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The Effect of Hibiscus Leaf's Adhesives on the Quality of Cow Dung Husk Charcoal Briquettes

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ABSTRACT

The research to find out the good briquette adhesive has been done, however the results have not been satisfactory yet. This study aims to determine the effect of hibiscus leaf adhesive (Hibiscus rosa-sinensis L) on charcoal briquette organic charcoal. The materials used in the manufacture of cow dung husk charcoal briquettes are rice husk and cow dung. The research was conducted in biology garden of Science and Technology Faculty, Islamic State University of Sunan Gunung Djati Bandung from May to June 2015. The research was conducted by using Random Design Complete (RAL) Factorial 3 X 4 with twice repetition (duplo). There are 3 compositions of treatment rice husk: cow dung, that are: 1: 1, 3: 1 and 1: 3, and addition of 4 levels adhesive from hibiscus leaf (Hibiscus rosa-sinensis L.), that are; control (without adhesive), 10 grams, 15 grams and 20 grams. The results showed that the adhesive combination of hibiscus leaves and the composition of organic charcoal briquettes was highest at density of 0.89 g / cm3, calorific value of 2432.62 cal / g, carbon content of 25.49% and lowest at water content of 8.75 %, vapor content 32.89%, ash content 45%. The best treatment combinations were found in the ratio of rice husk: cow dung ie 1: 3 and adhesive concentration 15 grams with the best heat value of 2431,62 kal /g.

Introduction

The increasing of economic and population growth in Indonesia have led to increasing in energy consumption in all sectors of life such as transportation, electricity and industry. Meanwhile, national energy reserves are getting depleted, so there are needs to be various breakthroughs to prevent an energy crisis (Syamsiro and Saptoadi, 2007).

The biggest potential biomass waste is from forest wood waste, rice husk, corn, cassava, coconut, oil palm, sugar cane and cow dung (Widodo, et al., 2006). Rice husk is produced from a rice milling process that is not optimal in its utilization. As waste, rice husks often cause problems. However, it is very potential as an alternative energy from raw material, because it has a fairly high fuel value of 3500 kal / g (Sugiarti and Widyatama, 2009).

The use of bio-briquettes as fossil fuels has greater calorific value than biomass without being processed into briquettes (Afrizal et al., 2013). Besides that the utilization of livestock manure as a source of organic fertilizer in vegetable production centers is also not optimal, some of which are just wasted, because farmers have not been able to change the habit of using chemical fertilizers to increase crop production (Rahayu et al., 2009). Cow manure produces 4000 cal / g of heat and high methane gas, so that the content of methane in cow dung is an important element in making natural-based fuels (Anugrah, 2010).

Charcoal briquette is an alternative energy source that can be used to replace the use of kerosene. Charcoal briquettes are solid fuels and come from the remnants of organic product (Budiman et al., 2010).

Charcoal briquette is charcoal which got further processed into a form of briquettes that has more attractive appearance and packaging and can be used for daily alternative energy needs. Charcoal briquettes can be made from various materials, such as rice husks, wood, sawdust and cow dung. Charcoal briquettes can be interpreted as alternative ingredients because they can produce a calorific value of 4689-5213 kal/gr (Irfansyah, 2016). This calorific value can be compared with briquettes from coconut shell material which has a fairly high calorific value of 5,780 kal / g with an easier flame (Siti, 2008). But when compared to coal, bagasse and straw, coconut shell briquettes still need other additives as mixers to reduce pollution (Jeni, 2009).

The quality of charcoal briquettes can be seen from the ash content and bound carbon content. Bahri (2007) conducted a study on the utilization of wood processing industry waste for the manufacture of charcoal briquettes in reducing environmental pollution. Data was obtained that the quality of the briquettes made by Bahri (2017) has a standards equal to the British and Japanese standards; it also met the requirements of Japan's standards because it produced low ash, low volatile substances, high carbon content bound and high calorific value.

