BIOBRICKETS MADE FROM CASSAVA SKIN WASTE UTILIZING BANANA PLASTIC WASTE GLUE AND WATER HYACINTH

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ABSTRACT: Cassava peel waste in large quantities can harm the environment. Cassava peel waste can be used as a renewable energy feedstock since it is environmentally friendly biomass converted into bio briquettes for use as an alternative fuel. The advantage of cassava peel can positively impact the environment while also adding value to the cassava peel. Cassava bio briquettes produced with water hyacinth and banana leaf stem were compared in this study. Temperatures of 300°C, 350°C, 400°C, 450°C, and 500°C are used to discover the best conditions for briquettes, with a carbonization time of 45 minutes. Bio briquettes can be made from water hyacinth and banana leaf stalks, according to the analysis. The best results were achieved at 400°C carbonization temperature, with a calorific value of 5461 Cal/g for water hyacinth adhesives and 5265 Cal/g for banana leaf stalk adhesives.

KEY WORDS: Bio briquettes, carbonization, water hyacinth, banana leaf stalk.

1. INTRODUCTION

Energy consumption has increased in numerous aspects of life due to economic advancements in the globalization period. Not only rich countries but nearly every country, including Indonesia, were affected. Despite being afflicted by the economic crisis, it saw an increase in energy use.

It may be observed in Indonesia's 2004 energy consumption, which was over 453 million SBM (equal to a barrel of oil), significantly greater than before the 1997 crisis. At the time, the total amount of energy consumed was 385 million BBM [1].

The Indonesian government has prepared a national energy management blueprint from 2005 to 2025 in anticipation of this. This policy stresses attempts to lessen reliance on petroleum as a source of energy.

Kerosene, which has been subsidized in Indonesia until now, is a huge financial burden for the government. The value of the subsidies has risen rapidly to more than 49 trillion rupiahs each year, despite the use of just about 10 million kiloliters per year.

Cassava skin waste comes from cassava plantations, tapioca flour companies, cassava processing products, and tape or perineum industries across Indonesia. Indonesia has a large cassava production because it is the world's fifth-largest cassava producer [2].

Because Indonesia has many cassava processing enterprises, a positive correlation can be formed between the amount of processed cassava and the amount of cassava skin waste produced. Cassava peel waste can amount to 10-15% of each cassava. This enormous amount of cassava peel can lead to a buildup, harming the ecosystem [3]. The goal of this study is to improve the utilization of cassava peel waste by making bio briquettes with water hyacinth adhesives and banana fronds, to determine the optimal temperature of the carbonization process in order to obtain high-quality bio briquette from cassava peel waste, to determine good bio briquette quality by using a type of water hyacinth adhesive or banana midrib, and to determine the optimal temperature of the carbonization process in order to obtain high-quality.

The benefit of this research is that it can use cassava peel waste in bio briquette production as an alternative fuel in energy-saving efforts to reduce pollution[4]. Bio briquette produced from research is expected to become alternative energy sources, and the results of this research are theoretically and practically known in small-scale laboratory bio briquette making techniques. The raw material used in this study is cassava peel generated from industrial waste processed cassava products, and it was conducted in Palembang, South Sumatra. A water hyacinth solution and banana midrib were utilized as a binder. The carbonization process is carried out at the South Sumatra Energy and Mining Development Laboratory. The variables employed in this study include the temperature in the carbonization process and the type of adhesive used, namely water hyacinth and banana midrib.

2. MATERIALS AND METHOD

2.1. Theoretical Method

2.1.1. Cassava Waste

Cassava peel is a waste product from cassava plants with a significant amount of carbohydrates and can be used to feed cattle. External waste accounts for 0.5-2 percent of the total weight of fresh cassava, whereas interior skin waste accounts for 8-15 percent. This cassava waste comprises 74.73 percent nutrients, 17.45 percent dry matter, 15.20 percent crude fiber, 0.63 percent calcium, and 0.22 percent phosphorus [5]. According to a United Nations Industrial Development Organization (UNIDO) survey, Indonesia is Asia's second-largest cassava producer after Thailand. At the same time, the globe ranks fifth after Nigeria, Brazil, Thailand, and Congo. [6]. The percentage of cassava peel generated varies between 8 and 15% by weight of peeled tubers, with a carbohydrate content of roughly 50% of the tubers' carbohydrate content. Cassava peel has an average moisture content of 10.06-13.14 percent, an average water absorption value of 82.49 percent -169.78 percent, an average development value of 35.70-102.30 percent, and an average density of 0.86-0.87 g/cm3 [7].

