International Journal of Eco-Innovation in Science and Engineering (IJEISE) Vol.4 (1), 2023 (18-23)
https://ijeise.upnjatim.ac.id/ E-ISSN:

Article

Characteristics Biobriquettes from Mushroom Baglog Waste Carbonization Production

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Received: 15th January 2023; Revised: 23th April 2023; Accepted: 10th May 2023;
Available online: 15th May 2023; Published regularly: May and November

Abstract

Bio briquette is a briquette based on agricultural waste because it is deliberately made from biomass charcoal. The utilization of agricultural waste such as mushroom planting media to be processed as bio briquette requires a very cheap cost. Bio briquettes that are processed properly and correctly, will produce high-quality briquettes. The purpose of this study was to produce a biobriquette from baglog mushroom waste and to determine the characteristics of the biobriquette. The research material used consisted of 400 grams of mushroom baglog waste and 40 grams of starch as adhesive. The briquette dough is then printed cylindrical. The printed briquettes are then heated at 80°C for 5 hours to reduce the moisture content. The result of smoke test is the smoke will stop in 17 seconds with the color of the smoke is white. The Combustion of speed test, the results obtained are 0,0019 gram/second with an initial sample weight of 2, 4 grams and burning for 20 minutes 35 seconds with a final sample weight of 0,387 grams. The result of ash content is 0.16%.This result is in accordance with the SNI issued by our government. SNI of ash content is max 8 %.

Keywords: Biobriquettes, Carbonization, Mushroom Baglog

1. Introduction

The consumption and demand for petroleum in Indonesia are currently increasing along with the increasing use of energy for industrial, transportation, and household purposes. To overcome these problems, the government has made a policy in the form of energy diversification to reduce dependence on oil and gas. About the energy diversification policy, it is necessary to search for, manufacture and develop alternative energy that is effective, efficient, and inexpensive so that it can be used by people from various circles.

Mushrooms exist fungi with high nutritional value, with over 2000 edible species found around the world. The most common cultivars are button mushrooms (Agaricus bisporus), shiitake mushrooms (Lentinula edodes), and oyster mushrooms (Pleurotus spp.). In 2018, the global market value of fresh mushrooms surpassed 38 billion US dollars, with China being the largest mushroom producer in the Asian area, accounting for around 35% of the global mushroom market [1]. Mushroom cultivation in Indonesia has developed very rapidly. One type of mushroom that has increased production is an oyster mushroom. It is undeniable that the high production of mushrooms causes new problems in the form of baglog waste for mushroom growing media. Therefore, baglog mushroom waste can be used as an alternative energy in the form of a biobriquette that has economic value. The purpose of this study was to produce a

biobriquette from baglog mushroom waste and to determine the characteristics of the biobriquette. The baglog mushroom waste used come from mushroom cultivation in Mojokerto.

2. Theoritical Foundation

Bio briquette is a briquette based on agricultural waste because it is deliberately made from biomass charcoal. The utilization of agricultural waste such as mushroom planting media to be processed as bio briquette requires a very cheap cost. Bio briquettes that are processed properly and correctly, will produce high-quality briquettes. Quality characteristics, among others: hard, dry, not easily broken, fine-textured, easy to ignite, stable, and not easily dead, the result of combustion is safe for living things and the environment [2].

Carbonization is defined as a process of breaking down organic matter into charcoal in the absence of air. Carbonization or pyrolysis is a chemical decomposition process using heating in the absence of oxygen. This process or also called the carbonation process or the process to obtain carbon or charcoal, is also called "High Temperature carbonization". Carbonization of biomass or better known as charcoal is a process to increase the calorific value of biomass and produce clean combustion with less smoke. The process of making briquette uses the principle of carbonization that converts the nature of the basic material of briquette into carbon through the process of combustion or authoring. The ideal heat temperature for biomass decomposition is 150° Celsius and above. During the authoring process, the furnace condition should be closed to reduce the possibility of oxygen mixing in the mixture of briquette-based materials that are nested. The carbonation process is stopped when the smoke in the furnace gets thinner and the color of the smoke turns blue. Such is the indicator that the authoring process is complete [3]. The change in smoke thinning and blue indicates that the energy in the basic ingredients of organic briquette, released little by little [4].

Biobriquette production process:

1) Drying materials

The first stage performed in the process of making briquette is drying, where when a particle is heated with high temperatures or fire radiation to remove moisture content in the material.

2) Grinding

Biomass particle size has a shape and size that is not uniform. For the shape and size of biomass materials to be uniform, it is necessary to grind to smooth / reduce the size of biomass materials.