Many studies conducted by researchers in determining the composition and quality of bio briquettes. In the study carried out by I Gede Bawa Susana (2009), the tapioca flour and horse dung were mixed and the composition are 1:3, 1:5, 1:7, 1:10 the result is 1:10 composition has the highest calorific value; 4708,775 kcal/g. The quality of briquettes produced from another experiments with the composition goat dung and candlenut shells contained 5.58% moisture content, 23.93% ash content, 35.16% volatile meters, 35.33% fixed carbon and 4.563kal / g heat (Sulmiyati, 2017). However, the bio briquettes from rice husk is the best with thermal efficiency values 31.13% (Idzni et al., 2016).

According to Irawan (2011) adhesive is materials used to provide adhesion to bio-briquettes as solid fuels. The use of binder must be arranged so that the binder can be active in its use. At present, the adhesive that is commonly used to make briquettes is starch. According to Retno (2017) hibiscus leaf extract has mucous which contains flavonoids and saponins which function as anti-bacterial. This material is suitable to be an adhesive for making charcoal briquettes.

Hibiscus leaf (*Hibiscus rosa-sinensis* L) is a single leaf, oval or heart with jagged edges, tapered leaf tips, leaf veins runny and pinnate, have foliage. The leaves are green, the leaves are 5-10 cm long and 3.0-7.5 cm wide (Apriyanti and Kriswiyanti, 2008).

The chemical content of Hibiscus is cyaniding-diglukosida, hibisetin, bitter and mucous substances. The chemical content of this leaves is taraxeryl acetate which also contains flavonoids, saponins and polyphenols, flowers contain polyphenols, and its roots also contain tannins, saponins, scopoletin, cleomiscosin A and cleomiscosin C (Harbone, 1987).

The phytochemical screening of Hibiscus shows the presence of steroids or triterpenoids, flavonoids, tannins, quinones and saponins. In leaf ashes found potassium, sodium, calcium, magnesium, phosphorus and iron. The adhesive compounds in Hibiscus's (*Hibiscus rosa-sinensis* L.) leave is tannin. Tannin has special properties such as alkaloid precipitation, gelatin and other proteins (Harbone, 1987).

Based on the description above, it is expected that the addition of hibiscus leaf (*Hibiscus rosa-sinensis* L.) will affects the heat produced in the rice husk and cow dung briquettes; also it will improve the quality of this product.

Materials and Methods

The research was conducted at the Faculty of Science and Technology, Islamic State University of Sunan Gunung Djati, Bandung, starting in May to October 2016. The study used a completely randomized design (CRD) consisting of two factorials with three repetitions, the research method was as follows:

Factor I: Comparison of the composition of rice husk (S. paddy) and cow dung (K. cow) (B), which consists of 3 levels:

a. B0 = S. paddy: K. cow (1: 1)
b. B1 = S. paddy: K. cow (3: 1)
c. B2 = S. paddy: K. cow (1: 3)

Factor II: Addition of hibiscus leaf adhesive (*Hisbiscus rosa-sinensis* L.) (K), which consists of 4 levels:

a. K0 = No adhesive (No leaves added)
b. K1 = 10 grams of leaves
c. K2 = 15 grams of leaves
d. K3 = 20 grams of leaves

Tools and materials

The tools used in this charcoal briquettes research are drum, stirrer, filter, plastic container, analytical balance, Hydraulic machine, porcelain cup, clamping device, calipers, bomb calorimeter, stopwatch, thermometer and stirring rod. The ingredients used are, rice husk, cow dung, hibiscus leaves (*Hisbiscus rosa-sinensis* L.) and water.

Drafting Stage

Each raw material is separated using the drum. After the drum is full, the raw materials arranged to fill the drum, after that the drum then watered with a little kerosene as a trigger for the combustion process. If the raw material has been burned evenly then immediately close the drum tightly so it will not become ash and the fire inside will slowly die.

Molding and Drying Phase

Charcoal powder from 2 different ingredients, that are rice husk and cow dung, then mixed with a ratio of 1: 1, 3: 1, 1: 3. The concentration of the hibiscus leaf (*Hisbiscus rosa-sinensis* L.) was weighed as much as 10 grams, 15 grams and 20 grams. The mixture was added 90 ml of water and then put into a molder that has a size of 7 cm long, 6 cm wide, and 5 cm high, then it is pressed. The molded briquettes are then dried in the sun for 3 days.