2.1.2. Biobriquette

The term "bio briquette" refers to a briquette made from biomass or biomass waste. Biobriquettes are widely used in nations in southern Asia, including Indonesia, India, and Thailand. Briquettes are made from biomass and compressed using a densification or compression technique. The process of densification will result in a more regular and solid shape. In manufacturing briquettes, the materials are compressed into a single unit to make them easier to handle. The process of handling the fundamental elements for making briquettes is usually done on a small-scale material available in large amounts. Aside from biomass or biomass waste, which is utilized as a basic material for briquettes, it is usually in powder or bulk form, making it challenging to handle and use as a fuel. Handling materials that aren't small enough to make briquettes necessitates a downsizing step ahead of time. It is done to ensure that the forging process is uniform in size and efficient [8].

2.1.3. Briquetting Technology

The briquette-making process involves crushing, mixing raw materials, molding, and drying under specific conditions to produce briquettes with a specific shape, physical size, and chemical qualities.

Briquettes are a type of solid fuel that can be utilized as an alternative energy source with a water content of 10-20 percent by weight. Briquettes range in size from 20 to 100 grams. To achieve an optimal value of economic, technical, and environmental, the briquette method must, of course, be selected to the market segment. Packaging intends to provide a high-quality fuel that may be used as a substitute energy source in various areas.

Briquettes come in various forms and sizes, including pillow (oval), honeycomb, cylinder, and others. The following are some of the benefits of briquette; the size can be changed to suit needs, the porosity of the material can be changed to make combustion easier, it is simple to use as a source of energy [9].

In general, some briquette specifications needed by consumers are the durability of the briquettes sizes and shapes suitable for their use, clean (not smoky), especially for the household sector free of harmful gases, the nature of combustion as a function of requirements (ease of burning, energy efficiency, stable combustion).

The following are some of the elements to consider when producing briquettes:

• Briquettes can be manufactured from a range of raw materials, including bagasse, rice husks, sawdust, and other materials. Cellulose is the primary element that must be present in the raw material. Briquettes with a high cellulose concentration are of better quality; briquettes with a high flying substance content generate smoke and odor.

• Binding material: To generate a compact briquette, a binding agent is required to bond the particles of substances in the raw material during the briquette-making process. The binder selection can be classified into three categories based on the purpose and quality of the binder: Gluing briquettes based on nature/raw material; By the sorts of raw materials typically used as briquette binders, namely: have an excellent cohesiveness style when mixed with semi-kokas or coal, are highly combustible and non-smoky, are easy to obtain in large numbers and at low prices, do not produce odors, and are non-toxic and harmless; Inorganic (cement, clay, and sodium silicate) and organic (cement, clay, and sodium silicate) binders are the most frequent types of raw materials used as briquette binders (starch, tar, asphalt, starch, molasses, and paraffin).

Water content, ash content, constituents of flying substances (volatile matter), and calorific value are some of the briquette quality factors determining its use. There are two forms of water in briquettes: free and intrinsic moisture. Evaporation, such as air drying, can remove free moisture. In the planning of coal handling and preparation equipment, the free moisture content is critical. The intrinsic moisture content of briquettes can be evaluated by heating them between 104 and 110 degrees Celsius for one hour. All briquettes contain inorganic components in the form of ash, which can be measured by the weight left after the briquette has been entirely burned. Clay, sand, and other mineral elements are used to make briquette ash. Briquettes with a high ash percentage will produce a crust, which is highly unfavorable. Flying matter mostly consists of combustible gases such as hydrogen, carbon monoxide (CO), and methane (CH_4), with unburned gases such as CO_2 and H_2O occasionally present. When briquettes are heated without air at 950°C, volatile matter (product) forms, volatile materials on combustion will produce a long flame and a lot of smoke at levels of 40 percent. Because the smoke produced is minimal, low volatile matter concentration (between 15 and 25 percent) is preferred in use. The heating value of calorific is stated as heating value, an essential metric of thermal coal. They were burning a sample of briquettes in a bomb calorimeter and restoring the system to ambient temperature yields the gross calorific value. The net calorific value of briquettes usually is between 93 and 97 percent of the gross value, depending on the moisture and hydrogen content of the briquettes.

2.1.4. Carbonization Process

Carbonization is a technique in which materials such as stems, leaves, coal, sawdust, coconut shells, and other materials are heated in a room without coming into contact with air during the combustion process, resulting in the formation of charcoal. One of the most crucial processes in the production of bio briquettes is carbonization. Because the content of volatile compounds will be depleted during this process, the initial pore structure will form. Carbonization is a technique in which materials such as stems, leaves, coal, sawdust, coconut shells, and other materials are heated in a room without contact with air during the combustion process, resulting in the formation of charcoal. One of the most crucial processes in the production of bio briquettes is carbonization. Because the content of volatile compounds will be depleted during this process, the initial pore structure will form [10].