3) Mixing

The natural properties of biomass tend to divide each other. With the help of adhesive materials or glues, biomass particles can be united and formed as needed. To produce briquettes with good quality, things to consider in the selection of adhesive material are as follows:

a. It has a good cohesion force when mixed with biomass materials.
b. Flammable and not smoky.
c. Easy to get and reasonably priced.
d. It does not emit odors, is non-toxic, and harmless.

4) Briquette Printing

Briquette printing aims to obtain high density and obtain a uniform shape and facilitate packaging and use.

5) Briquette Drying

Generally, the moisture content in briquettes that have been printed is still very high so it is wet and soft. Therefore, briquettes need to be dried. Drying aims to reduce moisture content and harden it to be safe from mold disturbances and physical impact.

Properties of Briquettes

Briquettes have several conditions that must be met to get good results, namely the surface is smooth and does not leave black marks on the hands. In addition, as fuel briquettes must also meet the following criteria [1]:

(1) easy to turn on,
(2) the emission of gas from combustion is non-toxic
(3) waterproof and not moldy when stored for a long time
(4) shows a good combustion rate effort.

Table 1. SNI Biobriquette Standard No.1/6235/2000

No.	Parameters	Value
1.	Water Content	≤ 8%
2.	Ash Content	≤ 8%
3.	Carbon Content	≥ 77%
4.	Calorific value	≥ 5000 cal/gr
5.	Levels of evaporating substances	≤ 15%

Mushroom Planting Media Waste Materials

The composition of the mushroom planting media mixture can be seen in table 2 [2].

Table 2. General Composition of Mushroom Baglogs

Composition	Total (kg)	%
Sawdust	100	86,6
Bran	15	13
Lime	0,5	0,4

Baglog waste composed of sawdust and bran will decompose and provide elements such as N, P, and K that can then be utilized by plants as nutrients to grow. Analysis of the content of elements N, P, and K in the waste baglog produced content as in table 3[3].

Table 3. Content of N, P, and K Waste Baglog Mushrooms

Element	Content (%)
Nitrogen	0,87
Phosphorus	0,05
Potassium	5,7

The raw material for oyster mushroom baglog is sawdust because it contains quite a lot of cellulose and lignin. oyster mushroom baglog waste had pH, organic C, total N, carbon to nitrogen (C/N) ratio, total P, and total K of 8.00, 14.38 mg kg-1, 0.74 mg kg-1, 19.43, 0.50%, and 8.08% [4]. Based on research that has been done sawdust can be used as raw material for making briquettes. Utilization of oyster mushroom baglog waste as raw material for briquettes has been carried out and it is known that the calorific value of the resulting briquettes is 3306 cal/gr at a printing press of 100 kg/cm2 [5].

Analysis of Biobriquettte Characteristics

1. Water Content

Calculation of the percentage of water content contained in the bio briquette using standard ASTM D-3173-03 with the following equation:

Water content (%) = $(G0 - G1)/G0 \ \ X\ 100\%$ (1)

Where:

G0 = sample weight before drying (gr)

G1 = sample weight after drying (gr)

2. Ash Content

To obtain the ash content value, it is necessary to calculate with standard ASTM D-3173-03 as follows:

Ash content (%) = $C/A\ x100\%$ (2)

Where:

C = Ash weight (gr)

A = Weight of material before it becomes ash (gr)

3. Smoke Gone

To find out how long the smoke produced by briquettes lasts after the briquettes have burned out, expressed in units of time.

4. Combustion Rate

To get a momentary burn rate (m) can use the formula:

$$M = \Delta m/\Delta t \quad (3)$$

Where:

Δm = mass reduction rate (gr)

Δt = time(s)

Ignition Time dan Burning Time

Ignition time is the time it takes to burn the briquettes until the flames appear.

Burning time is the time it takes to burn the briquettes from the start of the flame until the fire is finished burning out. Combustion time indicates that the duration of combustion increases from larger particle size to a smaller one.

3. Material and Method

3.1 Material

The research material used consisted of 400 grams of mushroom baglog waste and 40 grams of starch as adhesive.

3.2 Production of Hydroxyapatite Synthesis

Mushroom baglog waste is cleaned and then mashed and sifted using a sieve of approximately 100 mesh to produce a smooth and even charcoal powder. Baglog powder is carbonated (heated) until dry and burnt. Starch that has thickened as much as 10% of the mass of the ingredients mixed then stirred until evenly. The briquette dough is then printed cylindrical. The printed briquettes are then heated at 80°C for 5 hours to reduce the moisture content.