Analysis Phase

This stage aims to analyze the basic characteristics of rice husk briquettes and cow dung. These characteristics include fuel value, bound carbon value, moisture content value, ash content value, evaporating substance value and density value.

Analysis of biological materials in the laboratory

Hibiscus leaves (*Hisbiscus rosa-sinensis* L.) are washed and then thinly sliced, dried for a week at room temperature. Leaves are considered dry when they are brittle (kneaded to crush), then dried leaf simplicia is crushed using a blender, simplicia powder is stored in a plastic container.

Alkaloid examination

Simplicia powder was weighed as much as 0.5 g then added with 1 ml of 2 N hydrochloric acid and 9 ml of distilled water, heated over a water heater for 2 minutes. Cooled and filtered. The filtrate is used for the following experiment:

a) Filtrates as much as 3 drops with 2 drops of Meyer's reagent solution, will form white or yellow clumped sediment
b) Filtrates as much as 3 drops with 2 drops of Bouchardat reagent solution, will form brown to black sediment,
c) Filtrates of 3 drops with 2 drops of Dragendroff reagent solution will form turbid sediment at least two or three of the above experiments (Depkes RI, 1980).

Flavonoids Examination

0.5 g of simplicia powder was added to 10 ml of hot water, simmers for 10 minutes and filtered in hot condition, into 5 ml of filtrate we need to add 0.1 g of magnesium powder and 1 ml of concentrated hydrochloric acid and 2 ml of amyl alcohol, shaken and left separate. Flavonoids examination is positive if the colour red, yellow and orange is appeared on the amyl alcohol layer. (Depkes RI, 1980)

Saponin Examination

0.5 g of simplicia powder is put into a test tube, 10 ml of hot water is added, cooled then shaken for 10 seconds, if a foam around 1 cm to 10 cm high is performed, and stable for around 10 minutes, also it is not disappear after the addition of 1 drop of 2 N hydrochloric acid, it means the saponins is exist (Depkes RI, 1980).

Testing and Measurement

Physical Properties: Density

This density test can be done by using a caliper. The density is expressed in the results of a comparison between the weight and volume of charcoal briquettes, expressed by a formula according to (ASTM, 1996), as follows:

$$\text{Density} = \frac{weight\ (gr)}{volume\ (cm)3}$$

Analysis of Fuel Calorific Value

Fuel calorific value is analyzed by using a calorimeter and calculated based on the amount of heat released equal to the amount of heat absorbed, which is expressed in cal / gram according to the formula (ASTM, 1996), as follows:

Fuel Calorific Value = ΔT - 0.05 × Cv × 0.24

T2 : Temperature after combustion (^{0}C)
T1 : Initial temperature (^{0}C)
Cv : Water value from calorimeter = 73529,6 (kJ / kg^{0}C)
0,05 : the increasing temperature on wire
0,24 : Joule constant = 0.24 cal

Chemical Properties: Water Content

In principle, the water content checking is to vaporize the free part contained in the briquettes until the water content balance is reached the surrounding air, the method is as follows: charcoal briquettes are weighed 10 grams and then dried in an oven at a temperature of around 110^{0}C for about 2 hours. Then cooled and calculated the water content, according to the formula (ASTM, 1996), as follows:

$$\text{Water Content}(\%) = \frac{a-b}{a} x\ 100\%$$

a = Weight before drying (g)
b = Weight after drying (g)

Analysis of Volatile Substances

The levels of volatile substances are obtained by evaporating all volatile matter in powdered charcoal briquettes other than water. Porcelain plates containing samples of charcoal briquettes from the determination of water content were weighed as much as 5 grams and dipped in an electric furnace at a temperature of

800-900^{0}C for 15 minutes. Then the briquettes are cooled in the exicator and then weighed. Volatile substances are written using the formula (ASTM, 1996), as follows:

$$\textbf{Volatile matter (100\%)} = \frac{a-b}{a} \times \mathbf{100\%} - c$$

a = Initial briquette weight (g)
b = Weight after heating (g)
c = Water content (100%)

