Effect Of Tapioca Adhesives On Combustion Characteristics Briquettes Of Durian Waste And Wood Powder

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Abstract: An agrarian country with a tropical climate, Indonesia has a very natural potential for agricultural products. The management of large natural resources is in dire need of technological development for the production of agricultural products. Technological advances will continue to evolve in step with growing human resource needs, which will require the knowledge, skills and readiness to accept technical changes. Technological progress requires a lot of energy. Excessive use of fossil fuels (gas and oil) tends to reduce the volume of oil and gas reserves. It is therefore necessary to look for new sources of energy to reduce dependence on fossil fuels while strengthening energy security. The alternative energy solutions presented in this study focus on the presence of organic waste / waste in briquettes as a source of energy. In this study, briquettes were made with tapioca glue at 6%, 9%, 12% and 15% of the total carbon biomass in order to obtain heat (cal) and the rate value. of combustion (g /s). Wood powder briquettes are faster than durian peel briquettes. The comparison of flame time between durian peel briquettes and wood powder briquettes has a different ignition. the burning time of the wood powder briquettes with the same variation of adhesive as T cost = 250^{0}C burns faster, for {6,9,12,15}% of successive tapioca with time {3,27; 3.53; 3.57; 4.11} minutes compared to durian peel briquettes for {4.15; 4.23; 5.28; 6.29} minutes. Wood powder briquettes burn faster than durian peel briquettes. The smallest variation in the adhesive value of tapioca is 6%, at the burning rate of durian peel briquettes of 0.2616 g/min, while durian peel burning 0.2744 g/ min . While the variation of 6% of the value of the adhesive of the wood powder, the burning rate is 0.2142 g/min and the highest of 15% with a burning rate of wood powder. 0.2222 g/min. There are several influencing factors because the amount of adhesive contains the amount of water and fiber contained in the briquette material. By using the waste in briquettes, it is hoped that this will reduce some of the waste problem, reduce unemployment and meet national energy needs.

Index Terms: briquette, durian peel, wood powder, adhesive, burn rate

1. INTRODUCTION

Technological advances will continue to evolve in step with growing human resource needs, which will require the knowledge, skills and readiness to accept technical changes. Technological progress requires a lot of energy. Excessive use of fossil fuels (gas and oil) tends to reduce the volume of oil and gas reserves. It is therefore necessary to look for new sources of energy to reduce dependence on fossil fuels while strengthening energy security. The alternative energy solutions presented in this study focus on the presence of organic waste as a source of energy, converting briquettes into energy to produce new energy reserves that are beneficial to the community while reducing the amount of waste that can harm the environment and cause disease. Estimates of the amount of waste in Indonesia were 37.38 million tonnes in 2014 and increased by more than 50.45 million tonnes in July 2017[1]. In order to optimize the use of organic waste this study focused more on durian waste and wood powder. given the existence of these two wastes, it is often found in major cities in Indonesia. The durian fruit is a tree that grows a lot and is found in the countries of Southeast Asia, especially Indonesia. Its aroma and taste are very popular in the community and can be turned into other tasty durian foods. In the big cities of Indonesia, the durian is the icon of a city that aims to allow tourists to visit and savor the aroma and taste served.

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On the other hand, wood powder waste is obtained from the remnants of wood planer process that are often found in the woodworking industry. Bio charcoal briquettes are one of the fuels derived from biomass. The biomass used in research is the coconut shell and the wood powder. The results of his research showed that the composition of the briquetting material had a very significant effect on the water content, the heat value and the ash content[2]. Charcoal briquettes can be made in two ways: by making charcoal, then by mashing and briquetting, or by forming briquettes by compressing and then making them[3]. The results of research found that the calorific value of charcoal briquettes was 2789 kcal/g. Compression pressure is given to create contact between the surface of the material bonded to the adhesive. Once the adhesive is mixed and the pressure begins to be applied, the adhesive still in the liquid state will begin to flow and divide on the surface of the material. As the flow occurs, the adhesive also moves from the adhesive surface to the surface that is not yet adhesive[3]. The addition of adhesives has a significant effect on briquette characteristics, namely density, compressive strength, ash content and moisture content[4].