2.2. Experimental Method

To determine the moisture content of a dry bio-briquette that has been baked in the oven. The weight before and after heating can be used to calculate the moisture content. The weight loss from the heated sample (without oxidizing) under standard conditions is calculated, then corrected for moisture content to determine the content of the flying substance. The ash content of the sample was evaluated by weighing the residual combustion (residue) under normal conditions. The solid carbon content of a bio-briquette can be estimated by subtracting 100 from the moisture content, the levels of the flying substance, and the percentage ash content of the bio-briquette. A bomb calorimeter can be used to determine the calorific value of a bio-briquette.

3. RESULT AND DISCUSSION

The Fig. 1 showed that as the carbonization temperature rises, the water content decreases. This is because when the primary raw material is carbonized, the moisture content of the substance is released. Thus, according to the above assertion, the higher the temperature of carbonization, the more water content in the material evaporates. In other words, the lower the water content of the primary raw material and supplementary raw materials, the higher the carbonization temperature.

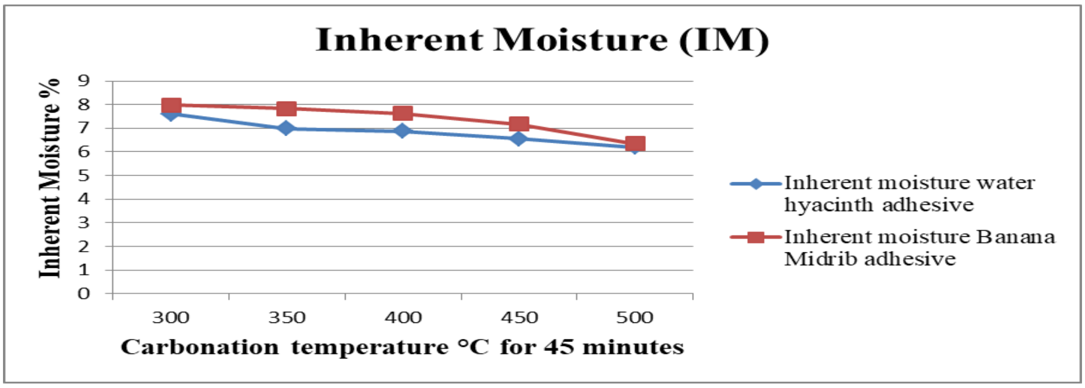

Fig. 1. Chart inherent mouisture (IM)

When it comes to the relationship between carbonization temperature and ash content, it appears that as the carbonization temperature rises, the tendency for ash content to rise as well (Fig.2). This occurs because the higher the carbonization temperature, the more material will be burnt to ash, resulting in a corresponding relationship between carbonization temperature and ash content.

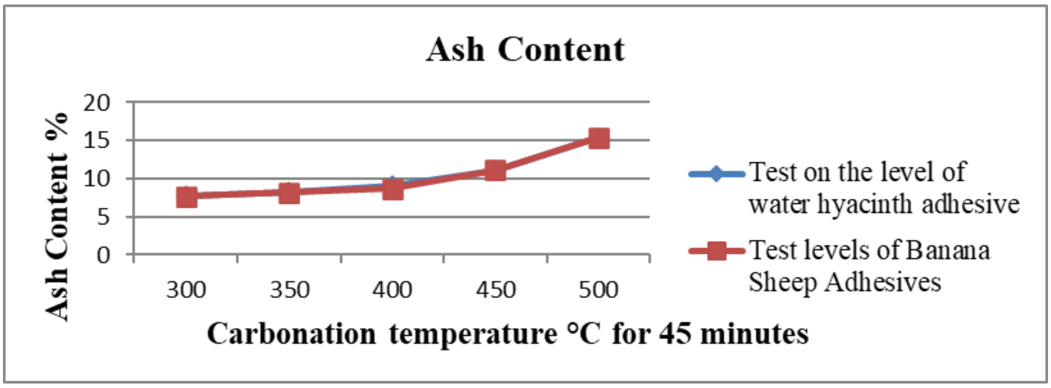

Fig. 2. Chart ash content

The link between carbonization temperature and levels of the flying matter is depicted in the graph above. It is clear that when the carbonization temperature rises, the propensity for levels of flying chemicals decreases. This is because when the raw material is carbonized, the flying chemicals contained within it evaporate. The higher the carbonization temperature, the more volatile stuff is extracted from the raw material. When a result, as the carbonization temperature rises, the amount of volatile matter decreases.