Ash content

Ash in charcoal briquettes consists of minerals that cannot be lost or evaporate in the process of ignition. The porcelain dish containing an example of 5 gram charcoal briquettes from the determination of the level of volatile substances is placed in an electric furnace at a temperature of 600^{0}C for 6 hours until the weight is fixed. Then it is cooled in the exicator, then weighed. Levels of ash are expressed in percent according to the formula (ASTM, 1996), as follows:

$$\text{Ash content(\%)} = \frac{residual\ weight}{kiln\ briquette\ weight} \times 100\%$$

Bonded Carbon Level

Bonded carbon is a carbon fraction (C) in charcoal briquettes apart from the fraction of water, volatile substances and ash. The bounded carbon levels are expressed in percent according to the formula (ASTM, 1996), as follows:

Fixed Carbon (%) = (100 - levels of volatile substances - ash content) %.

Data analysis

The data obtained were analyzed using the T Test followed by descriptive discussion. The experimental unit model used is:

Table 1 Research Unit Model

Rice Husk Composition (gram)	Adhesive Consentration (gram)			
	0	10	15	20
1:1	K0B0	K1B0	K2B0	K3B0
1:3	K0B1	K1B1	K2B1	K3B1
3:1	K0B2	K1B2	K2B2	K3B2

Results and Discussion

A. Results

Results are clear and directed findings, which are presented in tables and / or descriptions that are in accordance with the research.

The results of the research of the effect of hibiscus leaf adhesive (*Hibiscus rosa-sinensis* L.) on the rice husk and cow dung briquettes can be seen in Figure 6.1. The T test carried out on each data from the density, heat, water content, evaporating content, ash content and carbon content showed there is significantly different result at the real level (α) = 0.05

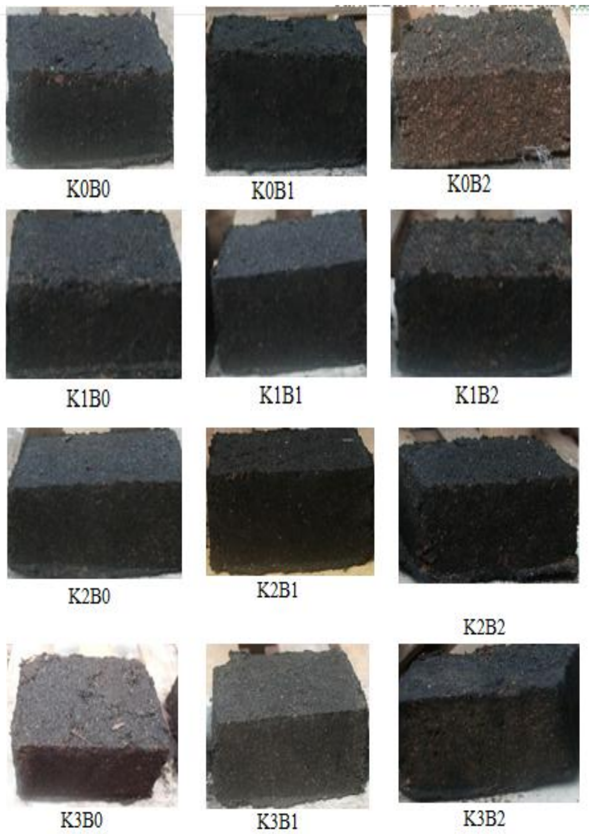

Figure 1. The briquettes from rice husk and cow dung (Doc. Research 2016).

Biological Material Analysis

The results of phytochemical screening of simplicia from hibiscus leaf (*Hibiscus rosa sinensis* L) can be seen in Table 6.1. These compounds are thought to also be present in the briquette that is made in this research.

Table 2. Phytochemical screening of simplicia from hibiscus leaf (*Hibiscus rosa sinensis* L)

No	Compound	Result
1	Alkaloid	+
2	Flavonoid	+
3	Saponin	+

Note: (+) positive (-) negative

Density

The results from the density examination of charcoal briquettes in this study are presented in Figure 2

