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Analysis Proximate, Ultimate, and Thermal Gravimetric Based on Variations Dimensions of Briquettes from Waste Jackfruit Crust

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Abstract— *This research was conducted to test proximate, ultimate, thermal gravimetic analysis based on variations in dimensions of briquettes from jackfruit crust, the process of charcoal making using pyrolysis furnaces. Jackfruit crust heating in the furnace uses a temperature of 550^{0}C for 30 minutes, after the white stove smoke is turned off and all the furnace doors are closed so that the jackfruit crust becomes charcoal and is held for 12 hours. Then the charcoal is removed and crushed with a crushing machine with an 80 mesh charcoal powder size. Then mixed with the adhesive material of tapioca flour with a weight percentage of 5% of the total weight of charcoal powder and enough water to be made to make the mixture. After that the dough is printed with a briquette dimension of 30 mm in diameter, and 40 mm, 50 mm, 60 mm in height and then dried. After being dry, proximate, ultimate and thermal gravimetric are tested.*

The objective of the research is to test the title proximate, ultimate, thermal gravimetric based on the dimensions variation of briquettes from jackfruit crust material is to obtain the same briquette heat value as the briquette heat value with SNI No.1 / 6235/2000 and the best thermal gravimetric using 80 Mesh briquette powder size with 30 mm diameter dimensions and 40.50 and 60 mm briquette lengths.

The results of testing proximate briquettes diameter 30 mm, and height 40 mm, 50 mm, 60 mm the calorific value above the Quality Standard of Wood Charcoal Briquettes SNI No.1 / 6235/2000 that is ≥ 5000 calories / gram. The ultimate test results based on the Dulong (1880) formula on briquettes with dimensions of diameter 30 mm, height 50 mm and 60 mm have a kaor value of ≥ 5000 calories / gram, and briquettes with a diameter of 30 mm and a height of 40 mm have a heating value of ≤ 5000 calories / gram. The best thermal gravimetric analysis of briquettes is briquettes with a diameter of 30 mm and a height of 60 mm because the percentage of burning briquettes is the lowest at 15.68% of the initial weight to reach temperatures of 301.70 C.

Keywords— *Briquettes, jackfruit crust, waste.*

I. INTRODUCTION

Energy needs and consumption are increasing in line with the increase in the human population and the increasing economic community. In Indonesia, energy needs and consumption are focused on the use of fuel oil whose reserves are depleting while on the other hand there is still a lot of abundant biomass energy that has not been optimized for use [3]. Energy problems cannot be separated from human life. Population growth, increasing human life patterns and the growing number of industries have resulted in increasing demand for energy needs, while the availability of energy reserves has diminished. This has resulted in an increase in the selling price of kerosene in Indonesia. Therefore, environmentally friendly alatern fuels are needed as a substitute for kerosene for small industries and households. One alternative energy is the use of briquettes from biomass waste [6].

The 2006-2025 National Energy Processing blueprint stated that 45.81 GW of biomass energy potential owned by Indonesia was only about 0.3 Gw which had been utilized. This biomass energy source includes jackfruit crust biomass. Indonesia, especially the Special Region of Yogyakarta is a warm city that produces abundant jackfruit crust waste which has the potential to be used as an alternative fuel as a substitute for kerosene and fuel wood for household use. Non-fossil energy available 75.67 GW water turbine installed 4.2 GW utilized 5.55% and for geothermal energy available 27 GW and installed 0.8 GW utilized 2.96% while for available biomass 49.81 GW and installed 0.3 GW utilized 0, 6%. The national energy management blueprint can be seen in table 1 [2].

TABLE 1. National energy potential

Non-fossil energy	Sources	Equal	Installed capacity
Water energy	84.500 millian BOE	75,67 GW	4,2 GW
Geothermal	219 million BOE	27.00 GW	0,8 GW
Micro hydro	0,45 GW	0,45 GW	0,206 GW
Biomass	49,81 GW	49,81 GW	0,3 GW
Solar energy	-	480kWh/m^2/day	0,01 GW
Wind energy	9,29 GW	9,29 GW	0,0006 GW
Uranium (nuclear)	24.112 tons eq 3 GW For 11 years		

The formulation of the problem in this study is how to get energy with low cost and environmentally friendly by utilizing biomass energy from jackfruit crust. How is the process of making briquettes with several dimensions from jackfruit crust material whose calorific value meets SNI No.1 / 6235/2000 standards and optimum thermal gravimetric analysis.

