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The Use of Arak Bali as a Fuel Influence on Fire Characteristics of Combustion

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A B S T R A C T

Analyze the characteristics of gas fuel from arak Bali, like shape and flame speed. Test characteristics such as methanol and ethanol content material gas from arak Bali, after it tested the gas fuel combustion characteristics of arak Bali such as the shape and speed of flame. Testing characteristics such as the content of methane and ethanol gas from arak Bali performed in the forensic laboratory while testing the ignition characteristics of the shape and speed of fuel from evaporating arak Bali done using a helle-shaw cell combustion chamber model. Air mixture ratio variations with gas fuel from arak Bali is 24/1, 25/1, 26/1, 27/1, 28/1, 29/1, 30/1 and 31/1. The observed effect is the shape and speed of the premixed flame propagation in the helle-shaw cell combustion chamber model. The results of the study, the moisture content of the basic ingredients of gas fuel arak Bali consisting of 40% methanol and 60% ethanol. Gas fuel from arak Bali has a stoichiometry air-fuel ratio of 30/1. Getting closer to the stoichiometry air-fuel ratio, flame color changes from reddish color faded to red, reddish blue, blue and bright blue last. The maximum speed of propagation of fire occurring in stoichiometry air-fuel ratio is 328.33 cm/sec.

1. Introduction

The government of Indonesia in 2008 made a policy on the management of national energy about the use of ethanol, biodiesel, and gasohol as an alternative energy in 2022. One source of alternative fuel in Bali is arak Bali. Arak Bali, with a quality above 85%, has an octane number of about 108,6. Arak Bali is non-toxic and is used as an environmentally friendly fuel. Arak Bali fuel mixed with gasoline at a certain percentage can increase the octane number of gasoline. Increased octane rating will improve the quality of combustion, decrease residual gases of combustion, and increase engine performance. The use of arak Bali as an alternative energy, from 2006 has done research on the use of arak Bali in liquid form as a fuel substitute for gasoline, examining the internal combustion engine carburetors and injection machines, with some testing variables such as rotation and compression ratio. Compared with gasoline, arak Bali fuel produces CO_2 emissions is larger than gasoline, CO emissions lower than gasoline, HC emissions higher than gasoline, and O_2 emissions higher than gasoline. Increased compression ratio to affects the increase of CO_2 and O_2, the decrease of CO and HC. The rotation engine is less steady, the engine torque decreases, and engine power, and engine torque decrease.[1-3]

This study uses arak Bali fuel in gaseous form. To obtain the fuel gas from arak Bali requires heating processes. Perfect gas combustion is influenced by three things: the air-fuel ratio, homogeneity of mixing, and combustion temperatures. A comparison of fuel with air has a less-than-perfect impact on the perfection of combustion, which can be seen in the shape and velocity of the fire. Research using gas fuel combustion has been carried out, such as a study of the mixture ratio of air and natural gas fuel to form and velocity of a fire. The results showed that the stoichiometry of the combustion air in comparison with the fuel gas, is 8/1, and the maximum flame

propagation velocity is achieved in the mixture stoichiometry.[4-7] Therefore we are interested in continuing research to determine the characteristics of the fuel gas content of arak Bali and its effect on combustion characteristics.

2. Methods

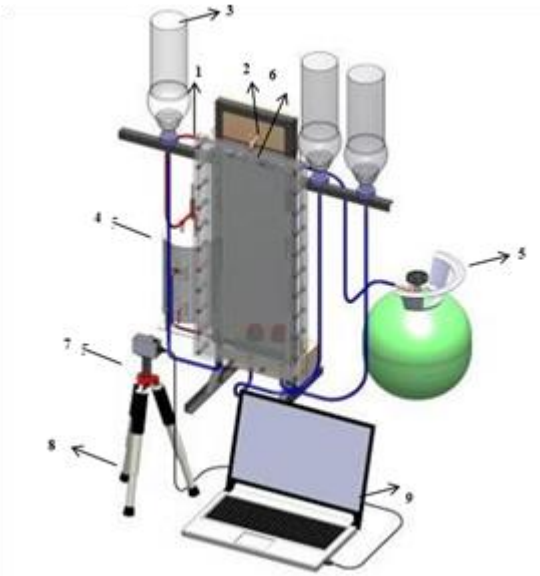

Figure1. Research schematic.