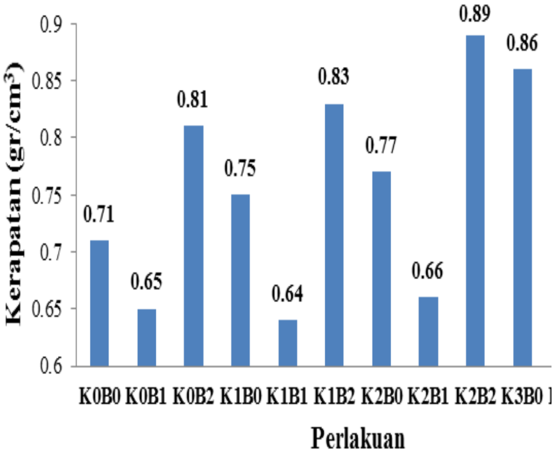

Figure 2. Graph of the effect of material composition and concentration of adhesive from Hibiscus leaf on the density of briquettes produced from rice husk and cow dung

Based on Figure 1, the lowest density value of briquettes is found in treatment K1B1, namely the composition of rice husk: cow dung is 3: 1 with the addition of 10 grams of hibiscus leaf adhesive (*Hibiscus rosa-sinensis* L.) of 0.64 g / cm3, while the highest density found in the treatment of K2B2 and K3B2 composition of rice husk: cow dung is 1: 3 with the addition treatment of 15 and 20 grams of hibiscus leaf adhesive (*Hibiscus rosa-sinensis* L.) of 0.89 g / cm3. This value is better than SNI of Indonesian charcoal briquettes which is 0.4407 g / cm3.

Heat Value

The results of testing the calorific value of charcoal briquettes in this study are presented in Figure 2. Based on Figure 4.2, the lowest calorific value is found in treatment K2B0, with composition of rice husk: cow dung is 1: 1 without the addition of hibiscus leaf adhesive (*Hibiscus rosa-sinensis* L.) the amount is 1674 cal / g, while the highest calorific value is found in the treatment of K2B2 composition of rice husk: cow dung is 1: 3 with the addition of 15 grams of hibiscus leaf the amount is 2431 cal / g.

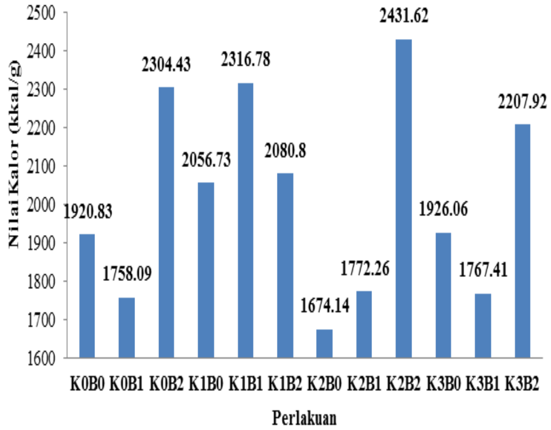

Figure 3. Graph of the effect of material composition and concentration of adhesive from Hibiscus leaf on heat of briquettes produced from rice husk and cow dung

Water content

The moisture content of the test results of charcoal briquettes in this study is presented in Figure 4.3. Based on Figure 4.3, the lowest water content was found in treatment K0B1, the composition of rice husk: cow dung was 3: 1 without the addition of hibiscus leaf adhesive (*Hibiscus rosa-sinensis* L.) which was 8.74%, while the highest moisture content was found K3B2 treatment composition of rice husk: cow dung is 1: 3 with the addition of 20 grams of hibiscus leaf adhesive, the water content value is 15.37%.

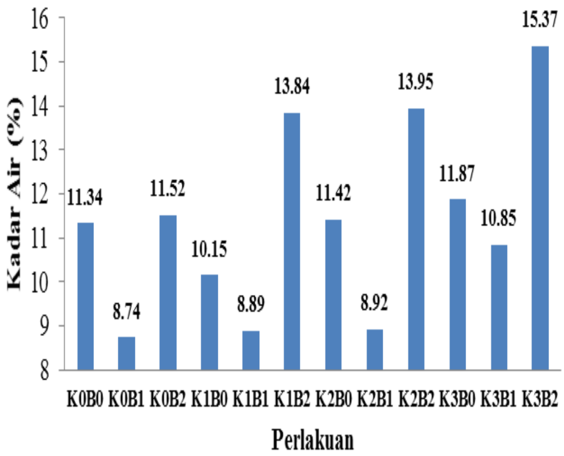

Figure 4. Graph of the effect of material composition and concentration of adhesive from Hibiscus leaf on the water content of briquettes produced from rice husk and cow dung

Volatile Substance

Based on Figure 4, the higher the adhesive concentration shows the higher the level of the volatile substance.