The results of this study aim to support strategic plans and road maps and research outputs of leading fields at the Institut Sains & Teknologi AKPRIND Yogyakarta. Whereas the benefits of this research are to obtain the optimum briquette dimensions whose heat values are in accordance with SNI 01-6235-2000 standards.

II. Material and Method

Fig. 1. The process of making briquettes.

From this research, it is expected to produce biomass briquettes from jackfruit crust waste with appropriate calorific value in accordance with Quality Standard of Wood Charcoal Briquettes (SNI No. 1/6235/2000) and continued with discussion and conclusions.

Bioarang rice husk briquettes that have been made with tapioca starch adhesive are tested for their thermal characteristics in various adhesive materials [3]. The highest calorific value of briquettes was obtained at 2789 cal / g with a combustion efficiency of 59.07% for the type of rice husk briquettes with 7% tapioca adhesive mixture.

Making jackfruit crust briquettes by making jackfruit crust briquettes with 40, 60 and 80 mesh powder grain with 30 mm briquette diameter and 40 mm height and briquettes that have heating values close to the Quality Standard of Wood Charcoal Briquettes (SNI No. 1/6235/2000), making jackfruit crust briquettes with 80 mesh powder grain with 30 mm briquette diameter and 40 mm, 50 mm high and 60 mm briquettes made have heating values close to the Quality Standard of Wood Charcoal Briquettes (SNI No.1 / 6235/2000) [7] and [8].

TABLE 2. Quality standards for wood charcoal briquettes [5]

Parameter	Quality Standards for Wood Charcoal Briquettes (SNI No.1 / 6235/2000)
Water content (%)	≤ 8
Ash content (%)	≤ 8
Carbon content (%)	≤ 77
Calor value (kal/kg)	≤5000

III. Resul and Discussion

The results of the research from proximate can be seen in table 3 below.

TABLE 3. Proximate test results

Briquettes Ø 30 mm	Analysis of test results				
	% Ash	% Water	% Volatil matter	Fixed Carbon	Calor value (Kal/g)
Height 40 mm	12,385	10,538	18,124	58,953	5377,922
Height 50 mm	11,920	10,226	17,693	60,616	5410,397
Height 60 mm	14,074	11,156	13,603	61,167	5727,513

TABLE 4. Ultimate test results

Sample	Ash (%)	Carbon (%)	Hydrogen (%)	Nitrogen (%)	Sulfur (%)	Oxygen (%)
Ø 30 mm H 40 mm	12,65	58,92	3,76	1,02	0,15	23,89
Ø 30 mm H 50 mm	12,35	59,93	3,63	1,07	0,14	22,88
Ø 30 mm H 60 mm	13,28	59,69	3,77	1,33	0,16	21,77

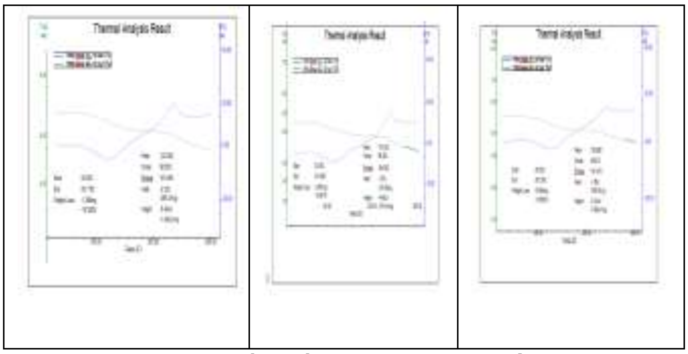

Fig. 2. *Thermal gravimetric* testing result

1. The Results of the Proximate Analysis

Table 3 shows the results of the research proximate percentage of ash, water, volatile matter, fixed carbon effect on the heat value of briquettes as for the influence of such alloying elements as follows:

a. *Water content*

Briquette moisture content affects the heating value. The smaller the water content, the better the calorific value. Based on table 2 the water content is best in briquettes with Ø30 mm and height 50mm and the worst moisture content of briquettes Ø 30 mm and height 60 mm is 11,156% and the best briquettes Ø 30 mm and 50mm height of 10,226%, for the moisture content of this study has not reached the standard SNI No1 / 6235/200 because it is still above 8%. As for the more clear water content values as in graph 1.