Testing characteristics such as methane and ethanol content of the fuel gas from arak Bali were conducted in the forensic laboratory. Testing characteristics of the shape and speed of ignition of the fuel gas from arak Bali performed by varying mixtures of air and fuel gas from arak Bali. Variables air fuel ratio is 24/1, 25/1, 26/1, 27/1, 28/1, 29/1, 30/1 and 31/1.

3. Results and Discussion

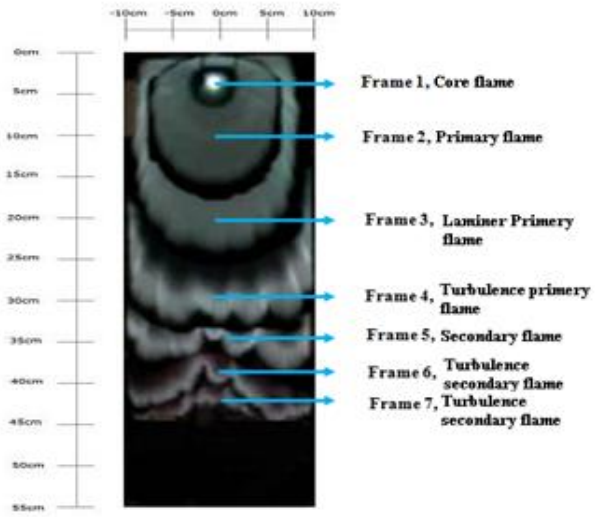

Figure 2. The shape of flame propagation.

Good combustion has obtained the release of heat energy contained in the fuel and suppresses the amount of heat lost. Ideal combustion is the burning of which produces only certain products. Ideal combustion is called stoichiometry. Its combustion products of hydrocarbon fuels is CO_2, H_2O, and N_2. Stoichiometry combustion is where all the atoms of the fuel and oxidizer react perfectly. There are two combustions classified: mechanics burning and natural burning. Premixed combustion is the process of burning fuel, and air is mixed first mechanically and then burned. Combustion of this type can be seen in the process of burning gasoline motors, carbide welding, and burning on a rocket. In the premixed combustion wave propagation, combustion occurs in what is called the front frame. A combustion wave propagates toward the reactants behind a wave of arson-formed combustion products.

The air-fuel ratio is the ratio between the air with the fuel in the combustion chamber. The mixture contains enough air for a complete combustion process called stoichiometry. The mixture that contains excess fuel is called a rich mixture, and a mixture containing less fuel is called a lean mixture. In this study was engineered at to determine fire propagation speed. Flame propagation velocity is defined as the velocity of the gas unburned perpendicular to the surface as a gas combustion wave moves toward the burning fields. Variables that affect of the speed of combustion are the ratio of oxidizer and fuel mixture, the molecular structure of the fuel, additive, pressure, and temperature of the mixture, the temperature of the fire, and thermal diffusivity. In general, the propagation of flame shape is parabolic, from a small satellite dish near lighters steadily developed into a large satellite dish, even further away from the lighter, originally parabolic, and eventually broke up into several small satellite dishes, as shown in Figure 2.