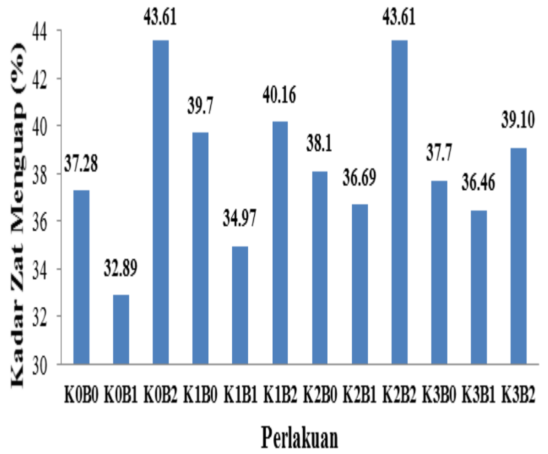

Figure 5. Graph of the effect of material composition and concentration of adhesive from Hibiscus leaf on the level of volatile substances of briquettes produced from rice husk and cow dung

Ash content

The results of testing the ash content of charcoal briquettes are presented in Figure 4.5. Based on Figure 5, from the three compositions in the treatment of the content of rice husk which is relatively small has the lowest ash content, the composition of rice husk treatment: cow dung is 1: 3 which is 37.45% -46.01%, while the highest ash content is at treatment on the composition of rice husk: cow dung is 3: 1 which is 41.63-56.15%.

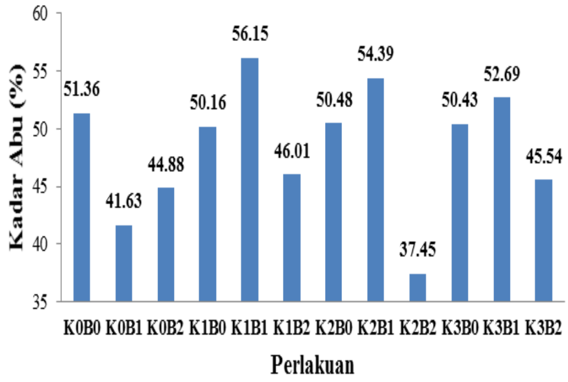

Figure 6. Graph of the effect of ingredients composition and the concentration adhesive from Hibiscus leaf on the ash content of briquettes produced from rice husk and cow dung

The test results of bound carbon content are shown in Figure 4.6. Based on Figure 5, the lowest density value of briquettes is found in treatment K1B1, the composition of rice husk: cow dung is 3: 1 with the addition of 10 grams of hibiscus leaf adhesive (*Hisbiscus rosa-sinensis* L.) as big as 8.89%, while the highest carbon content is in the K0B1 on the composition of rice husk: cow dung was 3: 1 without the treatment of hibiscus leaf adhesive, the value was 25.49%.

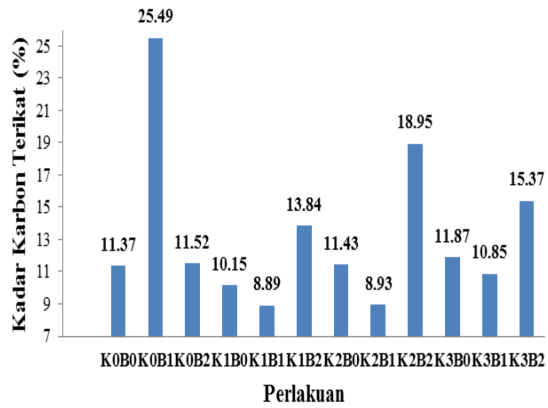

Figure 7. Graph of the effect of material composition and concentration adhesive from Hibiscus leaf on the carbon content of briquettes produced from rice husk and cow dung

Discussion

Based on phytochemical testing, the hibiscus leaf adhesive used in this research positively contained alkaloids, flavonoids, and saponins. The characteristic properties of hibiscus are thought to be an adhesive is saponin compounds, with foaming properties in water (Ainissiya, 2010). The formation of foam when extracting plants is characteristic of the presence of saponins in hibiscus leaves (*Hibiscus rosa-sinensis* L.). Whereas, flavonoida compounds are more likely to be anthocyanin in the hibiscus leaves (Hibiscus rosa-sinensis L.) (Harbone, 1987).

