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The Effect of Composition of Candlenut Shell Charcoal Briquette Mix With Petung Bamboo on Briquettes Performance

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Abstract. Briquettes are solid fuels produced through a compression process from biomass. It was discovered during its development that it was still less effective when only one ingredient was used in the formation of briquettes. As a result, it is necessary to combine charcoal briquettes rather than just one ingredient. The goal of this study was to determine the time it took to light a fire, the calorific value, the ability to boil water, and the thermal efficiency produced by a mixture of charcoal briquettes made from candlenut shell waste and bamboo petting of various compositions. The research method used is an experimental method that involves combining candlenut shell waste with petung bamboo in various compositions before testing chemical properties, calorific value, and burning briquettes in a biomass stove to obtain thermal efficiency values. The results revealed that the best mixture of candlenut shell charcoal briquettes and petung bamboo with various compositions was obtained in B4 briquettes (a mixture of 60% candlenut shell charcoal briquettes, 20% petung bamboo, and 20% additives) with an ignition time of 95 minutes, the calorific value is 5321 calories per gram, the capacity to boil water is 9 liters, and the maximum efficiency is 54.78 percent.

Keywords: Briquettes, Candle Chell, Petung Bambo

INTRODUCTION

In the millennial era, the demand for fuel is increasing in tandem with economic growth and the global community's needs. The level of community mobility for fuel continues to rise, unbalanced by the dwindling supply of energy due to its difficult nature to renew. As a result, it is critical to identify alternative energy sources that can supplement the

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availability of fuel oil, one of which is biomass energy. Biomass is a type of solid waste that can be recycled and used as a fuel source. Wood waste, agricultural waste, plantation waste, forest waste, and organic components from industry and households are all examples of biomass. Because of its beneficial properties, biomass energy can be used to replace fossil fuels (petroleum) as an alternative energy source. This energy source can also be used sustainably due to its renewable nature air, as well as increase the efficiency with which forest and agricultural resources are used. After passing the testing process, [1] research on the potential for renewable energy contained in areca nut yielded very good water content and ash content values of 8.08 percent and 1.47 percent, respectively. Regarding bamboo leaves. One of the biomasses uses that will be investigated in this study is biomass derived from plantations, specifically candlenut shell waste and bamboo petung waste. Both of these materials will be developed into fuel in the form of briquettes. [2] stated that biomass charcoal, which will be used as good material, should be made in the form of briquettes to reduce the high air pollution caused by the ash that will be generated.

Candlenut shell is a material that is frequently ignored by the community, resulting in useless waste. Candlenut shells, on the other hand, can be used as a cheap and economical alternative fuel. Furthermore, it can be used as a value-added product with applicable and popular technology, allowing the results to be easily disseminated to the general populace. Petung bamboo is a plant that thrives in the Kitatoraja region. This plant is adaptable to both hot and cold climates. Most bamboo plants in rural areas are allowed to grow wild, but bamboo can thrive even if not treated. As a result, bamboo is commonly planted in tropical areas or along riverbanks to prevent erosion and landslides. Because the quality of petung bamboo is good enough to be used as activated carbon, it can be used to increase the economic value of petung bamboo, which is used as charcoal [3].

Briquettes are solid fuels with a specific shape and size that are made up of fine particles that have been compressed with a certain compressive power to make the fuel easier to use. Condensing free waste into energy-rich waste in an easy-to-use form is one method of converting it. Briquette fuels are defined as organic fuels produced through compaction, external combustion, complete or combined carbonation. Briquettes are classified into two types based on their shape: yontan briquettes and egg briquettes (egg). According to previous research, the honeycomb cylindrical briquette shape has an advantage because the fire burning process is more evenly distributed [4].

