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The Effect of Methanol Fraction on the Diffusion Flame Characteristics of Pertamax Fuel

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ABSTRACT

The quality of fuel is an important factor in the process of firing on a vehicle. Good fuel having a high octane number and also has environmental kindness .The addition of methanol in fuel octane and gasoline can add value could reduce gas emissions on a vehicle .To get the optimum then required testing burning diffusion by comparing variation discharge fuel. In this study uses experimental methods to find angles and high fire and testing characteristic of burning use as a pengujinya bunsen a burner . The research value the largest fire is on G70M30 composition to discharge fuel 0,5 ml / minutes later followed discharge fuel 1 ml / minutes and 1,5 ml /minutes. The highest value of 21.82 ° while the lowest value of 16,34°. Methanol has an effect on the value of the flame besides discharge fuel also has an effect on the value of the resulting.The effect of the value of the flame on the composition of fuel effect by composition methanol. The addition of methanol cause the value of the fire increase. On a high value on the composition of the highest fuel G100M0 with discharge fuel 1.5 ml /minutes. While, the lowest on the high value G70M30 composition with discharge of fuel 0,5 ml /minutes. This phenomenon varies inversely with the angles fire. The composition of fuel affects high value. fireThe lower the methanol cause high value flame increased.

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1. INTRODUCTION

Fuel quality is a crucial factor in the combustion process in vehicles [1]. Good fuel has a high octane rating and is also environmentally friendly [2][3]. Methanol is a type of alcohol. Methanol has the chemical formula CH_3OH. It is a volatile, colorless, flammable liquid with a distinctive odor. Methanol is used as an antifreeze coolant, solvent, fuel, and industrial additive. Methanol is produced naturally [4] through anaerobic metabolism by bacteria [5]. The resulting product is methanol vapor [6] in the air. After several days, the methanol vapor is oxidized by oxygen with the help of sunlight to form carbon dioxide and liquid. One function of methanol in fuel is as an octane booster [7]. Adding methanol to gasoline can increase the octane rating and reduce vehicle exhaust emissions.

Effendi and Syaiful [8] conducted a study on the addition of methanol to gasoline fuel, which showed that methanol can improve vehicle acceleration and performance. This is evident in the consistent increase in torque and power output with each variation in engine speed. Furthermore, adding methanol can reduce fuel consumption in vehicles. Previous research has shown that the air-fuel mixture approaches stoichiometric equilibrium with the addition of methanol [9][10]. This is because the pressure and temperature in the combustion chamber increase during combustion [11].

Combustion is a rapid chemical reaction between fuel and an oxidizer, producing heat and light. Flame characteristics can be determined through combustion tests, both premixed and diffusion combustion. Diffusion combustion [11][12] is the combustion process between fuel and air without mechanical mixing. Combustion results can be analyzed from the combustion rate and flame characteristics. Flame characteristics indicate whether combustion is near complete or incomplete. This condition can provide insight into the combustion conditions before the fuel is introduced into the combustion chamber [13][14]. To achieve optimal combustion, diffusion combustion tests are required by comparing variations in fuel flow rate [15].

2. METHOD

This study used an experimental method to determine the flame angle and height. Combustion characteristics were tested using a Bunsen burner as the testing tool. The combustion testing process began with determining the fuel flowrate to be used. The fuel flowrates used were 0.5 ml, 1 ml, and 1.5 ml. The fuel flowrate was adjusted using a burette. After adjusting the fuel flowrate, the next step was to adjust the temperature used to heat the fuel. The temperature used was 700°C. The heater was placed on the surface of the pipe. After adjusting the fuel flowrate in the burette and the temperature in the heater, the next step was to conduct a combustion test.

The combustion test began by flowing fuel to the heater. Once it reached the heater, the fuel underwent a conversion from a liquid to a gaseous state. Once the fuel became a gaseous state, it was then flowed to the Bunsen burner. Once the fuel was in the Bunsen burner, a flame was ignited, causing a combustion reaction and the formation of a flame. The flame was recorded with a camera to analyze the flame angle and height. After the testing and data collection process was complete, the next step was to summarize and store the test data. The fire image data obtained measured the height (h) and flame angle (α) on the inner fire cone.