2. LITERATURE REVIEW

Fuel is any material that can be converted into energy. Usually, fuels contain thermal energy that can be released and manipulated. Most fuels used by humans during the combustion process will then release heat after reacting with oxygen. The good quality briquettes have properties such as smooth textures, difficult to break, hard, safe for man and the environment and with good ignition properties. These ignition properties are flammable, the ignition time is quite long, does not cause soot, the smoke is small and quickly lost and the calorific value is quite high. The duration of ignition will affect the quality and efficiency of combustion[5].

2.1 Calculation of briquette characteristics

The phase of calculation of the characteristics of the briquettes is the phase of test making it possible to calculate the density and the rate of combustion

Heat Value

$$H = \frac{W \times T - E1 - E2}{m}$$

Density

$$\rho = \frac{m}{\rho}$$

Where:

ρ = density (g / cm ^{3})
m = mass (g)
v = volume (cm ^{3})

2.2 Briquette Burn Rate

The burning rate of the briquettes is the ratio of the mass of the material to the test time where the material is tested. The burn rate can be calculated using the formula:

$$M = \frac{m}{s}$$

Where:

M =burning rate (gr / minute)
m = mass of test material (gr)
s = time (minute)

2.3 Calculation of ash content:

$$\text{Ash \%} = \frac{F}{C} \times 100\ \%$$

Where:

F = weight of residue
C = sample weight

3. RESEARCH METHODS

The method used in this study is the experimental method.

Tools and materials

The tools used in this study include 60 mesh screens or the equivalent of 0.250 mm, carbonized drums, chopper, briquette moulding, digital scales, thermocouples, ovens, stop watches, jars water, measuring cups, spatulas, bomb calorimeter and lighters. The material used in this study is durian peel, wood powder, water, tapioca flour

Briquette making

The durian peel and wood powder is chopped and crushed with a chopper, then the already smooth and dry skin is placed in the burning drum for about 3-4 hours. The carbon particles produced were refined with a mesh size of 60 mesh mixed with the amount of tapioca adhesive 6% (2.04 g), 9% (3.06 g), 12% (4.08 g)), 15% (5.1 g) of 34 g. The carbon particles of the durian peel and wood powder are mixed with clean, heated water until the tapioca flour solution thickens and changes color to become a starch adhesive . The blended material is printed and then dried in a heating oven at 150 ^{0}C in 20 minutes to reduce the water content of the briquettes. The characteristics of the briquettes are tested by inserting them in an oven at a constant temperature of 250 ° C.

4. RESULTS AND DISCUSSION

4.1 Heat Value Test

The calorific value is tested with a bomb calorimeter to obtain the value of the thermal energy contained in the bio charcoal (durian peel) with a tapioca flour adhesive.

