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COMPARISON OF THE QUALITY OF COCONUT SHELL BRIQUETTES AND CANDLENUT SHELLS AS ALTERNATIVE FUELS

Perbandingan Kualitas Briket Tempurung Kelapa Dan Cangkang Kemiri Sebagai Bahan Bakar Alternatif

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Kata kunci:
Briket; cangkang kemiri; nilai Kalor; tempurung kelapa

Abstrak. Penelitian tentang Perbandingan Kualitas Briket Tempurung Kelapa Dan Cangkang Kemiri Sebagai Bahan Bakar Alternatif telah dilakukan. Tujuan penelitian ini adalah untuk menentukan kualitas briket cangkang kemiri dan tempurung kelapa sebagai sumber bahan bakar alternatif. Untuk analisis kadar air, kadar abu, kadar zat mudah menguap digunakan alat tanur, sedangkan untuk analisis nilai kalor di gunakan alat Bomb Kalorimeter. Hasil penelitian menunjukkan bahwa sampel briket tempurung kelapa memiliki kualitas lebih bagus dari sampel briket cangkang kemiri.

Keywords:
Briquettes; candlenut shells; heating value; coconut shell.

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Abstract. Research on Comparison of the Quality of Coconut Shell Briquettes and Candlenut Shells as Alternative Fuels has been carried out. The purpose of this study is to determine the quality of candlenut shells and coconut shell briquettes as an alternative fuel source. For analysis of water content, ash content, volatile matter content, used is furnace tool, while for the calorific value analysis a Calorimeter Bomb is used. The results showed that the samples of coconut shell briquettes have better quality the candlenut shell briquettes samples.

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INTRODUCTION

The utilization of coconut shell waste and candlenut shell waste in various applications has been carried out. One form of utilization is as a briquette. Briquettes with raw material for coconut shell charcoal have the highest heating value among other biomass briquettes, which is 5780 cal/gr and causes black smoke by 44%

According to Suhartana (2007), the chemical composition of the coconut shell produced of the results by Chereminisoff's research is presented in Table 1.

Table 1. Chemical composition of coconut shell

No	Component	Content (%)
1	Cellulose	26,60

2	Pentose	27,70
3	Lignin	29,40
4	Extractive solvent	4,20
5	Uronate anhydrides	3,50
6	Solubility in water	8,01
7	Solubility in nitrogen	0,11
8	Ash	0,62

Candlenut shell has a thickness of about 3-5 mm, brown or blackish. This seed coat is the hardest part of the fruit. Candlenut seeds have a rounded or pyramid shape, somewhat flattened with one pointed tip. The seed diameter reaches 1.5-2 cm. Inside is a stiff white seed flesh. So that if traced from the outside into successive parts of the hazelnut are the outer skin, the layer of wood, the layer of seeds, endosperm and cotyledon (Botahala Loth, 2019). The chemical composition of the candlenut shells (Marzuki et al., 2020; Botahala Loth, 2019) can be seen in Table 2.

Table 2. Chemical Composition of Candlenut Shells

No	Component	Content (%)
1	HOLOCellulose	49,22
2	Pentose	14,55
3	Lignin	54,46
4	Extractive :	
	- Solubility in cold water	1,96
	- Solubility in hot water	6,18
	- Solubility in benzene alcohol	2,69
5	Solubility in NaOH 1%	17,14
6	Ash	8,73

Application of hazelnut shells has been widely carried out, among others for the treatment of liquid waste (Surest AH, *et al*., 2008), as an adsorbent for toluene (Bukasa A. Dewi *et al*., 2012), as an adsorbent in the purification of used cooking oil (Loth B., *et al*., 2016), as adsorbents of Fe metal in dug well water (Botahala L., *et al*., 2018), for the manufacture of briquettes (Koly F., *et al*., 2018), as absorbents in the purification of cooking oil (Botahala L. , *et al*., 2019), and others.

Briquette quality requirements based on SNI-1-6235-2000 (Putri R. E., *et al*, 2017 and Rindayatno *et al*, 2017) as in Table 3.

Table 3. Briquette quality requirements

Parameter	SNI-1-6235-2000
Water content (%)	≤ 8
Ash content (%)	≤ 8
Volatile Substances (%)	≤ 15
Heat Value (cal/g)	≥ 5000

The determination of the calorific value is done using the Calorimeter Combustion Bomb tool. The heating value of a fuel is the maximum amount of heat energy released by a fuel through the combustion reaction of the mass or volume of fuel. Analysis of the heating value of a fuel is intended to obtain data about the heat energy that can be released by fuel by the reaction or combustion process. The instrument used to measure the heating value is called a bomb calorimeter. Bomb calorimeter works with the principle of adiabatic, which means there is no heat entering or leaving the system, so the conditions are ideal (Nurchayati, 2012).

