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# ANALIZA PARAMETRÓW EMISJI MOTOCYKLI NAPĘDZANYCH EKO-PALIWAMI

**Streszczenie:** Obecnie, paliwa kopalne mają znaczący wpływ na środowisko, gdyż są one główną przyczyną globalnego ocieplenia oraz zmian klimatycznych. Zatem, ważnym zadaniem jest rozwój paliw alternatywnych, które w perspektywie wieloletniej zapewnią zrównoważony rozwój. W tym aspekcie, bioetanol jest obiecującym paliwem ze względu na cechę odnawialności oraz własności ekologiczne. W artykule, omówiono przypadek gdzie bioetanol był mieszany z benzyną i używany do napędu pojazdów osobowych (SOV). Przydatność bioetanolu oceniano poprzez moc, moment obrotowy oraz poziom emisji. Zastosowano następujące proporcje mieszania tzn. 5%, 10%, 30% oraz 50% zawartości bioetanolu. Wyższa zawartość bioetanolu (50%) w mieszaninie oznaczała spadek parametrów w porównaniu do zawartości 5%, zwłaszcza przy wysokich obrotach silnika. Mieszanina E5 charakteryzowała się najwyższą mocą oraz wartością momentu obrotowego. Jednakże, spalanie mieszanki bioetanolu i benzyny powoduje nieznaczny wzrost emisji CO2, podczas gdy emisja innych substancji pozostaje na stabilnym niższym poziomie.

**Słowa kluczowe:** analiza, rodzaje emisji, paliwa

# ANALYSIS OF EMISSION PARAMETERS OF MOTORCYCLES IN THE APPLICATION OF SUSTAINABLE FUELS

**Summary:** Today, fossil fuels are having a major impact on the environment as they are the main cause of global warming and climate change. It is therefore desirable to develop alternative fuels that are sustainable in the long term. Bioethanol is a promising fuel due to its renewable and ecological properties. In this paper, bioethanol was blended with gasoline and used to power a single-occupancy vehicle. The performance of bioethanol was defined by power, torque and emissions. The blend proportions were 5%, 10%, 30%, and 50% bioethanol content. Higher bioethanol content (50%) in the blend meant lower performance compared to 5%, especially at higher engine speeds. The E5 blend had the highest power and torque values.

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However, burning a blend of bioethanol and petrol resulted in a slight increase in CO2, while other emissions were steadily lower.

**Keywords:** analysis, emissions, fuels

## 1. Introduction

Biofuel is a promising energy source that can reduce CO2 emissions from transport vehicles. Renewable agricultural resources such as corn, potato, sugarcane are widely used as substrates for bioethanol production [1,2]. Ethanol is a compound that is used in various fields ranging from the chemical industry to the food industry. The reason for the growth of the ethanol market today is its use as a fuel [3]. Ethanol as a biofuel component is blended into gasoline, and this proportion is expected to increase gradually up to the maximum technological limit. Fourteen EU countries have introduced gasoline with an E10 label (10% bio-based content), which further reduces emissions from gasoline-powered cars and helps countries meet their targets for increasing the share of renewable energy. The aim of the scientific paper was to analyse the effect of alternative fuels with different biocomponent content in the petrol blend on the performance and emission parameters of the experimental engine.

## 2. Material and methods

In this study, bioethanol testing (torque and power) on a motorcycle was conducted on an engine running at 4000 to 8000 rpm. The torque and power testing was measured using a dynamometer test. Meanwhile, emission testing was carried out at engine speeds of 500 to 4000 rpm using a gas analyzer. Testing was carried out with different fuel blends of bioethanol and gasoline (5%, 10%, 30%, 50%). After fuel blending, a performance test was performed on a 125cc Yamaha motorcycle. Torque and power testing using DYNOJET i250 dynamometer.

## 3. Experimental results a discussion

Figure 1 shows the power output produced at different speeds and different fuel mixtures.

