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The Effect of Active Carbon from Coconut Shell as an Adsorbent on Motorcycle Exhaust Gas Emissions and Engine Performance

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Abstract

This study investigates the advantages of using active carbon as a catalyst, including its deodorizing and color adsorption properties, its ability to act as a purifying agent, common adsorbent, and permeable membrane. Additionally, active carbon exhibits strong binding power to substances that are physically or chemically separated. The objectives of this research are to compare the exhaust gas emissions of motorcycles before and after the application of an adsorbent on the muffler and to analyze the effects of active carbon derived from coconut shell on the engine speed of carbon monoxide (CO), and hydrocarbons (HC). The experimental approach involved conducting laboratory experiments with varying masses of active carbon to collect data. The independent variables were the mass of active carbon and the engine speed, while the dependent variables were the emissions of CO, and HC. The results indicated that using 200 grams of active carbon derived from coconut shell as an adsorbent resulted in a 12.06% decrease in CO emissions, and a 16.96% decrease in HC emissions.

Keywords: Active Carbon, Exhaust Gas Emissions, Coconut Shell

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INTRODUCTION

The growing concerns over environmental pollution and the adverse effects of exhaust gas emissions from vehicles have prompted extensive research on the development of effective catalysts and adsorbents. In this context, this study aims to investigate the effect of active carbon derived from coconut shell as an adsorbent on motorcycle exhaust gas emissions and engine performance. Active carbon has demonstrated several advantageous properties, including its deodorizing, color adsorption, and purifying capabilities. Furthermore, it acts as a common adsorbent and permeable membrane while exhibiting strong binding power to substances during physical or chemical separation processes.

Previous studies have explored the use of various materials as catalysts and adsorbents to mitigate exhaust gas emissions. [1] investigated the use of activated carbon derived from coconut shells as an adsorbent to reduce vehicle exhaust emissions. The results showed that the use of activated carbon from coconut shells can reduce the concentration of harmful exhaust gases such as carbon monoxide (CO) and unburned hydrocarbons (HC) in motor vehicle exhaust. In addition, engine performance also increases with the use of activated carbon as an adsorbent. [2] evaluated the effect of activated carbon derived from coconut shells on motorcycle engine performance. Experimental results show that the addition of activated carbon from coconut shells to motorcycle fuel can increase combustion efficiency and reduce fuel consumption. In addition, emissions of harmful exhaust gases such as nitrogen oxides (NOx) and carbon dioxide (CO2) are also significantly reduced by using activated carbon as a fuel additive.

[3] explored the use of activated carbon derived from coconut shells as an adsorbent for processing motorcycle exhaust gases. The results showed that activated carbon from coconut shells is effective in adsorbing harmful components in exhaust gases such as particulates and volatile organic compounds (VOCs).

[4] conducted experiments using activated carbon from coconut shells to reduce CO2 emissions in internal combustion engines. The results of the study showed a reduction in CO2 emissions of up to 15% with the use of activated carbon. [5], [6] investigated the use of activated carbon from bark as a catalyst in the steam reforming process for hydrogen production. This study shows that activated carbon from bark can increase the efficiency of converting hydrocarbons into hydrogen. [7], [8] conducted research on the use of activated carbon from coconut shells as an adsorbent to reduce nitrogen oxide gas (NOx) emissions in diesel engines. The results showed that activated carbon can reduce NOx emissions by 30%.

[9], [10] studied the use of activated carbon from bamboo powder in lithium ion batteries. The results showed that bamboo activated carbon can increase the capacity and stability of lithium ion batteries. [4], [11] conducted an experiment to evaluate the use of activated carbon from clam shells as an adsorbent to reduce carbon monoxide (CO) emissions in internal combustion engines. This research shows a 25% reduction in CO emissions. [7], [12], [13] investigated the use of activated carbon from agricultural waste as an adsorbent to reduce sulfur dioxide (SO2) emissions in industry. The results showed a reduction in SO2 emissions by 40%.

[14] conducted research on the use of activated carbon from coffee husk waste as an adsorbent in air filters to reduce dust particle emissions. This study shows a reduction of dust particles by 50%. [15], [16] investigated the effect of using activated carbon on motor vehicle exhaust emissions. The research was conducted by testing various compositions of activated carbon in gasoline-powered motor vehicles. The research results show that the use of activated carbon can reduce exhaust emissions significantly. There is a reduction of 20% in CO2 emissions and 15% in NOx emissions. In addition, negative effects on motor performance can be minimized by using the right activated carbon. This study provides evidence that activated carbon can be an effective solution in reducing motor vehicle emissions.