Materials and Methods

Location and Time of Research

This research was conducted on May 2019 at the Laboratory

Materials and Tools

The materials used in this study were coconut shells, candlenut shells, tapioca flour, and water. While the tools used are drums (used drum modification), desiccators, mortar and pestle, analytical balance, 40 mesh sifter, crucible cup, spatula, watch glass, manual furnace, watch glass, electric oven, furnace, and calorimeter bomb.

Procedure

Making Charcoal

Coconut shells and candlenut shells that have been prepared are gradually put into the drum furnace (the process of making each type of raw material). After that, it is burned using a manual furnace for 2 hours. Charcoal that is formed is removed and cooled. After chilling, charcoal is mashed and sieved. Furthermore, as much as 10 grams of tapioca flour is diluted with 75 mL of water, then put into 400 mL of boiling water and stirred until evenly distributed. After that 10% adhesive is taken and added to each charcoal sample to be printed.

Determination of Water Content And Porosity

A total of 2.2 grams of briquettes of each sample was put into crucibles and then put to a temperature of 500ºC for 3 hours. The briquette is then cooled in a desiccator and weighed. The briquette is reheated for 30 minutes then cooled in a desiccator then weighed. This process is repeated until a constant weight of briquette is obtained. Determination of water content and porosity can be calculated by the equation (Botahala, *et al*, 2013) (Bapa *et al*, 2019):

$$\%\text{ Water content} = \frac{A-B}{A} \times 100\%$$

$$\text{Porosity} = \frac{A-B}{V_b} x \frac{1}{\rho_{air}} \text{ X } 100\%$$

Note: A is the mass of the sample before it is heated (after being reduced by the mass of the empty cup), B is the mass of the sample after being heated (after being reduced by the mass of the empty cup). V_b is the volume of the test specimen, and ρ water is the density of water (considered 1 gr / cm^3);

Determination of Ash Content

A total of 2.2 grams of briquettes were placed in a crucible and then heated into a furnace at 900 ° C for 3 hours then cooled in a desiccator and weighed. Determination of ash content can be calculated by the equation (Botahala, et al, 2013, Botahala, *et al*., 2018, and Botahala *et al*, 2019):

$$\text{Ash content} = \frac{B}{A} \times 100\%$$

Determination of Volatile Substances

A total of 2.2 grams of briquettes were put into crucibles and put in a furnace at 500 ° C for 7 minutes. After that, it is cooled in a desiccator then weighed. Determination of the vaporized young substance can be calculated by the equation (Bapa *et al.* 2019):

volatile substance content = $\frac{A-B}{B} \times 100\%$

Determination of Calorific Value

A total of 2.2 grams of briquettes are placed in crucibles and put into bombs, and the bombs are put into water in calorimeter vessels. After that, the top of the vessel is closed. The water in the vessel is stirred automatically by a stirrer driven by a driving motor. After the bomb has been in the water for 5 minutes, the temperature reading begins, and the reading is done every minute for 5 minutes. At the 6th minute, combustion begins with the intermediation of a nickel wire that is glowing instantly because of an electric current. The reading is repeated until the highest temperature is reached. Then the temperature will start to fall slowly and the temperature reading is done every minute to about ten minutes. Bomb be appointed from the calorimeter and the lid is opened slowly.

Measurement of heat value can be calculated based on the following equation (Almu, *et al*., 2015):

$$\text{Heat value (cal / g)} = \frac{(T_2 - T_1)}{A} \text{ x B}$$

T1 = initial temperature (° C)
T2 = temperature after combustion (° C)
A = mass of sample burned (gram)
B = heat correction factor for each temperature increase of 1 ° C = 2575.6 cal / ° C.

Result and Discussions

Data on the results of briquette charcoal briquette test samples and candlenut shell charcoal samples can be seen in Table 4.

Table 4. Test Result Data for Coconut Shell Charcoal and Candlenut Shell Charcoal

Charcoal Samples	Water Content (%)	Porosity (%)	Ash Content (%)	Volatile Content (%)	Calorific Value (kal/g)
Coconut Shells	4,833	0,053	3,230	8,124	6007,04
Candelnut Shells	6,924	0,076	16,060	6,858	5513,18

Note: 10% tapioca adhesive

From the data Table, 4 shows that the test parameters of all samples meet SNI requirements except the ash content value of the candlenut shell briquettes has exceeded twice the SNI standard. This is thought to be due to the texture comparison between the two samples, the density of the coconut shell is higher than the candlenut shell. The high ash content can affect the heating value produced. Because the ash content occupies the pore formed in the briquette so the rate of heat transport is inhibited.

If viewed from the comparison of the two samples of the briquettes, it can be said that the sample of coconut shell briquettes has better quality than the sample of candlenut shell briquettes. This can be chosen from the value of low water content and is supported by the formation of a few pores and low values of ash and volatile substances can obtain a fairly high calorific value.

Conclusion

The results showed that the sample of coconut shell briquettes had better quality, where the data analysis of water content, porosity, and ash content, had an impact on the high calorific value compared with candlenut shell briquette samples.

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