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The Effect of a Mixture Bioetanol and 92 Octane Fuel on Motorcycle Exhaust Gas Emissions

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ABSTRACT

High concentrations of pollutants from incomplete combustion of motor vehicles have an impact on the surrounding environment and the health of living things. Incomplete combustion as a result of the design of the combustion chamber and the type of fuel used that does not correspond to its compression ratio. To improve the octane value of the fuel can be mixed bioethanol, because this alternative fuel is environmentally friendly. The purpose of knowing how much the change in the emission values of CO, HC, O2 and CO2 when using 92 octane fuel, and 95. additionally determines the change when using 92 octane fuel mixed with bioethanol 5, 15, 25%. The method of mixing fuel with bioethanol using splash blending method and exhaust emission testing based on dynamic method when the engine speed of 1250 to 9000rpm to obtain data. The result is a change in emissions of 0.07% CO, 16ppm HC, 2.3% CO2 and 0.2% oxygen at Octane 92, the change in emissions was 0.32 CO, 54ppm HC, 1.54% CO2 and 0.44% O2 when using BE25% fuel mixed with 95octane.

Keywords: Bioetanol, Bahan Bakar Oktan 92, Emisi Gas Buang, Sepeda Motor, Campuran Bahan Bakar

1. INTRODUCTION

The increase in the number of vehicles operating on the roads, especially motorbikes, increases every year, this condition causes a depletion of the amount of available fuel reserves. This condition requires a solution to overcome it. Apart from that, when a motorbike is in operation, an incomplete combustion process occurs which can worsen the living environment and cause human health to be disturbed.

One alternative fuel that can improve the combustion process for motorbikes is bioethanol, which is made by means of a fermentation and distillation process using vegetable waste or vegetable waste which contains very abundant carbohydrates or glucose and has the potential to pollute the environment. high makes it possible to use it as an ingredient for making ethanol [1]. The characteristics of fuel with a high octane value and environmental friendliness, when mixed with fuel that has an octane value of 92, there will be an increase in the octane value which has an impact on exhaust emissions[2].

A number of studies have shown that the use of bioethanol can reduce emissions of harmful gases such as CO and NOx. For example, a study by Johnson et al. [3] evaluated the effect of an E10 blend (10% bioethanol and 90% gasoline) and found a significant reduction in CO emissions at standard engine operating conditions. On the other hand, Lopez and colleagues [4] used an E20 blend and noted improvements in combustion efficiency as well as reductions in NOx and HC emissions.

Furthermore, [5] applied spectroscopic techniques to measure emission levels and found that increasing bioethanol concentration led to a decrease in particulate levels. This research uses exhaust gas analysis methods with a sophisticated spectrometer, which provides insight into combustion dynamics under different conditions. Additionally, [6] conducted a dynamic simulation study on the E30 blend and found that it provides better performance in terms of emissions when compared to pure gasoline, using the AVL BOOST simulation model.

Methods often used in this research include field testing using a dynamometer to assess the emission output of motorbikes operating under various operating conditions [7]. Statistical analysis was then used to evaluate the collected data, as described in the study by [8] which examines the long-term effects of bioethanol use on emissions.

Further studies [9] incorporated thermodynamic modeling techniques to predict the effect of changes in fuel composition on emission characteristics. At the same time, [10] emphasized the importance of understanding the physicochemical characteristics of bioethanol that influence combustion and emissions in his research using thermogravimetric analysis.

Some studies also involve the development of prototype emission sensors for real-time monitoring, [11], where nano-technology based sensors are developed to detect specific gases directly from the exhaust. This shows the

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evolution of methodology in research related to bioethanol mixtures.

While most studies show positive results, there are also challenges faced, including variability in bioethanol quality and its impact on performance consistency and emissions [12], [13]. The study by [14] highlights the need for standardization of bioethanol quality to maximize emission reduction potential.

In the context of regulation and policy, [15] conducted an in-depth policy analysis to evaluate the impact of fuel regulations on bioethanol adoption and the resulting national emissions. They used econometric models to predict future changes in emissions patterns from motorcycles.