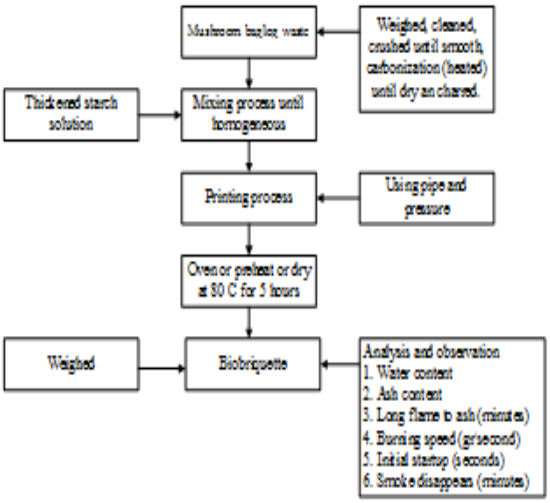

Fig 1. Biobriquette Process Diagram.

4. Results and Discussion

Biobriquets made with mushroom growing media waste and tapioca stratch adhesive are molded in the form of solid tubes or cylinders. After the biobriquets production is done, we have to several phydichal tests, including the initial flame tests, combustion speed tests, smoke content tests and ash content tests. Before we have tets each sample of biobriquets, biobriquets must be dried in an oven or using the heat of sun (convensional).

Table 4. Biobriquets Tests Result

No	Tests	Results
1	Smoke Level Test	White
2	Combustion Speed Test	20 minures 35 seconds
3	Ash Content Test	0.16%
4	Initial Flame Test	63 seconds and the orange-reddish colour

4.1 Smoke Level Test

The briquettes that have been made are then carried out several physical tests, including the smoke content test or the amount of smoke obtained when these briquettes are used. The smoke level test is carried out by burning the briquettes, then from the results of the burning coals will be generated which causes the sample to burn by itself, after the sample burns the combustion process is stopped to test the smoke formed. In this smoke test, the briquette sample used weighs 2.4 grams with the result that smoke is formed for 17 seconds. The smoke generated during this test is white and is produced quickly which is quite a lot.

The raw materials used greatly affect the quality of the briquettes produced. The raw material used in making this briquette is mushroom media waste with tapioca flour adhesive. One of the effects is the amount of smoke produced, if the calorific value produced in briquettes is low, the smoke obtained will also increase. The carbonation process also has an influence on the concentration of evaporative substances, the longer the carbonation time and the temperature used will reduce the evaporation rate, so that a lot of smoke obtained will be less. The concentration of added adhesive also affects the amount of smoke that will be obtained, if more adhesive is added, the briquettes will become sticky and there will be no air voids so that it is difficult to obtain oxygen, which will help the combustion process, so that more smoke is produced.

The high content of volatile substances in the briquettes will cause more smoke when the briquettes are ignited. The high smoke content is caused by the reaction between CO and alcohol derivatives [6].

4.2 Combustion Speed Test

After being tested, the observations showed the length of the process of burning biobriket from mushroom planting media is 20 minutes 35 seconds, with an initial weight of biobriket 2.4 gr and a final weight of 0.3837 gr. The comparison betwseen mushroom planting media and tapioca flour is 1:1. According to [7] Long briquette combustion is an important quality parameter for briquettes as fuel because it determines the quality of briquettes. So, The longer it burns, the better the quality of the briquettes. The addition of kanji as an adhesive affects the integrity and hardness of the briquettes formed, thus determining the length of burning of the briquettes. The higher the kanji percentage the longer the briquette burning time.

4.3 Ash Content Tests

For this test, the biobriquette sample that we used previously was weighed as much as 2.4 g.

After being completely burned into ashes, the remainder of the combustion was weighed 0.3837 gr. From these data we can calculate the ash content by dividing the weight of the ash produced by the initial weight of the biobriquette and then multiplied by 100% so that the ash content test results are 0.16%. This result is in accordance with the SNI issued by our government. According to SNI, the permitted ash content should not exceed 8%. So that the results we get are in accordance with SNI standards.

4.4 Initial Flame Test.

For the initial flame test, we get result that bio-briquette took 63 second to start burning, and showing the orange-reddish colour on the surface of the sample that we torched. The high moisture content of briquettes can reduce the calorific value of combustion, making the ignition process more difficult and producing a lot of smoke. The structure of the material, the content of bonded carbon and the hardness of the material influence the burning speed. Theoretically if the compound content high volatility then briquettes will be easy burn at high combustion rates [8]

5. Conclusions

5.1. Conclusions

1) The result of smoke test is the smoke will stop in 17 seconds with the color of the smoke is white.
2) In the Combustion of speed test, the results obtained are 0,0019 gram/second with an initial sample weight of 2, 4 grams and burning for 20 minutes 35 seconds with a final sample weight of 0,387 grams.
3) The result of ash content is 0.16%. This result is in accordance with the SNI issued by our government. SNI of ash content is max 8 %.

5.2. Suggestion

It is necessary to add other adhesive raw materials in the manufacture of biobriquets to improve the quality of biobriquets. Beside that a better carbonation process is also needed so that the quality of the briquettes obtained can be even better.

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