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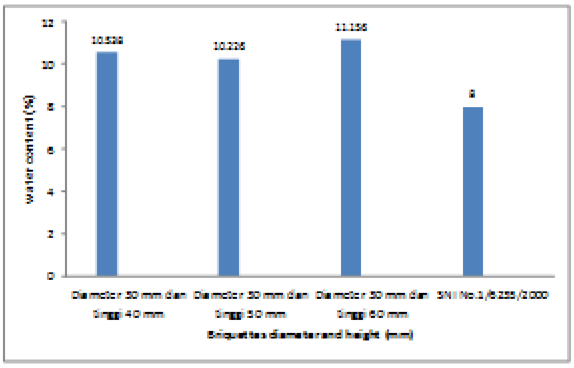
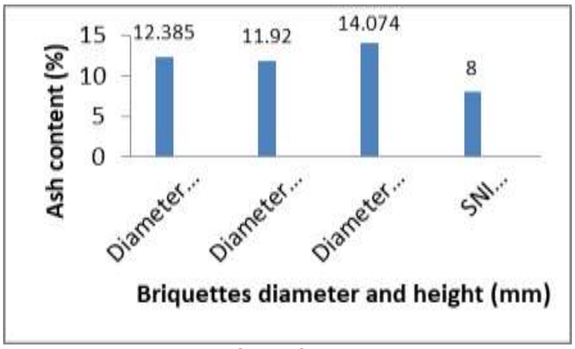


Graph 1. Water content

b. Ash content

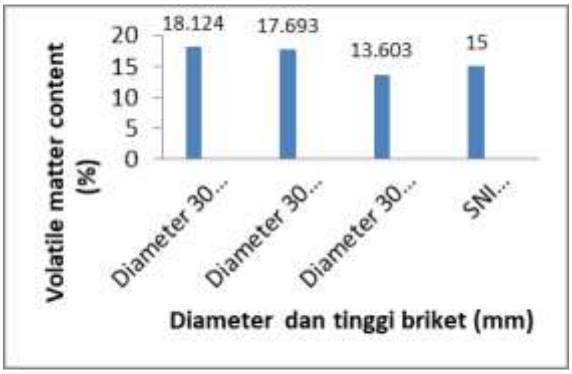
Ash is the remaining part of the combustion in this case is the residual burning of charcoal briquettes. One of the constituents of ash is silica. The effect is not good for the calorific value of the briquettes produced. The high ash content can reduce the heat value so that the quality of the briquettes decreases. Based on table 2 the best ash content in briquettes with a diameter of 30 mm and height of 50 mm the size of 11.920% and the worst in briquettes with a diameter of 30 mm and a height of 60 mm is 14.074%. 200 because it is still above 8%. As for the percentage of ash content can be seen on graph 2.



Graph 2. Ash content

c. Volatile matter

Volatile matter content aims to determine the amount of substance (volatile matter) that can evaporate as a result of the decomposition of compounds that are still present in other than water. The high volatile content in charcoal briquettes will cause more smoke when briquettes are turned on.

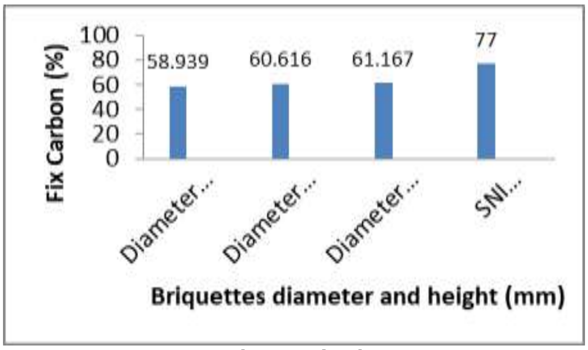


Graph 3. Volatile matter

High smoke content is caused by the reaction between carbon monoxide (CO) with alcohol derivatives high and low levels of briquette volatiles produced are influenced by the type of raw material, so that the difference in the type of raw material significantly affects the volatile briquette levels of volatile briquettes. The results of the tests that have been carried out as in table 2 of volatile matter values which are below the standard of the Minister and Energy (ESDM) No. 04 of 2006 is a maximum of 15% is briquettes with a diameter of 30 mm and a height of 60mm which is 13.603% ≤ 15%.

d. Fixed carbon

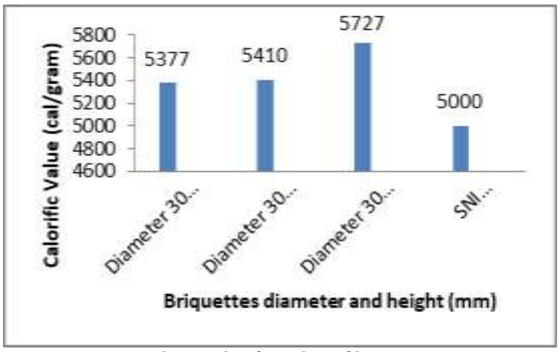
The bound carbon content in charcoal briquettes is recognized by the value of ash and carbon content and decomposition of volatile compounds. Bonded carbon content will be of high value if ash content and decomposition levels of low volatile compounds and good briquettes have a high carbon content, carbon content that is close to SNI No1 / 6235/200 which is 77% is briquette with a diameter of 30 mm and a height of 60 mm % carbon is 61.167%. As for the amount of carbon in the proximate test as shown in graph 4.