Flavonoid compounds are a group of natural material compounds from phenolic compounds with the chemical structure C6-C3-C6, flavonoids are plant pigments. Flavonoids can be divided into several sub-classes, such as: anthocyanidin, flavanol, flavanone, flavone, and isoflavones (Muchtadi, 2012).

While the saponin compound consists of Sapogenin, which is a free part of the Glycoside, also called "Aglycone". Sapogenin binds to saccharides that vary in length from monosaccharides to up to 11 monosaccharide units. The most frequent saccharide is between 2-5 units. The saccharide monosaccharide that is often encountered is D-Glucose and D Galactose. Sapogenin (Aglycone) can be triterpenoid or steroid. Because Sapogenin which is lipophilic and saccharide are hydrophilic, Saponins are amphiphilic. Thus Saponins can form foam and damage cell membranes because they can form bonds with lipids from cell membranes.

All three hibiscus leaf adhesives are needed to homogenize the ingredients mixed during the pressing process. Without a binder, the briquettes will be fragile into pieces when removed from the mold (Irawan, 2011).

The density value of briquettes from husks and cow dung that has been given additional adhesive from the leaves of hibiscus has increased. According to Wilaipon (2007) the value of briquette density is caused by adhesives and high forging pressure. If the concentration of the adhesive given is high, the value of the briquette density will also high. The reason is the higher the amount of adhesive, the more adhesive will fill the pores of the charcoal briquettes, so that the bond between the adhesive and the charcoal powder will be better because the charcoal particles can fuse together, solid and denser with each other (Bahri, 2007).

For the calorific value, it shows that the briquette which contains more cow dung will produce higher heat than those with more rice husk. It is possibly because cow dung contain methane gas.

The results of testing of charcoal briquettes showed the highest calorific value produced was 2431.62 kal / g. This value is lower than the Indonesian National Standard (SNI) which is 5000 kal / g. This is probably caused by the raw materials used, such as rice husk powder which has a low density and contains a lot of silica. In addition, it may also be caused by the factor of the duration of combustion (pyrolysis) so that it does not produce charcoal but ash. The high ash content has a low carbon content. According to Bahri (2007) high silica content means that the ash content of the charcoal is high and silica can reduce the heating value of charcoal briquettes.

The charcoal briquette water content value in this study exceeds the SNI standard. The high water content of charcoal briquettes from the results of this study may be due to overloading factors. This result is different from Onu, et al., (2010), the low pressuring pressure on large particle sizes will produce charcoal briquettes that are less dense and porous, making it easier for water vapor to seep. Other possibilities are short density and drying time. Charcoal particle size that is too smooth causes the pores of charcoal briquettes to get smaller so that the water contained in it is difficult to evaporate during the drying process, the higher the density, the cavities between charcoal particles will be more tight because of the solidity of the particles so that there is no gap or empty space.

The addition of hibiscus leaf adhesive will make the briquette become more hydrophilic. This is suitable with the research conducted by Irawan (2011) that mention that the moisture content of briquettes that use natural adhesives has high moisture content.

Water content can affect the resistance of organic waste charcoal briquettes from the activity of microorganisms, such as mosses and fungi. Storage for 4 days in a closed and humid place, turned out to be overgrown with fungi, so it is feared that it can damage the structure of charcoal briquettes. Therefore, it is necessary to pay attention to the treatment of charcoal briquettes storage in this study due to the effect of water content.

All levels of volatile substances in this study are higher than SNI (15%). Possibly caused by incomplete decomposition of non-carbon compounds such as CO_2, CO, CH_4 and H_2 (Pari, et al., 2002). In addition, according to Sudrajat, et al., (2005), high levels of vaporizing substances were caused by the inability of charcoal briquettes to absorb gas.