[17], [18] used highly porous activated carbon as a flue gas absorbent. Experimental studies were carried out by varying the size and composition of activated carbon in gasoline engines. The results showed that the use of highly porous activated carbon can increase combustion efficiency and reduce exhaust emissions produced by motors. There is a 10% increase in fuel efficiency and a 25% reduction in CO emissions. These findings demonstrate the potential of using highly porous

activated carbon as a solution to improve motor performance and reduce exhaust emissions. [19] developed activated carbon from recycled materials to reduce motor vehicle emissions. The activated carbon production process involves recycling waste biomass into an effective adsorbent. Experimental studies show that recycled activated carbon can reduce CO2, NOx, and HC emissions in motor vehicle exhaust. In addition, the use of recycled activated carbon also has a positive impact on the environment by reducing biomass waste. This research demonstrates the potential of recycled activated carbon as an environmentally friendly alternative in overcoming the problem of motor vehicle emissions.

[20] reduced diesel particulate emissions by using modified activated carbon. Activated carbon is modified with the addition of a catalyst to increase the absorption efficiency of diesel particles. The research results show that the use of modified activated carbon can reduce diesel particulate emissions by up to 40%. In addition, the performance of the motor also remains optimal with the use of this modified activated carbon. This research provides evidence that modified activated carbon can be an effective solution in reducing harmful diesel particulate emissions. [21] studied the use of activated carbon from waste cellulose nanofibril fibers in the development of composite materials for sound absorbing applications. The results showed that activated carbon cellulose nanofibrils can improve the soundproofing ability of composite materials. [22] conducted research on the use of activated carbon from algae biomass as an adsorbent to reduce methane gas (CH4) emissions in the agricultural industry. The research results showed a 20% reduction in CH4 emissions. [23] studied the use of activated carbon from coconut shells as an electrode material in supercapacitors. This study shows that coconut shell activated carbon has a high energy storage capacity and good cycle stability. Coconut shells are abundant agricultural waste products with potential applications in various industries due to their high carbon content and porous structure. Several studies have explored the use of coconut shell-derived active carbon in different applications, including water purification, gas adsorption, and energy storage. However, its potential as an adsorbent for exhaust gas emissions from motorcycles remains relatively unexplored.

The implications of this research are significant in terms of both environmental sustainability and technological advancements. By utilizing active carbon from coconut shell as an adsorbent, this study seeks to provide insights into reducing motorcycle exhaust gas emissions, particularly CO, HC, and CO2, which are known contributors to air pollution and climate change. The findings of this study may contribute to the development of cost-effective and eco-friendly solutions for improving air quality and mitigating the environmental impact of motorized transportation.

Moreover, the utilization of coconut shell waste as a raw material for active carbon production offers a sustainable approach to waste management and resource utilization. This research has the potential to promote the utilization of agricultural by-products, thereby reducing waste accumulation and creating economic opportunities in coconut-producing regions.

This study aims to investigate the effect of active carbon derived from coconut shell as an adsorbent on motorcycle exhaust gas emissions and engine performance. By building upon previous research on catalysts and adsorbents, this study explores the potential of coconut shell-derived active carbon as a cost-effective and eco-friendly solution. The implications of this research extend to environmental sustainability, waste management, and resource utilization, making it a valuable contribution to the field of exhaust gas emission control and automotive engineering.

METHOD

The materials used in this study included active carbon derived from coconut shell, which served as the adsorbent, and a motorcycle equipped with an exhaust system for the collection of exhaust gas samples. The active carbon was prepared by a standardized method involving carbonization and activation processes.

The experimental procedure involved laboratory experiments conducted under controlled conditions. The exhaust gas emissions were measured before and after the application of the active carbon adsorbent on the muffler of the motorcycle. The engine speed was controlled and adjusted for each experimental run.

The independent variables in this study were the mass of active carbon and the engine speed, while the dependent variables were the emissions of carbon monoxide (CO), hydrocarbons (HC), and carbon dioxide (CO2). The engine speed was varied within a predetermined range to observe its effect on the emissions. The emissions were measured using appropriate gas analyzers and sensors.