The use of bioethanol as fuel can be used to improve the process, considering that its calorific value is quite high, this fuel can improve the combustion process through the combustion process. Apart from that, bioethanol is able to reduce exhaust emissions by up to 18% [16], [17], so this condition has an impact on reducing exhaust emissions and increasing engine performance. Increasing the octane value will certainly speed up the combustion process because this condition will change the characteristics of the fuel. Its characteristic is self-ignition of the fuel, meaning that when the temperature of the fuel and air mixture rises high enough, it will burn itself without the need for a spark plug when the fuel is injected into the combustion chamber. Apart from that, the compression ratio is high. Engines that use fuel with a high octane value can reduce engine performance [18], [19].

2. RESEARCH SIGNIFICANCE

Research on the effect of a mixture of bioethanol and 92 octane gasoline on motorbike exhaust emissions is very important because it can provide in-depth insight into the potential for reducing pollutants originating from motorized vehicles. With increasing global awareness of the problems of climate change and air pollution, the use of alternative fuels such as bioethanol is becoming increasingly relevant. This study aims to identify how different proportions of bioethanol in the fuel mixture can affect the type and amount of emissions released by motorbikes. It is hoped that the results of this research can be used by policymakers to develop stricter emissions standards and by vehicle manufacturers to design more efficient and environmentally friendly engines.

3. RESEARCH METHODS

a) Type of Research

Testing the laboratory experimental method for mixing fuel with bioethanol using the splash blending method, while testing exhaust gas emissions using the dynamic test method.

b) Research Place

This testing was carried out at the state polytechnic of malang and VEDC workshops.

c) Population and Sample

The population is 3 (three) times for each round change

d) Research Variables

There are 2 (two) variables in the research, namely independent and dependent,

• The independent variable is a variable that influences the dependent variable, where in this study the independent variable is the type of 92 octane and 95 octane fuel with a mixture of 5%, 15% and 25% bioethanol and the engine speed is stationary speed, 1250 to 9000 with a range 1000rpm.

4. RESULTS AND DISCUSSION

Figure 1 and 2 show test data from exhaust emissions testing using 92 octane fuel, in addition to a mixture of 92 octane fuel mixed with 95% bioethanol content and 5% water.

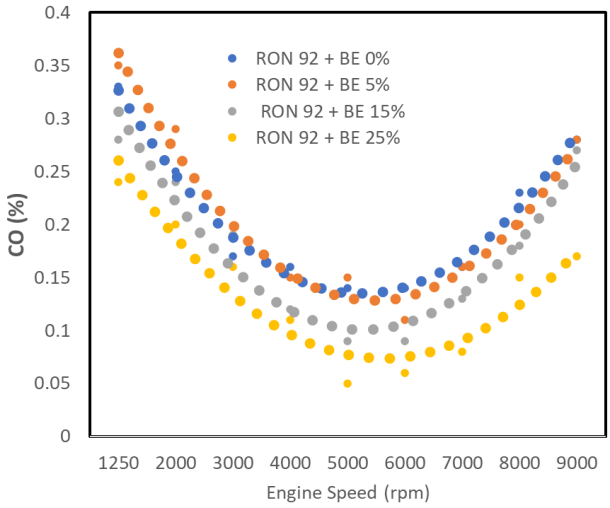

Fig 1. Test results of the RON 92 mixture on BE at rotation speed (rpm) on CO exhaust emissions

Figure 1 shows that in general, increasing the bioethanol content in fuel tends to reduce the level of CO emissions at most of the rpm conditions tested. At 1250 rpm, CO emissions show a decrease from 0.33 (0% bioethanol) to 0.24 (25% bioethanol). A similar pattern is seen at higher speeds, where CO emissions at 9000 rpm decrease from 0.28 (0% bioethanol) to 0.17 (25% bioethanol).

Specifically, at lower rpm such as 1250 and 2000, the addition of bioethanol even in small amounts (5%) shows an increase in CO emissions, but at higher concentrations (15% and 25%), CO emissions decrease significantly compared to gasoline pure. For example, at 5000 rpm, a 25% bioethanol mixture provided the most significant reduction in CO emissions, from 0.14 (0% bioethanol) to 0.05.

Optimal conditions for reducing CO emissions are achieved at a bioethanol concentration of 25%, which consistently provides the lowest values at almost all rpm levels, especially at high rpm. However, the effectiveness of bioethanol mixtures in reducing CO emissions tended to increase with increasing bioethanol content, indicating that the 25% bioethanol level was the most effective among the conditions tested in this study.