Several previous studies have found that both petung bamboo and candlenut shell materials are suitable for use as fuel, with [5] researching with candlenut shell briquettes to produce a calorific value of 4850 cal/gram. [6] A mixture of candlenut shell charcoal carbon increases reactive combustion by 10%. [7] A mixture of 70% candlenut shells and 30% rice husks yielded a low porosity value of only 1.7 percent. [8] When raw materials are combined with candlenut shells, the combustion efficiency is 46.98 percent, [3][9] the research aims to reduce CO emission ions by burning candlenut shells, reducing harmful air pollution from CO emissions by 25%. [10] The use of activated carbon derived from candlenut shells as an adsorbent to improve the quality of VCO has been investigated. Water content, free fatty acid, and peroxide were the parameters tested. The results showed a decrease in water levels from 0.1655 percent to 0.0597 percent, a decrease in peroxide number from 0.1991 percent to 0.0991 percent, and a decrease in free fatty acid content from 0.4186 percent to 0.366 percent. Researching local bamboo resulted in the highest thermal efficiency produced on bamboo petung of 54.12 percent. [11] The addition of 15% cow dung to bamboo petung and variations of dry cow dung adhesives resulted in a calorific value of 6680 cal/gram. As a result of this, the author attempts to combine candlenut shell charcoal with bamboo as the main ingredient for making briquettes in a variety of combinations. [12] Tested briquettes with sawdust charcoal and coconut leaves, yielding a boiler efficiency of 61.17 percent.

Based on the issues raised above, the authors attempted to carry out a study titled "The Effect of Mixed Candlenut Shell Charcoal Briquettes with Petung Bamboo on Briquette Performance." The goal is to achieve a fast-boiling time (boiling time, calorific value, combustion power, and thermal efficiency) by varying the composition of raw materials between candlenut shell charcoal and petung bamboo.

METHODS

The research method used is an experimental method in which proximation testing, calorific value, and briquette combustion tests were performed on a biomass stove using a mixture of petung bamboo briquette charcoal and candlenut shells with varying material compositions to obtain thermal efficiency values. The following is the composition of the two-ingredient mixture:

Table 1. Material Compositions

Sampel Code	Materials Composities				
	Charcoal		ReinForcing material	Adhesive	Schert
	Candlenut Shells	Petung Bamboo	Clay		Water (ml)
	(%)	(%)	(%)	(%)	
B1	0	80	10	10	300
B2	20	60	10	10	
B3	40	40	10	10	
B4	60	20	10	10	
B5	80	0	10	10	

Table 1, depicts the composition of briquettes B1 to B5 with adhesive and reinforcing agents as well as solvents, as well as the addition of hot water to mix the four ingredients to form honeycomb briquettes.

RESULTS AND DISCUSSION

Result

The study's findings include briquette manufacturing, proximate testing, calorific value, and combustion tests (performance) on five different types of charcoal briquettes mixed with candlenut shell charcoal briquettes with bamboo petung based on various material compositions.

The amount of heat energy used during the process of converting useful energy divided by the amount of heat energy released by the fuel during the combustion process is referred to as efficiency. The thermal efficiency for burning briquettes 1 (B1) in boiling water was determined by calculating twice, and the fire temperature was obtained at a spent 0.39 kg of burned briquettes. Furthermore, the data can be seen as follows:

1) m_a = Mass of heated water (kg) = 3 kg
2) m_p = Mass of the pot (kg) = 0,9 kg
3) m_{bt} = The mass of briquettes that have been used (kg) =0,39 kg
4) Cp_{air} = Specific heat of water (kJ/kg ^oC) = 4,1769 kJ/kg ^oC
5) *LHV* = 24810.22 kJ/kg
6) T_b = Initial water temperature (^oC) = 26^oC
7) T_a = Boiling temperature
8) h water in a pot (^oC) = 100 ^oC
9) C = Calories = 1

The results of the calculation of the combustion efficiency for the three types of rice husk charcoal briquettes with candlenut shells can be seen in Figure below: Using the equation, the thermal efficiency is obtained as follows:

1) Fuel Consumption Rate (FCR)

$$FCR = mbt/LHV = \frac{0,39}{10200}$$

$$= 3,82353x\ 10^{-5}\ Kg/s$$

2) Clean Power (P_{out})

$$P_{out} = \times \times (-)$$

$$= [3x4.179x[2(100-26)+(59-26)+(624-26)+(408-26)]+0.4x0.9x+2256.482x0.12\ \frac{}{10200}$$

$$= 0,281376\ kW$$

3) Combustion Powet (P_{in})