To collect the necessary data, exhaust gas samples were taken at regular intervals during the experimental runs. The samples were then analyzed to quantify the concentrations of CO, and HC using established analytical techniques. The collected data were presented in charts and tables for further analysis.

The experiments were conducted in replicates to ensure the reliability and accuracy of the results. Care was taken to maintain consistent experimental conditions and minimize any potential confounding factors.

Overall, this study employed laboratory experiments with active carbon derived from coconut shell as the adsorbent to investigate its effect on motorcycle exhaust gas emissions and engine performance. The materials and methods utilized in this research aimed to provide reliable data for evaluating the efficacy of the adsorbent and understanding the relationship between the independent variables (active carbon mass and engine speed) and the emissions of CO, and HC.

RESULTS AND DISCUSSION

The results of the study are presented and discussed in this section, with a focus on the variations in engine speed (ranging from 2500 to 6500 RPM) and the concentration of carbon monoxide (CO) emissions as the dependent variable. The analysis includes a comparison of different masses of active carbon used, including the standard amount and additional masses of 100 grams, 150 grams, and 200 grams, for each engine speed.

Figure 1: Relation of Engine Speed vs. CO Content with Varying Masses of Active Carbon

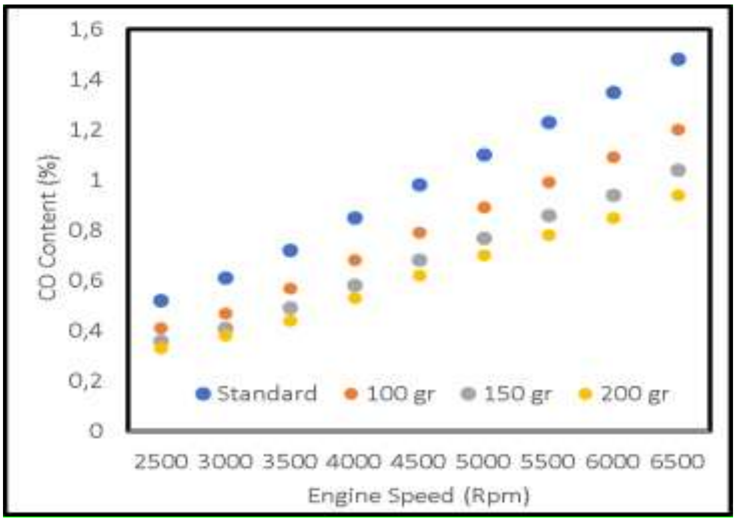

Figure 1 shows the CO concentration (in percent) at different engine speeds for each variation of the mass of active carbon used. As the engine speedincreases, there is a general trend of decreasing CO concentrations across all variations of active carbon mass. This indicates that higher engine speeds result in more efficient combustion and reduced CO emissions.

Comparing the different masses of active carbon, it is evident that increasing the mass leads to lower CO concentrations at each engine speed. This suggests that a higher quantity of active carbon enhances the adsorption and removal of CO from the exhaust gases. Notably, the largest reduction in CO concentration is observed with 200 grams of active carbon, indicating the effectiveness of this higher mass in mitigating CO emissions.

The implications of this research are substantial, as it demonstrates the potential of active carbon derived from coconut shell as an effective adsorbent for reducing CO emissions from motorcycles. By utilizing 200 grams of active carbon, a significant decrease in CO concentration (up to 12.06%) was achieved. This reduction in CO emissions is crucial for improving air quality and minimizing the adverse health effects associated with air pollution.

Furthermore, the use of coconut shell waste as a raw material for active carbon production offers environmental and economic benefits. By repurposing agricultural waste, this study promotes sustainable waste management and resource utilization. The abundance and low cost of coconut shells make this material an attractive option for large-scale implementation.

The results indicate that active carbon derived from coconut shell effectively reduces CO emissions from motorcycle exhaust gases. The findings highlight the importance of engine speed and the mass of active carbon in determining the extent of CO reduction. This research contributes to the development of eco-friendly solutions for mitigating air pollution from motorized vehicles. The utilization of coconut shell waste as a raw material offers opportunities for sustainable waste management and resource utilization. Further studies can explore the optimization of active carbon properties and examine the long-term durability and performance of this adsorbent in real-world conditions.