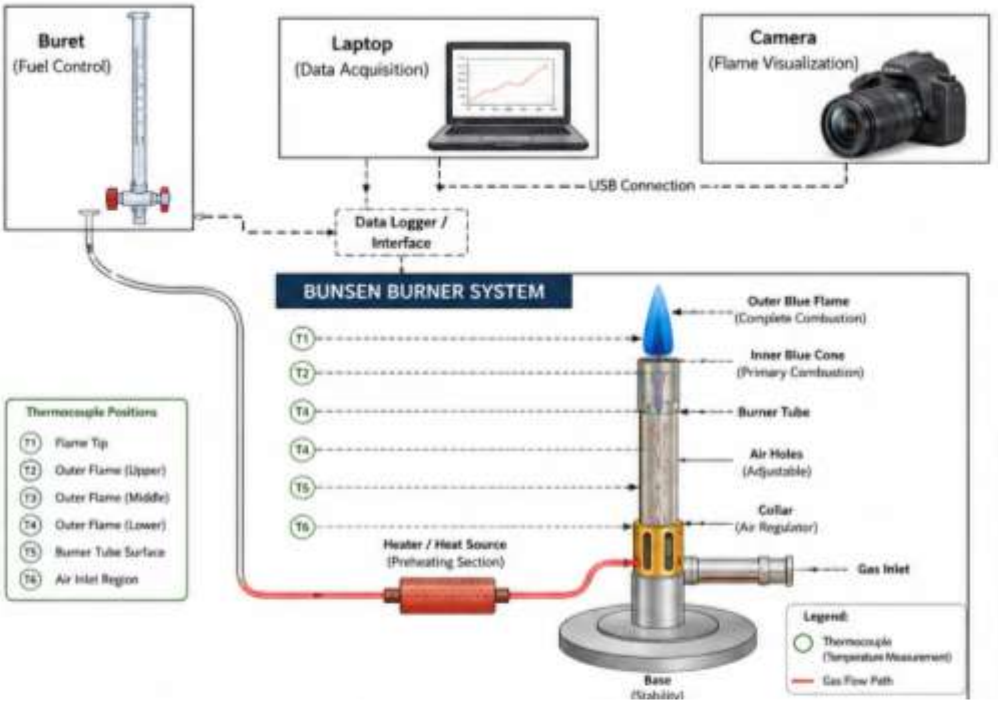

Figure 1. Combustion Test Scheme

2.1 Research Flowchart

The experimental procedure begins with the proposal preparation stage, where the research objectives, scope, methodology, and expected outcomes are established. This stage provides the scientific foundation for the study and ensures that all experimental activities are conducted systematically. After the proposal has been completed, the necessary equipment and materials are prepared, including the burner system, fuel supply, measuring instruments, data acquisition devices, and safety equipment. Proper preparation is essential to guarantee the reliability and safety of the experiment.

The next stage involves sample fabrication, in which fuel samples are prepared according to the predetermined composition. If blended fuels are used, the proportions of each component are carefully measured to achieve a homogeneous mixture. Once the fuel samples are ready, the combustion test is conducted under controlled laboratory conditions. During this stage, the fuel is supplied to the burner, ignited, and observed to evaluate its combustion characteristics. A critical step in the experiment is the assessment of flame stability. The combustion process must produce a stable flame before any measurements can be taken. If the flame is unstable, adjustments are made to the fuel composition, fuel-air ratio, or operating conditions, and the combustion test is repeated. When a stable flame is achieved, the experiment proceeds to the measurement phase. At this point, the fuel composition and fuel flow rate are recorded because these parameters have a significant influence on combustion performance and flame behavior.