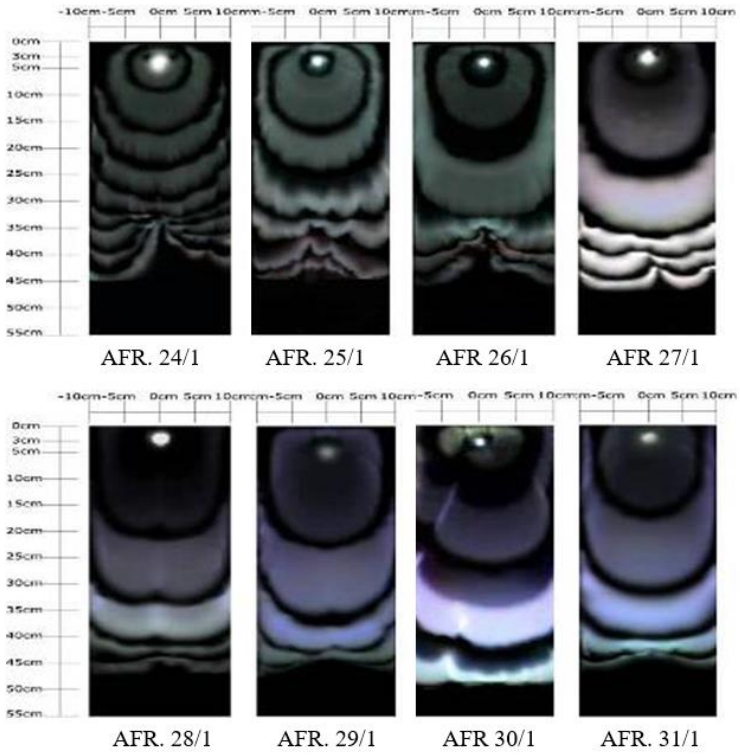

Figure 3. The flow patterns propagation of fire with the lighting from above on a variation of AFR.

AFR greatly affects the speed of propagation of fire. This phenomenon occurs because a ratio of air and fuel gas from arak Bali makes the process more complete combustion. The comparison of air and fuel is getting closer; comparison stoichiometry raises fire velocity. In AFR 24/1, 25/1, 26/1, 27/1, 28/1, 29/1, 30/1, and 31/1, the maximum flame propagation velocity of each is 178.75 cm/sec, 187.50 cm/sec, 248.33 cm/sec, 271.67 cm/sec, 246.67 cm/sec, 268.33 cm/sec, 328.33 cm/sec, and 230.63 cm/sec. With the AFR stoichiometry on 30/1, it will generate the maximum flame propagation velocity, where the flame propagation velocity is 328.33 cm/sec.

The mixture of arak Bali and gasoline was tested by varying the fraction of the mixture to obtain physical properties closer to gasoline. And followed by Artayana, Sukadana on 2007 did test an addition of alcohol on gasoline to know the quality of the exhaust gas on a motorcycle engine. This research showed that a greater percentage of alcohol consumption causes the exhaust gases produced to increase as hydrocarbon and oxygen levels increase. The gasoline exhaust gas tends to be lower. The greater percentage of the engine rotation the more exhaust gases produced is decreases. Arak Bali is a substitute fuel motorcycle for acceleration and fuel consumption. The results showed, at a compression ratio of 9.3/1, uses of arak api can improve acceleration and can save fuel consumption, where are: in 1st gear at a speed of 0-20 km/h acceleration is 2.835 m/dt^2 with a fuel consumption of 0.091 lt/km. In 2nd gear at a speed of 20-40 km/h, acceleration is 1.190 m/dt2 and fuel consumption is 0.102 lt/km. In 3rd gear at a speed of 40-60 km/h, acceleration is 0.518 m/dt^2 with a fuel consumption of 0.117 lt/km. At the 4th gear speed of 60-70 km/h acceleration is 0.146 m/dt^2 with a fuel consumption is 0.183 lt/km.[8-12]

The procession of arak api as a substitute fuel motorcycle to the content of the flue gas, the results of research by varying the concentration of ethanol as a fuel will greatly affect the content of the exhaust gases. With a higher concentration of exhaust gas produced, such as carbon dioxide, it increases. The greater the concentration of ethanol produced, the more CO, HC, and O_2 emissions decrease. The use of arak Bali as fuel on the four-stroke engine with compression ratio variations. The results obtained show that fuel produces arak api to engine performance that is better than gasoline because it is able to work at a higher compression ratio so that the thermal efficiency in fuel uses higher fire procession. Technical studies of the performance of the continuous distillation and the use of wine as a fuel substitute for gasoline by testing in conventional combustion engines in the carburetor, with several variable testing such as rotation variable, compression ratio variable to the engine performance such as emissions. Research results show that higher temperature influences the higher evaporation capacity of wine products but inversely proportional to the product quality is getting lower. Compared with gasoline, fuel arak produces high CO_2 gas, low CO, high HC, and high O_2. Increased compression ratio affects the increase in CO_2, reduced CO, HC emissions increase, and the less gas O_2.[13,14]