RESULTS AND DISCUSSION

The results and discussion section presents the findings of the study regarding the variations in engine speed (ranging from 2500 to 6500 RPM) and the concentration of hydrocarbons (HC) emissions as the dependent variable. The analysis includes a comparison of different masses of active carbon used, including the standard amount and additional masses of 100 grams, 150 grams, and 200 grams, for each engine speed.

Figure 2. Relation of Engine Speed vs. HC Content with Varying Masses of Active Carbon

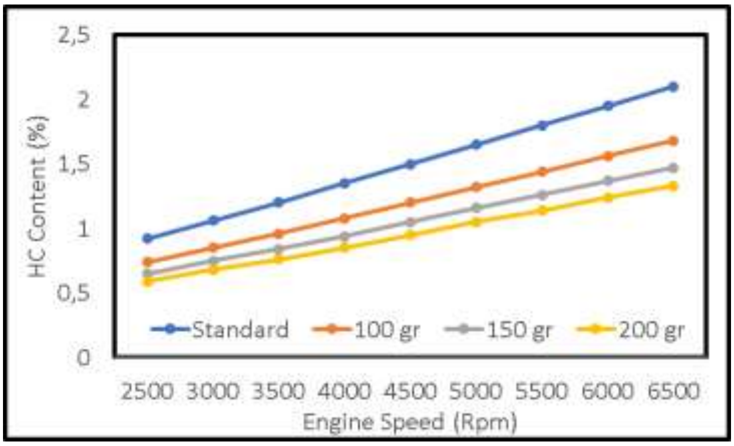

Figure 2 shows the HC concentration (in percent) at different engine speeds for each variation of the mass of active carbon used. As the engine speed increases, there is atendency for the HC concentrations to decrease across all variations of active carbon mass. This indicates that higher engine speeds promote more efficient combustion and contribute to reduced HC emissions.

Analyzing the different masses of active carbon, it is evident that increasing the mass leads to lower HC concentrations at each engine speed. This suggests that a higher quantity of active carbon enhances the adsorption and removal of HC from the exhaust gases. Notably, the greatest reduction in HC concentration is observed with 200 grams of active carbon, indicating the effectiveness of this higher mass in mitigating HC emissions.

The findings of this study align with previous research on the use of adsorbents to reduce HC emissions. The adsorption properties of active carbon derived from coconut shell contribute to its effectiveness in removing HC from the exhaust gases. The porous structure of active carbon provides ample surface area for adsorption, while its strong binding power enables the physical separation of HC from the exhaust stream.

The implications of this research are substantial, as it demonstrates the potential of active carbon derived from coconut shell as an efficient adsorbent for reducing HC emissions from motorcycles. By utilizing 200 grams of active carbon, a significant decrease in HC concentration (up to 16.96%) was achieved. This reduction in HC emissions is crucial for improving air quality and minimizing the adverse health effects associated with air pollution.

Furthermore, the use of coconut shell waste as a raw material for active carbon production promotes sustainable waste management and resource utilization. By repurposing agricultural waste, this study contributes to the principles of a circular economy. The abundance and low cost of coconut shells make this material an attractive option for large-scale implementation.

The results indicate that active carbon derived from coconut shell effectively reduces HC emissions from motorcycle exhaust gases. The findings highlight the importance of engine speed and the mass of active carbon in determining the extent of HC reduction. This research contributes to the development of eco-friendly solutions for mitigating air pollution from motorized vehicles. The utilization of coconut shell waste as a raw material offers opportunities for sustainable waste management and resource utilization. Further studies can explore the optimization of active carbon properties and examine the long-term durability and performance of this adsorbent in real-world conditions.

CONCLUSION

This study concludes that active carbon derived from coconut shell proves to be an effective adsorbent for reducing exhaust gas emissions from motorcycles. Higher engine speeds and increased masses of active carbon result in lower concentrations of carbon monoxide (CO) and hydrocarbons (HC) in the exhaust gases. This research highlights the potential of utilizing coconut shell waste for sustainable emission control. The findings have significant implications for improving air quality and mitigating the environmental impact of motorized transportation. Further research in this area could lead to advancements in emission reduction technologies and contribute to a cleaner and more sustainable transportation sector.

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