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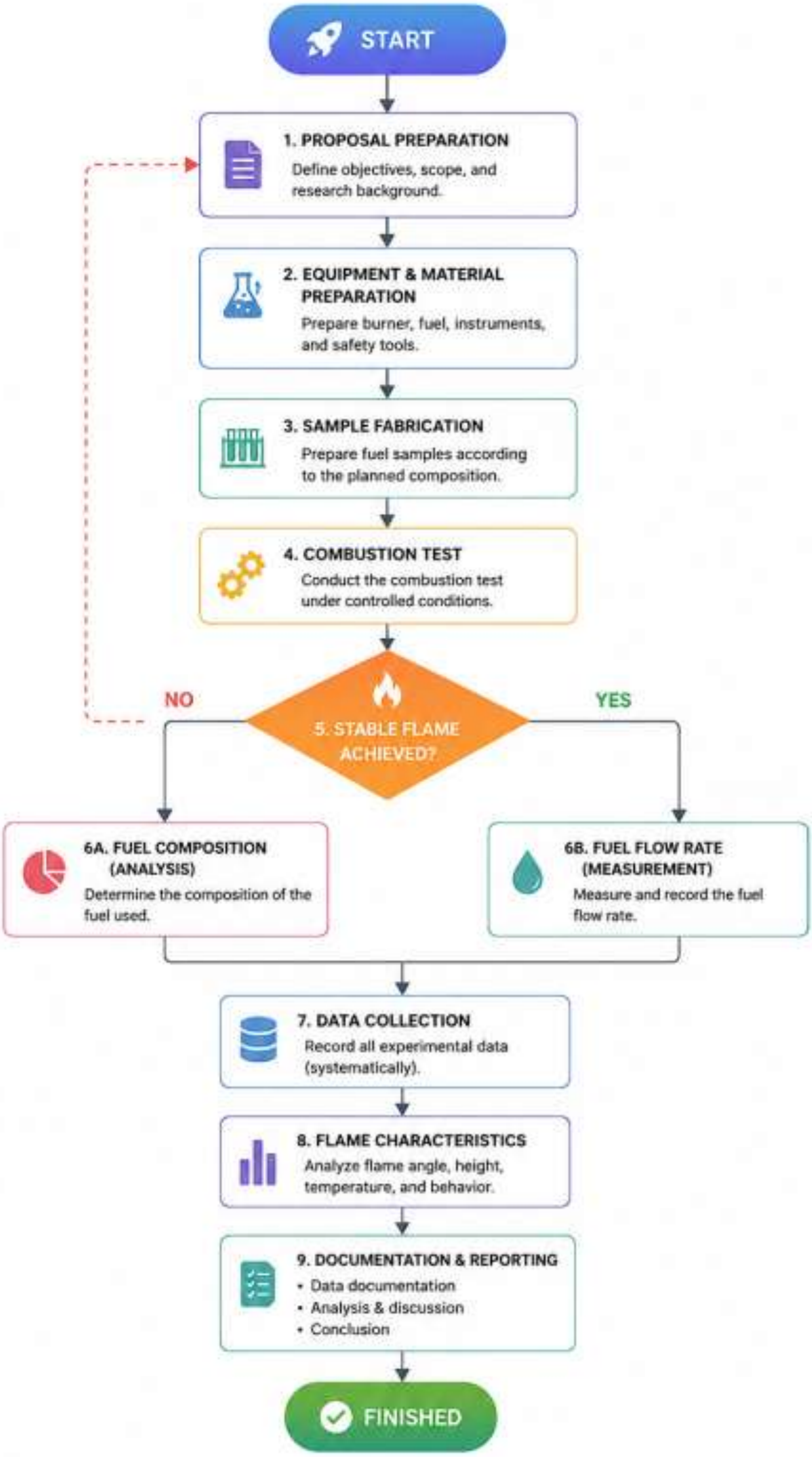

Gambar 2. Diagram Alir Penelitian

Following the establishment of stable combustion conditions, all relevant experimental data are collected. The recorded parameters may include flame height, flame angle, flame appearance, temperature distribution, fuel composition, and fuel flow rate. These data provide valuable information about the combustion process and serve as the basis for evaluating the performance of the tested fuel.

The collected data are then analyzed to determine the flame characteristics and overall combustion performance. Parameters such as flame height and flame angle are examined to assess flame stability and combustion intensity. Temperature measurements are used to evaluate heat release and thermal behavior, while observations of flame shape and color can provide insight into combustion efficiency and completeness.

Finally, the results are compiled in the documentation and reporting stage. This stage includes organizing the experimental data, conducting detailed analyses and discussions, interpreting the findings, and drawing conclusions. The completed report presents the relationship between fuel composition, fuel flow rate, and flame characteristics, providing scientific evidence that can be used for further research and the development of more efficient combustion systems.

3. RESULTS AND DISCUSSION

The fuel composition and flow rate were varied according to Table 1. This was done to determine the effect of fuel composition and flow rate on combustion characteristics. The combustion results were observed on the resulting flame. The flame was observed for changes in angle and flame height.