$m_{bt}{}^{x\ LHV} = 0{,}39x24810{,}22$

$P_{in} = t$

4) = 0,9486 kW Losses power (P_{losses}) $P_{losses} = P_{in}$-P_{out}

= 0,9486-0,281376 = 0,595216 kW

5) Combustion Efficiency (n_{th}) η_{th} = x 100 %

= 0,2813

0,9486x 100 %

= 29,65 %

10200

Recapitulation of thermal efficiency calculation results

No Parameter B1 B2 B3 B4 B5 1 Long Ignition Time, (m) 65 78 86 95 84 2 Calor Value, HHV (Cal/gr) 3200 3320 4233 5321 4210 3 Water B Ability, mwa (liter) 3 3 6 9 6 4 Thermal Efficiency, ηt (%) 29.65 34.08 48.96 54.78 49.12

According to recapitulation, the best thermal efficiency was obtained at 54.78 percent in a mixture of candlenut shell charcoal briquettes and bamboo petung with material compositions of 60 percent:20 percent: 20 percent clay and tapioca flour.

Discussion

The basis of the findings of the research that will be discussed: boiling time, clean power, combustion power, power loss, and thermal efficiency:

Extensive Ignition Time

As shown in Figure 1, the higher the composition of the candlenut shell charcoal, the longer the fire maintains its heat until a certain mixture of briquettes depletes somewhat. It can be seen that the longest flame duration maintains its heat for up to 95 minutes, namely in B4 briquettes (mixture of 60% candlenut shells, 20% bamboo petung, 10% clay, and 10% tapioca flour), whereas B1 briquettes have the shortest time in the ignition of only 65 minutes. This is consistent with the fact that B4 briquettes have the highest fire temperature of 597°C and the highest density is that the charcoal grain structure is mixed with additives so that the entire charcoal can burn completely and keep the briquette fire warm. According to [13] research, a long time in burning is very influential in increasing the calorific value.

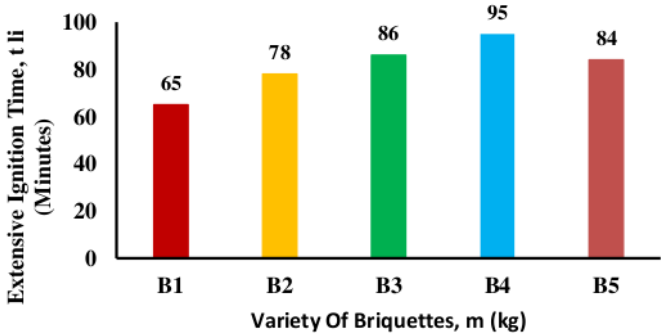

Figure 1. Extensive Ignition Time

Calorie content

Figure 1 shows that the higher the calorific value of the briquettes, the higher the composition of the candlenut charcoal material. The highest calorific value was produced in B4 briquettes (mixed briquette charcoal) at 5321 cal/gram. When compared to Briquette B1 only 3200 cal/gr, this flour contains 60% candlenut shell charcoal, 20% bamboo petung, 10% clay, and 10% flour. This is because B4 briquettes have a carbon content of the second composition of 78 percent, and the water and ash content contained in it are low, very low, namely 5.32 and 4.55, respectively, so that it can increase the calorific value contained during testing in the bomb calorimeter.

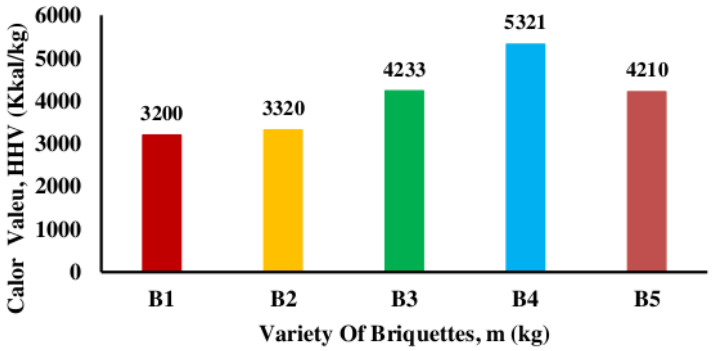

Figure 2. Correlation between Variations in Charcoal Briquette Materials and Calorific Value

Capability to Boil Water

In figure 2, the more hazelnut shell mixture has been cooked, the more water is cooked until a certain mixture of briquettes decreases slightly. It can be seen that the ability to boil water in B4 briquettes (a mixture of 60% candlenut charcoal briquettes) is the highest. This is because B4 briquettes have the longest burning time (95 minutes) and the highest calorific value (5321 calories/gram), allowing them to maintain the heat of the briquette fire long enough to boil water. up to three times the boiling process.