Graph 4. Fixed carbon

e. Calorific value

The heating value greatly determines the quality of charcoal briquettes. The higher the calorific value of charcoal briquettes, the better the charcoal briquettes produced, as for the briquette research data from jackfruit crust material with a diameter of 30 mm and height of 40 mm, 50 mm and 60 mm, all achieve the standards of SNI No1 / 6235/200 because the calorific value produced above 5000 cal / gram. As for the clearer the calorific value of the research results can be seen on graph 5.



Graph 5. Calorific value of briquettes

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2. The Results of the Ultimate Analysis

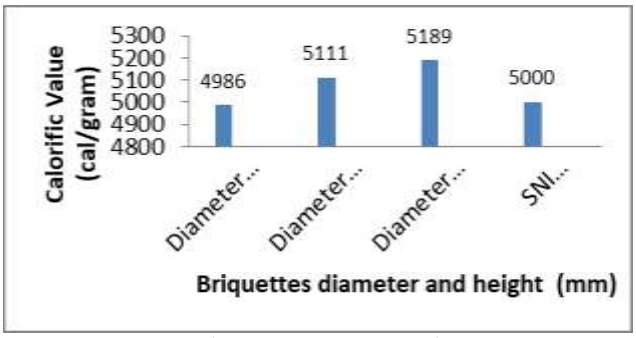
From table 4 the results of ultimate research on the percentage of ash, carbon, hydrogen, nitrogen, sulfur and oxygen affect the heating value of briquettes as for calculating heat values by using the formulas below for briquettes with Ø 30 mm and H 40 mm with dulong formula (1880), Vondrecek (1927) and D Huart (1930) (Changdong 2005) are as follows:
HHV Dulong (1880) = 0.3383.C + 1,443 (H-O / 8) + 0,0942S
= 0.3383. 58,92 + 1,443 (3,376-23,89 / 8) + 0,0942.0,15
= 20,871 MJ / Kg
= 4,986 Calori / gram

In the same way for briquettes with Ø 30 mm and H 50 mm and Ø 30 mm and H 60 mm then the calculation results are as in table 5.

TABLE 5. Calculation of ultimate testing heat values

Sample	Researcher	High Heating Value	Calorific value (cal/gram)
Ø 30 mm and H 40 mm	Dulong (1880)	0,3383C+1,443(H-(O/8))+0,0942S	4.986
Ø 30 mm and H 50 mm	Dulong (1880)	0,3383C+1,443(H-(O/8))+0,0942S	5.111
Ø 30 mm and H 60 mm	Dulong (1880)	0,3383C+1,443(H-(O/8))+0,0942S	5189

From the calculation of heat values for the Dulong formula (1880), as in table 5 can be analyzed as in the graph below.



Graph 6. Calorific value with the Dulong formula (1880)

Graph 6. in the calculation of dolung (1880) the calorific value under the standard SNI No1 / 6235/200 on briquettes with Ø 30 mm and H 40 mm the size of 4986 cal / gram.

3. The Results of Thermal Gravimetric

From the results of thermal gravimetric analysis as in figure 2, it is seen to reach a temperature of 301.76^{0}C, briquette with dimensions of diameter 30 mm and height of 60 mm is best because the percentage of burnt briquettes is lowest at 15.68% of the initial weight followed by briquette with a diameter dimension 30mm and 50 mm height and 30 mm and 60 mm height respectively 19.667%, 19.938% of the initial weight

IV. Conclusion

1. In ultimate testing (indirect calculation of 1880 Dolung) briquettes with dimensions of 30 mm and H 40 mm the size is 4.986 calori / gram ≤ 5000 calori / gram under the standards of SNI No1 / 6235/200 and for bibriketdimensions in diameter 30 mm and height 50 and 60mm the calorific value is ≥ 5000 calori / gram.
2. On the proximate test of charcoal leather briquettes for dimensions of diameter 30 mm and height 40 mm, 50 mm and 60 mm, it meets the standards of SNI No1 / 6235/200 which is the result of proximate testing the calorific value of 5,000 5000 calori / gram.
3. In the best TGA briquette testing with briquettes with a diameter of 30 mm and a height of 60 mm the lowest burning mass is 15.68% to reach a temperature of 301.76 ^{0}C,

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