |

### Table 4. Fuel consumption of 80% pertalite and 20% bioethanol

| Engine speed (RPM) | Fuel consumption (liter/hour) | Starting temperature (°C) | Final temperature (°C) |
|--------------------|------------------------------|----------------------------|------------------------|
| 1000               | 0.398                        | 37                         | 98                     |
| 2000               | 0.402                        | 38                         | 120                    |
| 3000               | 0.450                        | 38                         | 139                    |

### Table 5. Fuel consumption of 70% pertalite and 30% bioethanol

| Engine speed (RPM) | Fuel consumption (liter/hour) | Starting temperature (°C) | Final temperature (°C) |
|--------------------|------------------------------|----------------------------|------------------------|
| 1000               | 0.354                        | 38                         | 112                    |
| 2000               | 0.390                        | 37                         | 132                    |
| 3000               | 0.438                        | 39                         | 141                    |
Table 1–5 show that the amount of fuel consumption decreased along with the addition of the fuel mixture ratio, the fuel mixture ratio of 30% bioethanol and 70% pertalite had the lowest fuel consumption value of 0.438 liters/hour, but along with the increase in fuel efficiency. There is a negative thing from the use of a fuel mixture, that increase in engine temperature. It can be cause damage to the engine and the oil that dries up due to the increase in engine temperature. Mourad [12] mentioned that gasoline was blended with ethanol showed a clear reduction in pollutants emitted from the engine 13.7% for carbon monoxide and 25.2% for hydrocarbons as well as fuel consumption by 8.22%. However, the engine power was negatively impacted and could reach up to 11.1% for the fuel blends.

4. Conclusion
From the results of this study, it can be concluded that the addition of a mixture of bioethanol and pertalite fuels affects the consumption of the resulting fuel. The increase in the ratio of the fuel mixture causes the consumption of the resulting fuel to be lower, but there is a significant increase in engine temperature which adversely affects the engine.

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