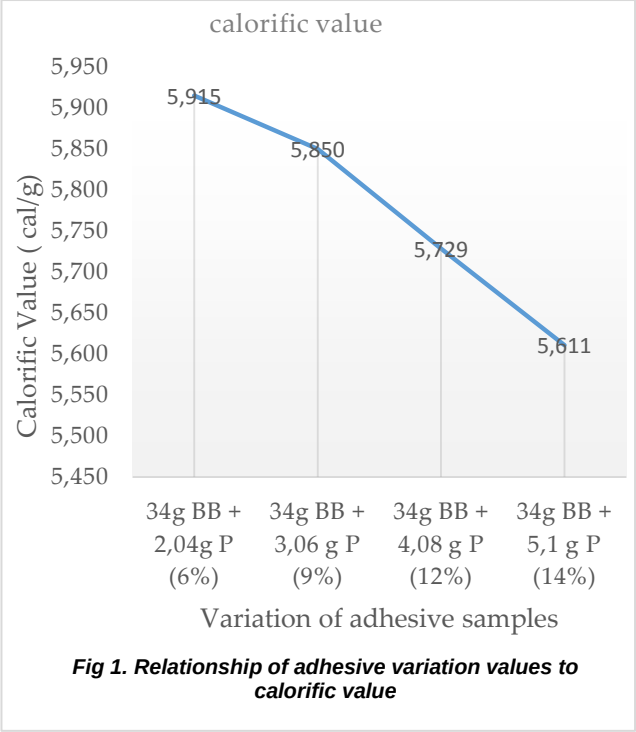


Fig 1. Relationship of adhesive variation values to calorific value

Figure 1 above shows that the increase in calorific value is inversely proportional to the increase in the percentage of adhesive for tapioca flour in each sample of briquettes. The highest calorific value is 5915 cal/g (34 g coal powder, 6% adhesive), while the lowest value is 5611 cal/g (34 g coal powder and 14% adhesive). Based on the calorific value test of this study, it can be analyzed that the addition of tapioca flour to briquettes should be controlled, tapioca from moisture-sensitive vegetable (biological) ingredients; excessive use can therefore increase the water content and the ash content, which damages the heat of the briquettes.

Burn Rate Test

The test of the burning rate of durian briquettes and wood powder is carried out with the aim of obtaining an energy efficiency value making it possible to determine the feasibility of the material used. This test is performed by observing the phenomenon that occurs when the briquette is introduced into the oven from volatile material, combustion occurs until the briquettes are completely ashy.

TABLE 1

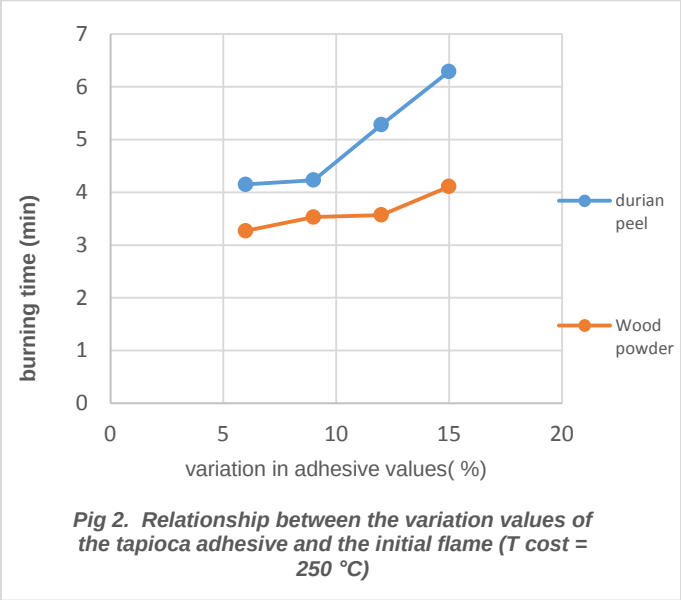
Relationship of the variation of the adhesive value of tapioca with durian peel briquettes with a combustion time (T cons 250 ^{0}C)

Adhesive Value (%)	burning time (min)	time stop burn (min)	Temp. max (^{0}C)
6	4,15	187,25	297
9	4,23	190,11	297
12	5,28	191,56	288
15	6,29	193,13	288

TABLE 2

Relation of the variation of the adhesive value of tapioca with briquettes of wood powder with a combustion time (T cons 250 ^{0}C)

Adhesive Value (%)	burning time (min)	time stop burn (min)	Temp. max (^{0}C)
6	3,27	168	295
9	3,53	170	295
12	3,57	174	295
15	4,11	180,02	295



Pig 2. Relationship between the variation values of the tapioca adhesive and the initial flame (T cost = 250 °C)

Figure 2. above shows that the increasing the amount of adhesive mixed with the briquettes, the longer the burning time. The comparison of flame time between durian leather briquettes and wood powder briquettes has a different ignition. the burning time of the wood powder briquettes with the same variation of adhesive burns faster for 6% tapioca in 3.27 minutes, compared to durian briquettes of 4.15 minutes

TABLE 3

Fuel distribution at a rate burning briquettes (T cons = 250 ^{0}C)