Table 1. Fuel Composition and Flow Rate

No.	Composition	Fuel Flow (ml/menit)
1	Gasoline 100%, Metanol 0%	0,5
		1
		1,5
2	Gasoline 90%, Metanol 0%	0,5
		1
		1,5
3	Gasoline 80%, Metanol 0%	0,5
		1
		1,5
4	Gasoline 70%, Metanol 0%	0,5
		1
		1,5

3.1 Flame Image

The results of this test produce a flame.

G100M0 G90M10 G80M20 G70M30

Figure 3. Flame with a fuel flow rate of 0.5 ml/minute

Figure 3 shows a more stable flame. The ambient air and fuel are more balanced. The resulting flame tends to be lower. The resulting angle appears more oval at the tip of the Bunsen burner. Furthermore, the flame appears to have a bluish color at the core.

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G100M0 G90M10 G80M20 G70M30

Figure 4. Flame with a fuel flow rate of 1 ml/minute

Figure 4 shows a more fuel-rich flame compared to the 0.5 ml/minute fuel flow rate. This indicates a greater fuel content compared to the surrounding air. This condition results in fuel dominance during combustion. The flame appears taller and the resulting angle is more conical. The flame begins to turn red, visible in the flame outside the core.

G100M0 G90M10 G80M20 G70M30

Figure 5. Flame with a fuel flow rate of 1.5 ml/minute

At a fuel flow rate of 1.5 ml/minute, more fuel was produced than with the other fuel variations. The diffusion flame was higher, and a red flame was visible at the core of the flame. This indicates that the combustion reaction was predominantly fuel-driven rather than air-driven. Furthermore, the flame appeared to be very conical, projecting above the tip of the Bunsen burner.

3.2 Flame Angle

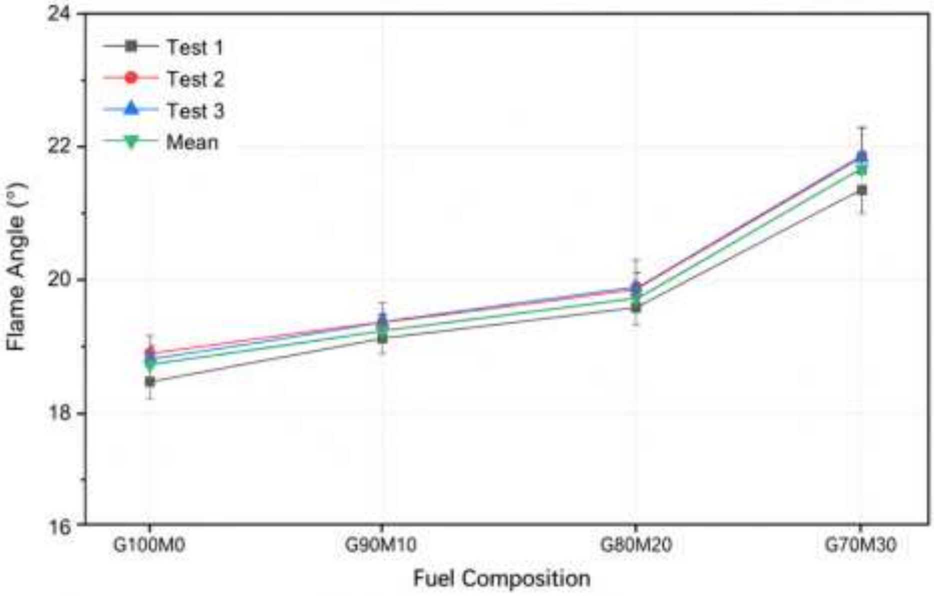

Figure 6. Flame angle with a fuel flow rate of 0.5 ml/min

The lowest flame angle value is found in the G100M0 fuel composition with pure fuel without methanol mixture. The average value of the resulting angle is 18.54°. The largest flame angle value is found in the G70M30 composition. The average value of the flame angle produced in the G70M30 composition is 21.78°. This shows that the addition of methanol can increase the flame angle value during the combustion reaction process. The increasing methanol composition causes the flame to shorten so that the flame angle increases.