Technical studies continuous distillation column-type to the capacity and quality production. The results from this study show that the capacity and quality of wine production are influenced by many number levels of distillation. The greater the level number influence, the lower the distillate production capacity, the higher the quality of production, and the production efficiency are lower. Improving the quality of arak Bali production as an alternative fuel with continuous distillation method. This research conducted a variable number of levels of distillation: one level, two levels, and three levels. Each variable has a setting different temperature. Showed that the higher level of distillation used can produce quality wine with higher but lower production capacity. To increase the production capacity of alternative fuels, arak Bali used the forced fluid flow method. Research conducted showed that more levels of continuous distillation influence temperature distribution patterns, lower evaporation, lower production rate, and the quality of production is increases.[15]

Application of the method of forced condensation-type crossflow on alternative fuel of arak Bali to quality and capacity production process. The bigger the cooling fluid flow rate results, the greater the cooling rate affects the rate of condensation, which is greater, and the rate of production is increased. However, the greater cooling fluid flow rate affects the quality of production, which is low. Arak Bali was tested as a fuel in the carburetor type engine, and the result was that the increased concentration of arak Bali affects the specific fuel consumption, increasing torque and decreasing engine power. One of the alternative fuels that are beginning to get special attention is ethanol from arak Bali, a clear liquid with no color and a unique aroma. Because it is non-toxic and widely used as a solvent in the pharmaceutical, food, and beverage industry, ethanol mixture with water gives a sweet taste, but at high concentrations, will give you a burning sensation. The molecular formula Ethanol is C_2H_5OH, which is a group of chemical compounds containing hydroxyl compound-OH attached to a carbon atom (Wikipedia Indonesia, ensiklopedia bebas berbahasa Indonesia).[9,10]

In addition to its clean combustion, as well as its being easily produced or by another name, it is a green fuel. Ethanol is a fuel that is produced by some plants, including palm trees. The main result of a number of plant species, among others, is juice, the juice obtained by tapping a virgin coconut tree that has not bloomed. A virgin can be tapped for 10-30 days, with the results obtained from 0.5 to 1 liter of juice per day. Nira can be easy to experience because it contains wild yeast fermentation. Fermentation will end one day later after the sugars in the juice run out and are converted so that the sap will contain alcohol. The sap will be distilled to produce wine. Nira is derived from the sap of palm trees and is often called the Balinese coconut palm wine. In the distillation process of coconut, sap will undergo some fractional distillation to obtain varying levels of ethanol. Fuel gas is ideal for internal combustion engines because the gas phase is homogeneously mixed with air. Analysis of gas fuel is based on the analysis of volume measured at standard temperature and pressure 60°F, 30 inHg or 15, 56°C, 1 atm. Characteristics of gas fuel include ignition temperature, which is the temperature at which the fuel gas can ignite by itself. Ignition temperature cannot be calculated exactly the same as specific gravity obtained from the experimental results. Inflammability limits. The temperature of the mixture of fuel and air can ignite in air at certain mixed conditions. The mixture boundary conditions known as flammability limit both the lowest and the highest.[16]

4. Conclusion

Based on the results of research and discussion that has been done, it can be concluded as follows: the gas content of the basic ingredients of arak Bali consists of 40% methanol and 60% ethanol. For gas fuel from arak Bali, the stoichiometry air-fuel ratio occurs at 30/1. Getting closer to the stoichiometry air-fuel ratio, the fire changed color from reddish color to red, reddish blue, blue, and bright blue last. The maximum speed of propagation of fire occurring in stoichiometry air-fuel ratio is 328.33 cm/sec.

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