The results of ash content testing in all treatments in this study (37.45–56.15%) were higher than SNI. The high ash content is probably caused by drying the briquettes in contact with the air so that a further combustion process occurs where the activated charcoal formed turns to ash.

The low value of bound carbon content is probably caused by high levels of volatile substances and ash content. According to Taonisi, et al., (2010) charcoal briquettes that have low levels of evaporating substances will have a high carbon-bound content.

After finding a number of briquette formulas, both briquettes from rice husks and cow dung, the next step is the possibility of large-scale production to be traded in order to increase economic value. But the problem is arises when briquettes made from cow dung are allowed or not in jurisprudence in Islam. Therefore it will be discussed whether or not the use of cow dung as a briquette material is traded according to the study of jurisprudence in Islam. Inputs related to the stipulation of halal law in the form of sale and purchase transactions are very necessary at the practical level to be more effective, so there is no overlap (Yusuf, 2015).

Cow dung is one of the objects included in *najis mukhofafah* (Sulaiman rasyid: 2008; 16). Najis means *al qadzarah* (القذارة) which means dirt. While in terms of the name, unclean according to the definition of Ash Syafi'iyah is:

> *"Something that is considered dirty and prevents the validity of shalat without any mitigation,"*

And according to Al Malikiyah's definition, najis is:

> *"The legal nature of an object that requires a person to be prevented from performing shalat when exposed or in it."*

Basically the sale of unclean goods such as cow dung is a forbidden thing (Abu Bakr: 2012; 497). According to Imam Syafii in Muhammad jawad: 2000; 12) all remaining animal waste including cow dung is included in *najis*. In the manufacture of briquettes when their basic ingredient is the cattle dirt, therefore several discussions are needed regarding the sustainability of the results of this study if produced on a large scale and commercialized. The following are some explanations to illustrate.

Summarized from the book "*Islamic Fiqhu wahbah az-zuhaili*: 3431" in essence, the basic ingredients of the briquette come from cow dung so that there are some opinions (difference among scholars). According to Imam Syafi'iyah scholars, the condition of the goods in the sale and purchase must be sacred and beneficial, so that the sale and purchase above is punished illegally. The solution for the legitimate transaction is through the contract "*tanzul*" *anil ikhtishosh* "/ such as the barter contract for mass goods; sack briquettes, or something else. As for the Hanafiyah Islamic scholars, the terms of goods in buying and selling are beneficial. So, buying and selling briquettes above is still valid because there is an element of benefit (and not buying and selling that is prohibited by *syara*; such as khomar, pork, and carrion, etc.).

In another statement, a hadith states that samin oil which has fall rat carcasses should not be eaten but may be sold as fuel for lights or other. In this case the briquettes that come from the raw material of rice husk and cow dung may be allowed to be traded (Ahmad, 2017). Because its morphologically and chemical structure's has been change from its initial conditions. So, humans who are given perfect reason are able to process various resources according to their nature. Fitrah is not only sacred but has multiple potentials for processing natural resources (Quraish sihab. 2010).

Based on the results of the research the effect of hibiscus leaf adhesive (*Hisbiscus rosa-sinensis* L.) on rice husk briquettes and cow dung can be concluded as follows:

1. The combination of adhesives and composition of organic waste charcoal briquettes have a significant effect on decreasing the calorific value.
2. Adhesive from hibiscus leaves (*Hisbiscus rosa-sinensis* L.) has a significant effect on decreasing the quality of organic waste charcoal briquettes.
3. The combination of adhesive and composition of the briquette gives the highest increase in density of organic waste charcoal is 0.89 g / cm3.
4. The adhesive combination and composition of organic waste charcoal briquettes gave the highest decrease in water content of 15.37%, evaporating substances 43.61%, ash content 56.15%; and carbon content of 25.49%.
5. The combination adhesive from hibiscus leaf (*Hisbiscus rosa-sinensis* L.) and composition of organic waste charcoal briquettes which showed the best quality was 15 grams of hibiscus leaf adhesive (*Hisbiscus rosa-sinensis* L.) and composition of rice husk: cow dung, 1: 3.
6. Briquettes from paddy husk and cow dung added with Hibiscus leave extract can be traded because it is not for consumtion, but is functionally used as fuel.

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