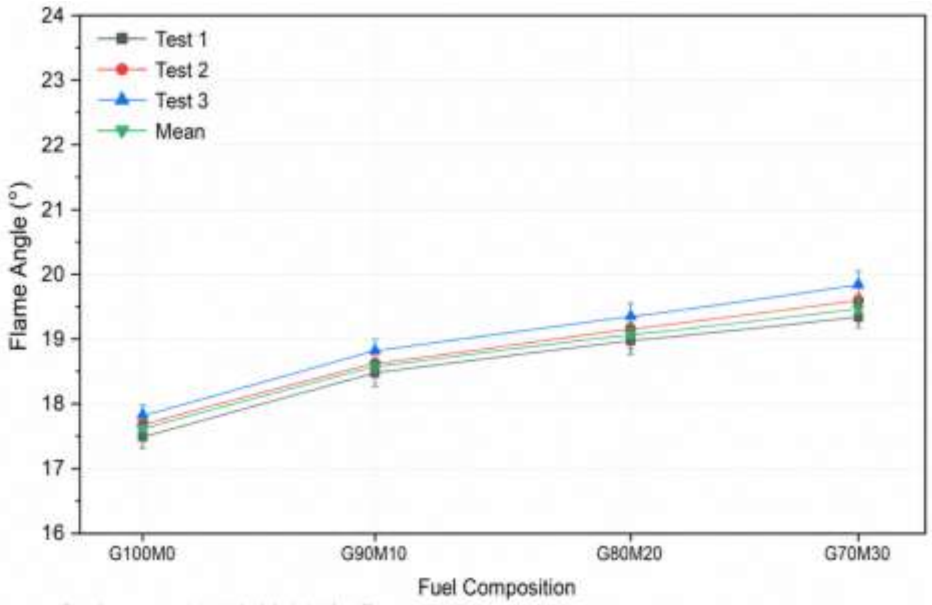

Figure 7. Flame angle with a fuel flow rate of 1 ml/minute

Figure 7 shows the flame angle at a fuel flow rate of 1 ml/minute, showing the differences in flame angles produced by each fuel composition variation. The lowest average flame angle was found in the G100M0 fuel composition, with an average flame angle of 17.75°. The highest flame angle was found in the G70M30 fuel composition, at 19.34°. The combustion test demonstrated the effect of adding methanol to the fuel. The flame angle increased with the addition of methanol.

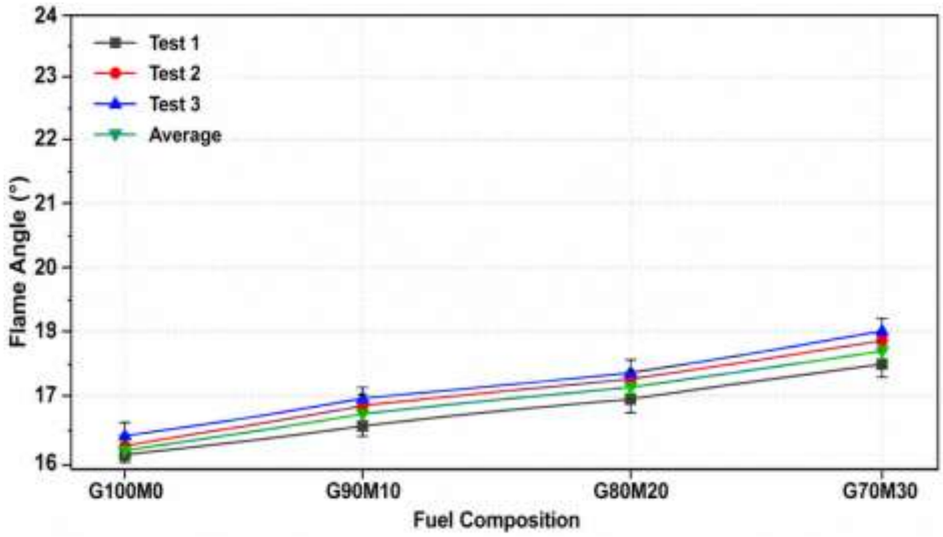

Figure 8. Flame angle with a fuel flow rate of 1.5 ml/minute

In Figure 8, the flame angle with a fuel flow rate of 1.5 ml/minute shows the effect of adding methanol. The addition of methanol can increase the flame angle value. The lowest average flame angle value is found in the G100M0 fuel composition with an average angle value of 16.31°. The highest average angle value is found in the G70M30 fuel composition with a flame angle value of 18.64°. Combustion testing with a fuel flow rate of 1.5 ml/minute produces a low flame angle value when compared to other tests. This is because the fuel is richer while the ambient air composition is minimal.

