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Study of Making Biomass Briquettes from Coconut Shell and Tapioca Adhesive

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***Abstract*—One of the natural resources in Indonesia, especially Tarakan City, is the coconut plant. Coconut shells in Tarakan City are usually used for charcoal to be burned directly as an alternative fuel. This study aims to process charcoal from coconut shells into a more efficient fuel, that's is biomass briquettes. Biomass briquettes from coconut shells are processed from charcoal making, milling, dough making, molding and drying. Coconut shell charcoal is mashed manually and combined with adhesive from tapioca flour with a ratio of coconut shell charcoal powder to tapioca flour powder is 5:1. Briquettes are printed in the form of tubes with a diameter of 4 cm and a length of 3 cm. The briquettes that have been molded are then dried in an oven at 110ºC for 24 hours to remove the moisture content in the briquettes. In the study of application, it takes 10 minutes to cook 2 liters of water to a boil, which is equivalent to using a PGN gas stove with a medium flame setting, and in the process of cooking 2 liters of water it uses 602.8 grams of fuel with 390.2 grams of remaining fuel, and the efficiency is 37.14 %**

Keywords—Briquettes, Coconut Shell, Tapioca, Efficiency

I. INTRODUCTION

Tarakan is one of the cities in Indonesia. The city is an island with an area of 250.80 km² surrounded by the ocean. The existence of this ocean facilitates the spread of coconut plants along the coast of the city of Tarakan, so that coconut trees are spread almost all over the coastline to the residential areas of Tarakan City [1]. Coconut plant is a plant whose entire part is of economic value, whose main potential is its fruit. Coconuts have water, flesh, shell and skin (coir) that can be used. Old coconut shell itself has the benefit of being used as fuel in the form of charcoal as an alternative fuel. The use of coconut shells as fuel in Tarakan City is usually directly burned to make charcoal. However, the use of coconut shells in this way will not be effective because they are more easily exhausted in the furnace, therefore it is necessary to do further processing of coconut shells in the form of briquettes.

One type of flour on the market is tapioca flour. Tapioca flour comes from cassava tubers which are made into flour, which is often used as an ingredient for making cakes and various dishes. The use of tapioca flour as an adhesive is because the starch contained in the form of carbohydrates in cassava tubers serves as a food reserve. Tapioca when made as an adhesive has a high adhesion compared to other types of flour [2].

Based on this, the authors are interested in making Biomass Briquettes Made from Coconut Shell and Tapioca Adhesive. Based on this, it will also be studied and analyzed how the fabrication process is to obtain a briquette made from coconut shell and tapioca adhesive.

II. METHODS

The manufacture of these briquettes begins with making and refining charcoal from coconut shells, making dough, molding briquettes, and performance test.

A. Charcoal Making and Milling

The initial process begins with the manufacture of coconut shell charcoal, in which the shell is washed and separated from the coconut flesh which is still attached to the inner wall of the coconut shell. This is done so that the combustion process occurs properly and perfectly to produce coconut shell charcoal with conditions into charcoal (not in the form of coconut shell texture). Burning is done manually and traditionally by using a closed combustion system using a metal container from a paint can bucket that has been perforated at the bottom to provide oxygen supply. After the charcoal is finished, the next process is charcoal milling, which means making charcoal into charcoal powder. The process is carried out manually with mechanical treatment, namely by beating until smooth. In this process, the charcoal is put into an elastic container that is not easily torn, namely the inner tube of a motorcycle which is elastic, thick enough and not easily torn. While the beater is mechanically treated using a hammer.

B. Making the Dough

After it is in the form of powder, the next step is to make a basic dough consisting of coconut shell charcoal powder mixed with an organic adhesive/binding agent, namely tapioca flour. The use of tapioca will produce smokeless and durable briquettes [3]. In this study, the amount of charcoal powder to tapioca flour used had a ratio of 5:1. This is done so that the amount of charcoal powder as a combustion material is very dominant so that it supports the combustion process. The process of making the dough is by mixing 1 gram with 10 ml of chili water heated on the stove, then mixed with 5 grams of charcoal powder. In order to make the process more efficient and produce a lot of dough, an additional amount of mixture is used according to the ratio.

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C. Molding of Briquette

After the dough is ready, the next thing to do is mold it into a solid form before the dough becomes hard. The molding process is carried out manually with mechanical treatment by inserting the dough into a pipe with 4 cm diameter and length of 3 cm. This process is carried out by pressing and compressing. Furthermore, in the center of the circle a hole is made using a pencil with a diameter of 1 cm. The next process is drying, this drying is done with the aim of drastically reducing the water content in the briquettes. This drying process is carried out using an electric heater with a temperature of up to 110^{o}C and carried out for 24 hours.