The highest power generated was over 6 Kw at 7500 rpm using E5 fuel. Subsequently, the parameters deteriorated with the use of E10. With the use of higher bioethanol content the performance parameters stabilized but were slightly lower than with E5. The analysis shows that the biofuel contributes to an increase in performance by improving the resistance to detonation, but it is necessary to increase the compression ratio for the changes to have a real effect. [4,5]

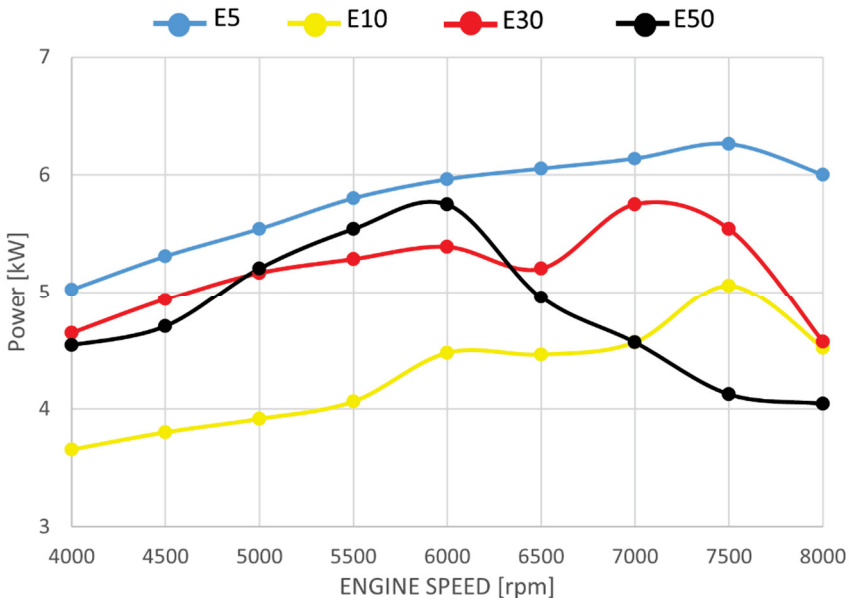


*Figure 1. Performance at different fuel mixtures*

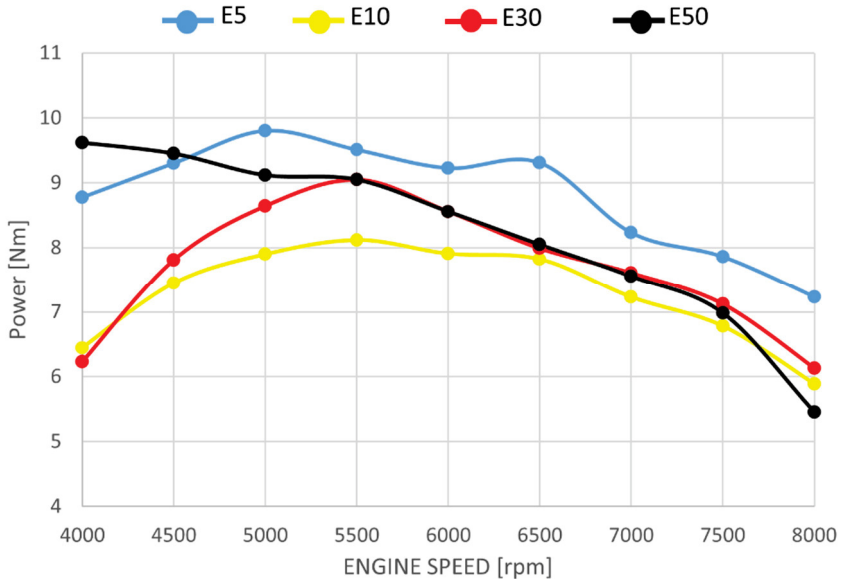


*Figure 2. Torque waveform for different fuel mixture*

Figure 2 shows the variation of torque with engine speed for a blend of bioethanol and gasoline. Overall, the bioethanol-gasoline blends should produce higher torque results than pure gasoline. [7,9]