3.3 Flame Height

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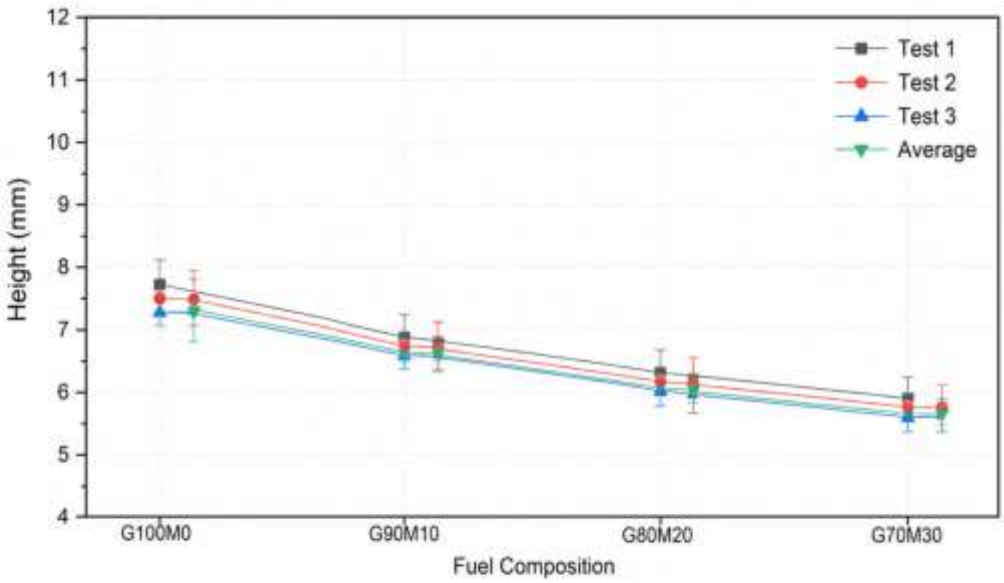

Figure 9. Flame height with a fuel flow rate of 0.5 ml/minute

Figure 9 shows the difference in flame height for each fuel composition. This phenomenon indicates that fuel composition affects the flame height value. The flame height for each fuel composition varies according to the Pertamax and methanol composition levels. The test results obtained data on the lowest average flame height value were found in the G70M30 fuel composition with an average flame height value of 7.47 mm. Meanwhile, the highest average flame height value was found in the G100M0 fuel composition. The average flame height value was 5.88 mm.

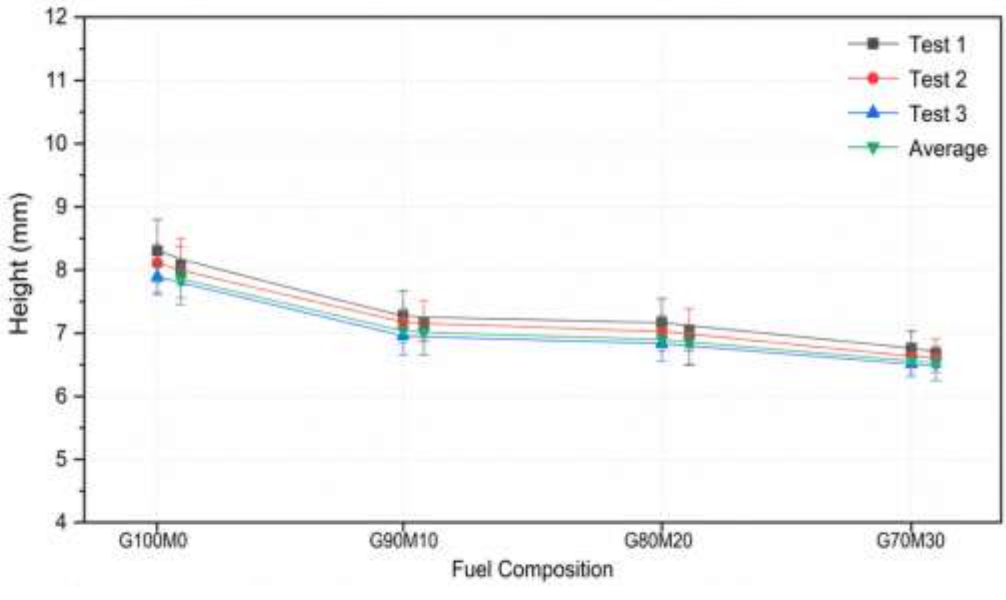

Figure 10. Flame height with a fuel flow rate of 1 ml/minute

Based on the measurements, the highest average flame height value was found in the G100M0 fuel composition with a value of 8.23 mm, while the lowest average flame height value was found in the G70M30 fuel composition with a flame height value of 6.67 mm. In this test, it can be observed that the methanol composition affects the flame height. The lower the methanol composition, the lower the flame height value.