D. Performance Test

Performance test as Trial The experiment was carried out by using briquettes as fuel to boil 2 liters of water. The furnace is used by calculating the amount (in kilograms) used for the cooking process. The indicator to be considered is the length of time the process of boiling water as much as 2 liters will be compared to the use of other fuels, such as oil and gas.

III. RESULT AND DISCUSSION

At the beginning of the activity, namely the manufacture of charcoal, a burning process was carried out manually and traditionally by using a closed combustion system using a metal container that had been perforated at the bottom to provide oxygen supply to support the fire. While the fire is burning from the bottom of the tin bucket, the coconut shells are inserted one by one slowly and gradually until they fill the tin bucket which is then closed tightly and left for 1 day. The charcoal refining process is carried out in a traditional manual mechanical way by inserting charcoal into the inner tube, closing it and hitting it with a hammer. The use of inner tubes is carried out with the aim that the pounding process does not reduce the powder due to wind and open air, besides that with an elastic shape that is not easily torn, the mechanical treatment and the sharp edges of the charcoal surface do not tear the container which causes the powder that has become reduced due to fly in the open air.

Figure 1. Charcoal Making and Milling

For the formation of briquettes, it is necessary to glue the particles of substances in the raw material, so a binder is needed so that a compact briquette is produced. According to [4], stated that organic binders produce relatively little ash after burning briquettes and are generally effective adhesives. Tapioca starch adhesive in liquid form as an adhesive produces low value fiberboard in terms of density, compressive strength, ash content and volatile matter, but will be higher in terms of moisture content, bonded carbon and calorific value when compared to those using molasses adhesive. The use of tapioca will produce briquettes that are smokeless and durable [2].

Figure 2. Making the Dough

The molding process is carried out manually with mechanical treatment by inserting the pipe. This process is carried out by pressing and compressing. Furthermore, in the center of the circle a hole is made using a pencil with a diameter of 1 cm. The purpose of this perforation is that the combustion process will affect the heat from the surface and the core of the briquettes. Based on Sudirman and Hadi [1], this method is effective in making the process of evaporation of water content in briquettes. The water content in the briquettes is helped to evaporate by heating at 110^{o}C for 24 hours. The process of evaporation of the lost water content can effectively remove 32% of the water content.

Figure 3. Molding of Briquette

Before the trial is carried out, what is needed is to determine the amount of fuel according to the dimensions of the available furnace by taking into account the number of briquettes and the total mass of briquettes used, so that the data are presented as follows:

- Total of briquettes : 14 pieces
- Briquette mass : 620.8 grams

Furthermore, the 14 briquettes were arranged in such a way in the stove and ignited with the help of a little kerosene (less than 20 ml) and oxygen support for the formation of the fire and the rapidity of the fire using the blower from the stove. The fire that has been lit from the blower stove fueled by coconut shell charcoal briquettes is then tested by cooking 2 liters of water in a kettle. The results show that the process of cooking water from room temperature to boiling water temperature (100^{o}C) is for 10

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minutes, which is the same as when the experiment was carried out in cooking 2 liters of water in a kettle using a PGN gas stove with a medium flame boiling in within 10 minutes too.

Figure 4. Performance Test (Boiling Water)

After the water boils, then the fire is extinguished and the remaining fuel is then weighed to obtain the mass of the remaining briquette combustion. In terms of the remaining use of fuel in the trial process of boiling 2 liters of water is 390.2 grams. So that according to equation 2, data on fuel use (PBB) can be obtained by determining the difference between incoming fuel (BBM) and residual fuel (BBS) as follows [5];

PBB = BBM – BBS
PBB = 620,8 gram – 390.2 gram
PBB = 230.6 gram

Thus, according to the above equation used to determine the efficiency of fuel use, it is obtained;

η = PBB/BBM x 100 %
η = (230.6 gr)/(620,8 gr) x 100 %
η = 37.14 %

The resulting efficiency shows data below 50% which indicates that the efficiency is quite low. However, it can be assumed that this occurs because the process of starting a fire with the process of boiling water has a time span that is not the same, when the briquettes start to burn the kettle has not been placed on the stove due to get a stable fire. In addition, the blower rotation setting is very influential in producing oxygen which causes the combustion process to spend the briquettes much faster. However, 37.14% is not a very low efficiency, so it can be said that this briquette can be used as an alternative biomass fuel to replace gas and kerosene stoves.

IV. Conclusions

Based on what has been done above, it can be concluded that the fabrication of briquettes using coconut shell charcoal was successfully carried out with a mixture of coconut shell charcoal powder and tapioca flour in a ratio of 5: 1. These briquettes can be used to cook 2 liters of water to a boil in 10 minutes. , which is equivalent to using a PGN gas stove with a medium flame setting. In the process of cooking 2 liters of water using 602.8 grams of fuel with the remaining 390.2 grams of fuel with an efficiency of 37.14%.

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