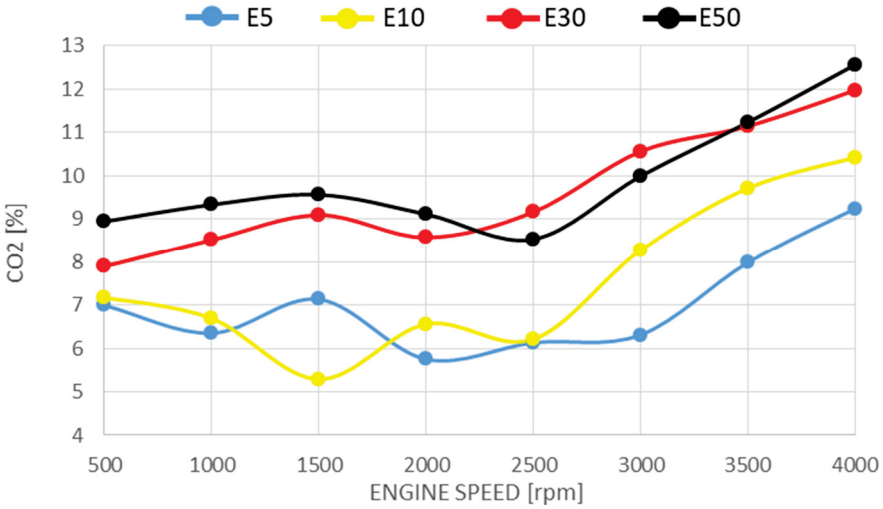


*Figure 3. Analysis of CO2 emissions*

This is done for several reasons, one of which is that oxidized fuel allows for better fuel combustion results, which leads to increased torque. In addition, mixtures of bioethanol and gasoline have a higher oxygen content, this can cause more efficient combustion than pure gasoline. A large torque is required for good acceleration, therefore the moment of inertia when the crankshaft rotates is greater, leading to more efficient fuel consumption.[5,6]

The measurement results of the CO2 content of the exhaust gases at engine speeds from 500 to 4000 are shown in Figure 3. More CO2 emissions are produced by a mixture of bioethanol and gasoline compared to pure gasoline. The higher the engine speed, the higher the CO2 emission production. Based on the graph, the CO2 emission content of bioethanol-gasoline blends is higher than that of pure gasoline and increases with the amount of bioethanol used. The highest CO2 emission content was obtained in the E30 blend. [1,7] While the lowest CO2 content was achieved in E5 blends. The increase in CO2 emission is due to the higher oxygen content in the fuel blend [4].

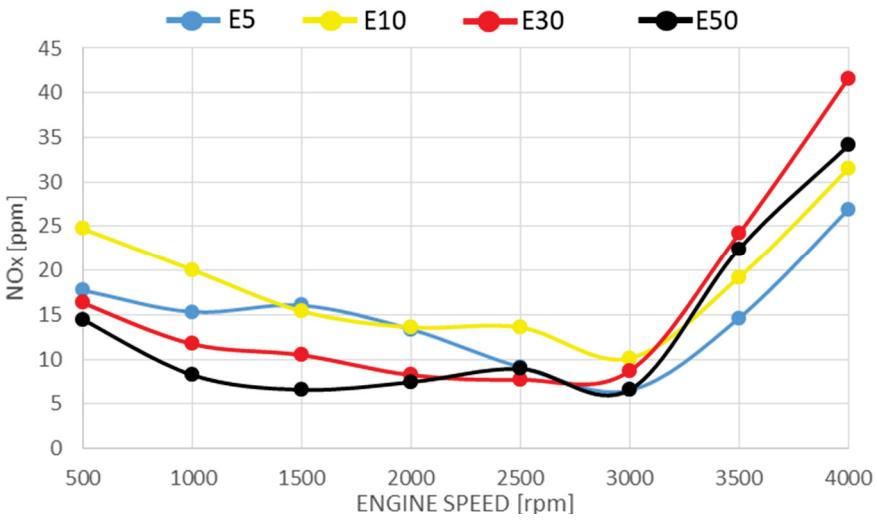


*Figure 4. NOx emission analysis*

The effect of engine speed on NOx emissions is shown in Figure 4. The NOx compound is a combination of nitric oxide (NO) and nitrogen dioxide (NO2) formed by the reaction of nitrogen gas and oxygen in the air during combustion. Flame burning temperature, oxygen concentration and combustion duration are three important parameters that affect NOx formation [4]. Figure 4 shows the trend of higher engine speed leading to less NOx emissions produced, then the NOx content increased again with increasing engine speed. NOx emissions from all bioethanol/gasoline blends are generally lower than those of pure gasoline. The lowest NOx values were obtained in the E30 and E50 blends. [3,9]

## 4. Conclusion

This study successfully investigated the performance of bioethanol-gasoline blends. Bioethanol should provide higher fuel performance, which was confirmed by the analyses. [4,5,8] The problem was that the fuel blend had a different specific gravity and therefore different mixing with air. Another significant change is the improvement of the anti-dentonation properties, which at a certain compression ratio and standard fuel map caused a temporary drop in performance parameters. In other words, the fuel performance was not utilized by the engine design. To fully exploit the potential of the fuel mixture, it is necessary to increase the compression ratio and modify the fuel map. [1,2,3]

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