Fuel carbon + adhesive particles	burning rate (g/s)	
	durian peel briquettes	Wood powder briquettes
34g BB + 2,04g P (6%)	0,2616	0,2142
34g BB + 3,06g P (9%)	0,2682	0,2176
34g BB + 4,08 g P (12%)	0,2714	0,2183
34g BB + 5,1g P (15%)	0,2744	0,2222

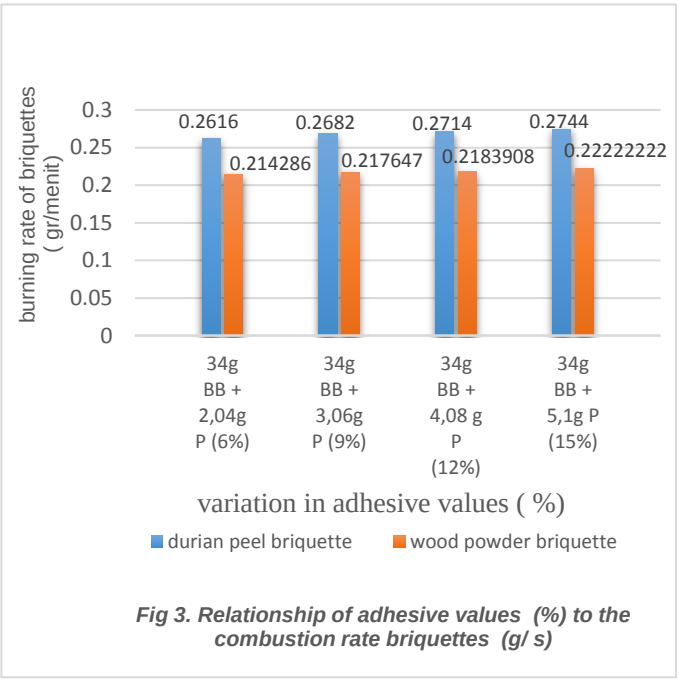


Fig 3. Relationship of adhesive values (%) to the combustion rate briquettes (g/ s)

Figure 3 above shows that the increase the percentage of adhesive given, the higher the burning rate of the briquettes. Wood powder briquettes burn faster than durian peel briquettes. The smallest variation in the adhesive value of tapioca is a 6% variation with the burning rate of durian leather briquettes of 0.2616 g/min, while the highest value is 15% with a speed of burning of the durian peel of 0.2744 g / min. While in the wood powder, the variation of the adhesive value is 6%, the burn rate is 0.2142 g/min and the highest of 15% with a burning rate of the wood powder 0.2222 g/min. There are several influencing factors because the amount of adhesive contains the amount of water and fiber contained in the briquette material.

5. CONCLUSION

From the results of the research conducted, conclusions are drawn:

1. The increase in heating value is inversely proportional to the increase in the percentage of adhesive for tapioca flour in each sample of briquettes. The highest calorific value is 5915 cal/g (34 g 6% coal powder adhesive) while the lowest value is 5611 cal/g (34 g of 14% charcoal powder adhesive)
2. The larger the amount of adhesive, the longer the briquette burns
3. Wood powder briquettes light up faster than durian peel briquettes. the burning time of the wood powder briquettes with the same variation of adhesive as T cost = 250 ^{0}C burns faster, for {6,9,12,15}% of successive tapioca with time {3,27; 3.53; 3.57; 4.11} minutes compared to durian leather briquettes for {4.15; 4.23; 5.28; 6.29} minutes
4. increases the burning time
5. Wood powder briquettes burn faster than durian leather briquettes. The smallest variation in the adhesive value of tapioca is 6% with a durian peel burn rate of 0.2744 g/min. While in the wood powder,

the variation of the adhesive value is 6%, the combustion rate is 0.2142 g/min and the highest is 15% with a combustion rate of the powder of wood of 0.2222 g/ min

6. Factors affecting the amount of adhesive containing the amount of water and fiber contained in the briquette material

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