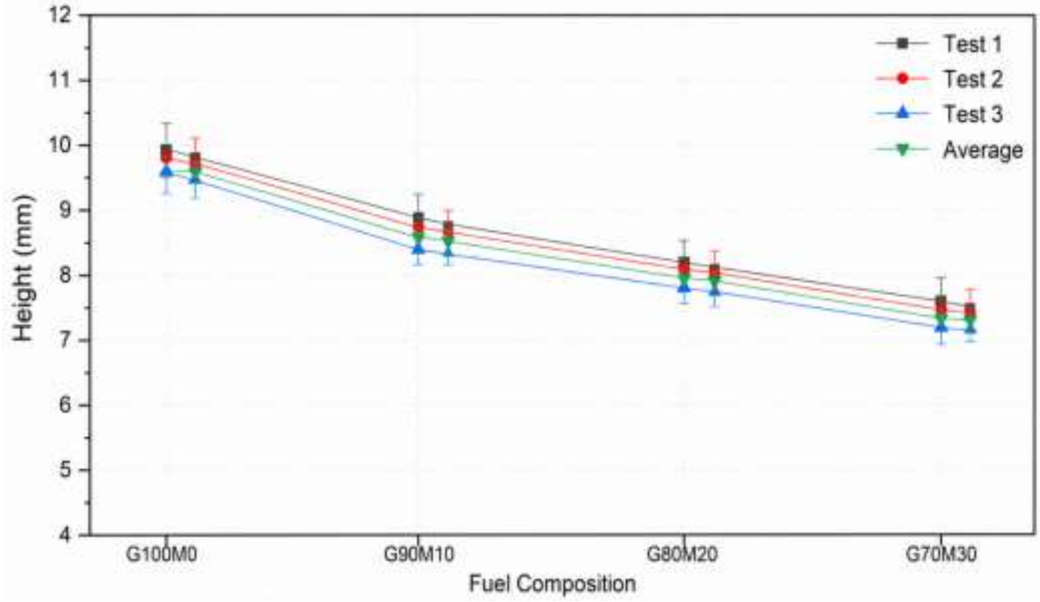

Figure 11. Flame height with a fuel flow rate of 1.5 ml/minute

The lowest flame height value is found in the G100M0 fuel composition with an average flame height value of 9.88 mm and the lowest value is found in the G70M30 composition with an average value of 7.39 mm. Low methanol composition can cause the flame height value to decrease. When compared with fuel flow rates of 0.5 ml/minute and 1 ml/minute, the fuel flow rate of 1.5 ml/minute has the highest average flame height value. The higher the fuel flow rate, the higher the flame height value.

4. CONCLUSION

The results of the diffusion combustion characteristic tests with varying fuel composition and flowrate yielded flame angle data. The obtained data showed that the flame angle value continued to increase with the addition of methanol, but decreased with increasing fuel flowrate. This is due to the higher calorific value with methanol addition, but the inverse effect with increasing fuel flowrate. The results showed that with increasing fuel flowrate, the flame angle value decreased. This is because the fuel is more difficult to evaporate and more of it is retained at the tip of the Bunsen burner. When fuel is retained at the tip of the Bunsen burner, diffusion combustion increases, resulting in a decrease in the flame angle value.

The results of the diffusion combustion characteristic tests with varying fuel composition and flowrate yielded flame height data. The results showed that the flame height increased with increasing fuel flowrate. Furthermore, with decreasing methanol content, the flame height value increased. Increasing fuel flowrate affects the flame height value. This effect results in an increase in flame height. This is because the fuel is more difficult to push out at the tip of the Bunsen burner. When fuel is difficult to push out, diffusion combustion increases. This is when high diffusion combustion occurs at the tip of the Bunsen burner. This is also influenced by the decreasing calorific value of the fuel, which contains less methanol, resulting in ignition delay when the combustion reaction is delayed.

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