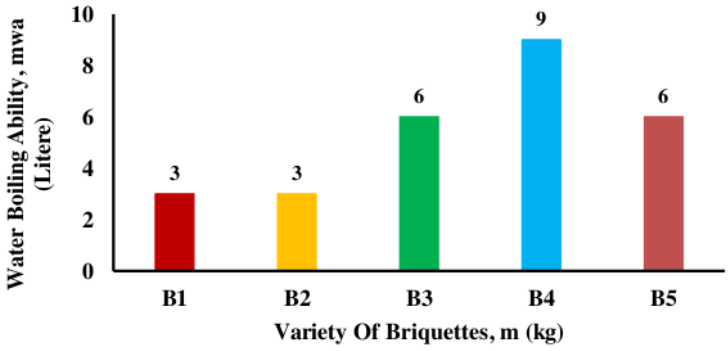

Figure 3. Variety of Briquettes to Water Boiling Ability

Thermal Effectiveness

In figure 3, the more hazelnut shell mixture has been cooked, the more water is cooked until a certain mixture of briquettes decreases slightly. It can be seen that the ability to boil water in B4 briquettes (a mixture of 60% candlenut charcoal briquettes) is the highest. This is since B4 briquettes have the longest burning time (95 minutes) and the highest calorific value (5321 calories/gram), allowing them to maintain the heat of the briquette fire long enough to boil water. up to three times the boiling process.

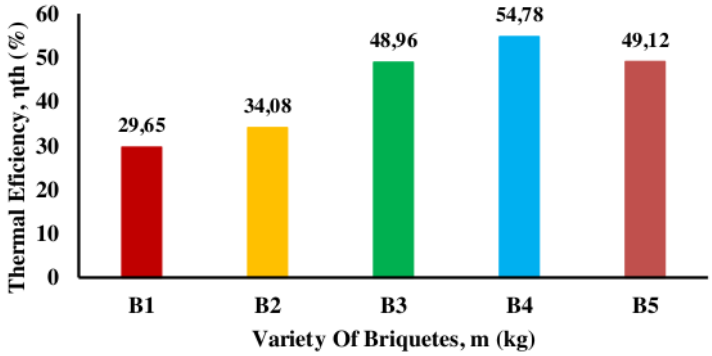

Figure 4. Shows Variety of Briquettes to thermal Efficiency

CONCLUSION

Based on the findings of this research and discussion, the following conclusions can be drawn the longest duration of ignition in a mixture of candlenut shell briquettes and bamboo petung with different material compositions was 95 minutes in B4 briquettes. According to the findings of their testing, the ignition time for charcoal briquettes made from bintaro fruit (candlenut) and bamboo betung is 1 minute 09 seconds, and the burning period is 2 hours 10 minutes [15]. It can be noted that the difference in ignition duration between the researchers' findings and the conclusions of earlier investigations is not too far apart. B4 briquettes with a calorific value of 5321 cal/gram had the highest calorific value in a mixture of candlenut shell charcoal briquettes and bamboo petung with various compositions. [15] Also stated that the optimum composition obtained in the construction of charcoal briquettes is 50%:50% and at a temperature of 4000C with an inherent moisture value of 2.13 percent, ash 2.66 percent, volatile matter content 25.33 percent, fixed carbon 72 percent, and calorific value 6775.6 cal/g. The ability to boil the most water in a mixture of candlenut shell charcoal briquettes and bamboo petung with varying material compositions, specifically 9 liters of boiling water for B4 briquettes. The highest combustion efficiency is found in a mixture of candlenut shell charcoal briquettes and bamboo petung with varying material compositions, specifically B4 briquettes (54.78%). If we look at the data above, we can see that biochar briquettes ignite faster in the briquette flame test because the volatile matter in charcoal briquettes is higher than in coal. Meanwhile, coal briquettes have a longer burn period than charcoal briquettes since they contain more carbon.

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