From the analysis of this table, it can be concluded that the use of bioethanol as a fuel mixture in motorbikes has great potential in reducing CO pollution, with a concentration of 25% bioethanol as the most profitable option to achieve maximum efficiency in reducing emissions. This shows the

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importance of further developing and optimizing the use of bioethanol in fuel to support efforts to reduce exhaust emissions in vehicles.

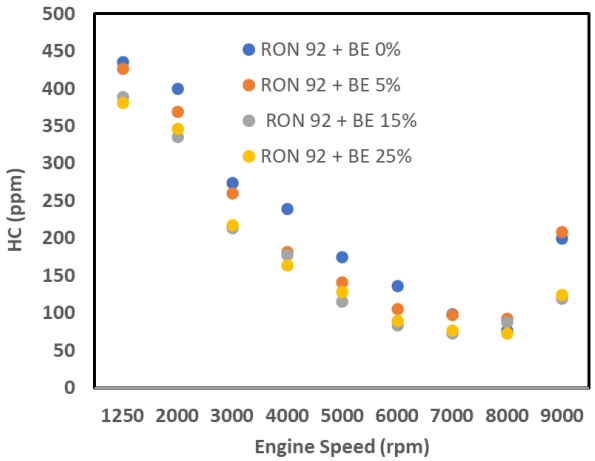

Fig 2. Test results of the RON 92 mixture on BE at rotation speed (rpm) on HC exhaust emissions

Fig 2 show that a pattern will usually be seen that with increasing bioethanol content, HC emissions tend to change. In general, bioethanol is known to help reduce HC emissions because it burns cleaner than pure gasoline. At a concentration of 5%, there may be a slight reduction in HC emissions, indicating the effectiveness of bioethanol in reducing this pollutant even in low proportions. When the concentration is increased to 15%, there could be a significant further reduction in HC emissions, indicating that this could be the optimal point at which bioethanol works effectively for certain engine operating conditions without negatively affecting performance.

However, at 25%, the results may be different. Sometimes, a further increase in bioethanol content can cause problems such as a decrease in the available energy in the fuel, which in turn can cause the engine to not operate as efficiently as it should, which may not always result in a further reduction in HC emissions or even an increase in emissions due to an imbalance in air-fuel mixture. Therefore, although 25% bioethanol may show lower performance in reducing HC compared to 15%, this suggests that this proportion may exceed the point where bioethanol provides optimal benefits for HC emission reduction.

From this analysis, it can be concluded that a bioethanol proportion of around 15% may be optimal for reducing HC emissions from motorbikes, while a concentration of 25% may be considered the maximum limit at which the benefits of reducing emissions begin to diminish or become ineffective. Further research is needed to optimize the mixture and verify these findings across different engine types and operating conditions.

5. CONCLUSIONS

The effect of a mixture of bioethanol and 92 octane fuel on motorbike exhaust emissions shows that the use of bioethanol as a mixture in 92 octane fuel has significant potential in reducing exhaust emissions. Bioethanol, as a more environmentally friendly fuel, helps reduce carbon monoxide (CO) and hydrocarbon (HC) content in exhaust gases, which are the main contributors to air pollution. The bioethanol mixture in 92 Octane fuel produces more efficient combustion, increases fuel oxidation, and reduces emissions of harmful pollutants without significantly reducing engine performance.

Furthermore, the addition of bioethanol to fuel also affects the combustion temperature and the formation of carbon dioxide (CO_2), which can help reduce the negative impact of motorized vehicles on the environment. These findings support the policy of using alternative fuels to achieve a cleaner environment and demonstrate the potential of bioethanol in meeting stricter emissions standards. This study recommends the continued development of bioethanol blends in motorbike fuel to reduce vehicle carbon footprints and support environmental sustainability.

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7. AUTHOR CONTRIBUTIONS

Conception and design: Agus Dani,
Methodology: Yuniarto Agus Winoko
Data acquisition: Santoso,
Analysis and interpretation of data: Listiyono
Writing publication: Agus Dani,
Approval of final publication: Yuniarto Agus Winoko
Resources, Listiyono
Supervision: Yuniarto Agus Winoko, Santoso, Listiyono

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