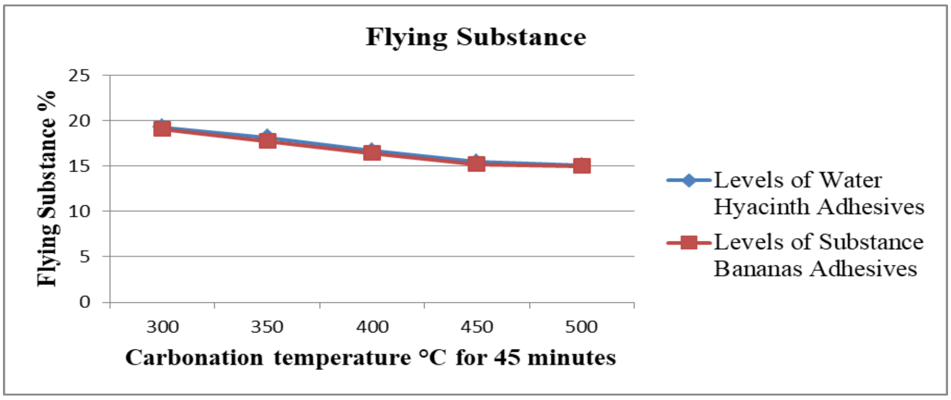

Fig. 3. Chart flying substance

Obtained the solid carbon (fixed carbon) value, which is the same as the caloric value (calorific value) that was previously obtained. Biobriquettes with a higher solid carbon content will burn for longer than those with lower solid carbon content. According to the (Fig.3) above, the most significant solid carbon content is achieved with water hyacinth adhesives and banana fronds at a carbonization temperature of 400°C, while the lowest is achieved at 500°C.

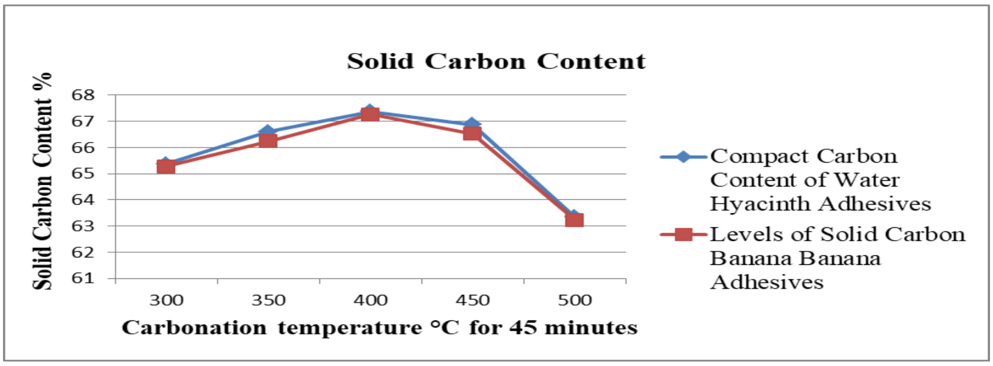

Fig. 4. Chart solid carbon levels

Obtained the solid carbon (fixed carbon) value, which is the same as the caloric value (calorific value) that was previously obtained. Biobriquettes with a higher solid carbon content will burn for longer than those with lower solid carbon content. According to the Fig. 4 above, the most considerable solid carbon content is achieved with water hyacinth adhesives and banana fronds at a carbonization temperature of 400°C. In contrast, the lowest is achieved at 500°C as can be seen in Fig. 5.

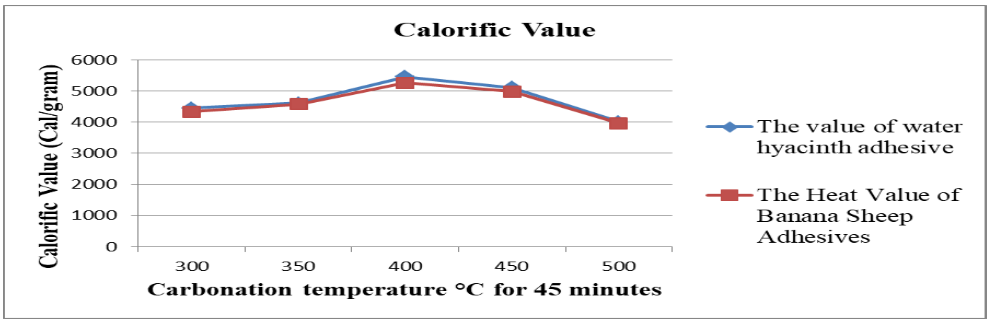

Fig. 5. Chart calorific value

4. CONCLUSION

Cassava peel, previously exclusively a waste from the household sector, may now be used as an alternative energy source thanks to the briquette-making process.

For the heating value in creating bio briquettes from cassava peel, the ideal temperature for the carbonization process is 400°C. The water hyacinth glue has a calorific value of 5461 cal/gr, but banana stem adhesive has a calorific value of 5265 cal/gr. When compared to other carbonization temperatures, this is the best heating value.

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