Characteristic of Areca Fiber Briquettes as Alternative Energy

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Abstract. The level of demand and use of fuel oil in Indonesia has exceeded domestic production. So that the acceleration of the choice of alternative energy adoption becomes a step and effort to overcome this problem. Efforts to develop a diversified solid fuel product program in the form of areca-based fiber briquettes are the choice. Areca nut is a natural fiber derived from Areca Catechu which has the potential to be used as a raw material for making briquettes which has only been a waste in the community. The experimental method carried out in the manufacture of briquettes is a mixture of areca fiber (particle) and tapioca adhesive in a variation ratio of areca fiber concentration of 90%, 80%, 70%, and 60%. This research resulted in the characteristics of areca fiber briquettes with a concentration variation of 80% of areca fiber and 20% tapioca adhesive which has the highest heating value of 12352.9 kJ/kg with a density of 318.71 kg/m\(^3\). Success in processing and producing briquettes in correctional facilities can reduce dependence on fuel oil. Areca fiber-based briquette development as an effort to get alternative energy that has quality products. The use of areca fiber waste as an alternative fuel substitute can be realized in the community to achieve national energy security through the process of applying technology.

1. Introduction

The need for fuel is quite large in the community, both small and medium industries, resulting in lack of energy sources. Indonesia is experiencing serious energy problems entering 2020. Increasing the price of petroleum fuels, which until now continues to have an impact on selling prices in the community and burdening the government with fuel subsidies. From various print and electronic media information, world energy needs will reach twice the current needs, especially petroleum. Development of bioenergy as an alternative energy source, outside of fossil energy sources that are increasingly scarce. The acceleration of providing various options and adopting alternative energy is one step that must be taken in the future. One of the renewable energy which has great potential in Indonesia is biomass. Renewable energy is needed to overcome this condition. As in the renewable energy development and energy conversion policies of the Ministry of Energy and Mineral Resources [1] it is stated that the potential of biomass energy in Indonesia is quite large reaching 434,008 GWh. In Presidential Regulation [2] Concerning the National Energy Policy, it is formulated that an increase in the use of new energy sources in the form of solid and renewable energy sources from the type of biomass and waste is needed. The development needed is more applicable in getting fuel as an alternative energy source. Biomass can be burned in the form of fiber, briquettes, or bars. Briquette is a solid fuel that is processed with effective methods to convert solid raw materials into a form of product that is easy to use. The government has issued instructions on the use of alternative fuels from vegetable oils [3]. This is an opportunity for all components of the nation to participate in developing energy resources by diversifying, including the potential of biomass energy from agricultural...
production waste, such as the utilization of areca nut fiber, sugarcane bagasse, durian skin, coconut shell / coconut shell charcoal, and so on. Waste and residues from agriculture and industry can be used as alternative renewable sources to produce energy and raw materials such as chemicals, cellulose, carbon and silica [4]. In this regard, efforts are needed to optimize the development of biomass energy sources and potential sources into innovative product forms that can meet the demands of energy needs. Biomass energy can be achieved through the production of solid fuel types, such as areca fiber based briquettes.

Areca catechu is a potential alternative energy source because it produces betel nuts consisting of betel nuts and areca fiber. So far, areca nut plants that can be used only in the form of betel nuts. The use of betel nuts as ingredients for medicines, cosmetics, coloring, and so on. After the areca nut is utilized, the remaining areca fiber will become wasted and unused waste. The chemical content of areca nut fiber is 70.2% cellulose content, 6.02% ash, 10.92% water [5]. In the community, usually areca nut fiber waste that has dried is only burned. The use of areca fiber waste into briquettes as a substitute fuel for oil is possible. Briquetting is an effective method for converting solid fuel (biomass) into a certain form after pressing or the results of compacting so that it is easier to use [6]. In making briquettes, briquette technology is distinguished in three ways [7], namely high pressure briquette, medium pressure briquette with heating, low pressure briquette with binder. Through the process technology approach and test variables, as well as making a mixture choice of a number of other biomass energy source materials is an effort to improve the quality of yield characteristics. Factors that influence the characteristics of fuel combustion are the density (bulk density) of the fuel being tested / burned and will also provide an increase in the heating value of the combustion [8]. Success in processing and producing it will be able to reduce dependence on fuel oil energy. Utilization of areca fiber waste is used as briquette fuel, which is processed with a combination of potential biomass energy sources is one form of innovation in solid fuel products.

In finding a type of solid fuel as a useful alternative it takes efforts to develop, enhance and improve its characteristics. The findings in the development of a new product in the form of areca fiber briquettes became an innovation model so that it could be developed in the community. So that the betel fiber briquettes can be a kind of alternative solid fuel that has quality and quality. The study of the quality of briquettes is carried out as a reinforcement of the recommendation statement so that it meets the requirements for commercialization in the community. Based on the discourse and conditions, this study will analyze the heating value of briquettes made from areca fiber as an alternative fuel. By conducting this study, it becomes the basis in achieving the development of national energy security.

2. Research Methods

In this study, an experiment was conducted on briquette test samples which were oriented to get its characteristics in the form of heating value. The tested briquettes were made from a mixture of betel nut fiber with tapioca adhesive. The method of making briquettes is done by preparing dried areca nut fiber waste (Figure 1) which is then chopped.

![Figure 1. Areca Fibre](image1.png)

![Figure 2. Areca Fibre Particles](image2.png)

The results of the enumeration are ground using a disk mill machine to be made into particles or mesh measuring ± 0.3 to 0.6 mm (Figure 2). The next step is to print the briquettes by mixing the areca fibre particles and tapioca (Figure 3). In this briquette printing, manually compacted pressure of
100 kgf/cm² through a briquette press. Variation in areca fiber concentration ratio of 90%, 80%, 70%,
and 60%. The briquettes that have been printed are then heated at 120 °C using an oven for 1 hour.
After that removed and dried in the sun in a few days until the water content is low. The briquettes that
have dried, the test samples taken for testing the heating value in the laboratory. The test samples of
each concentration variation with 5 samples were tested for their characteristics.

Figure 3. Tapioca

Availability of laboratory test equipment in conducting research is needed. Briquette test samples
taken and prepared for testing using the OXY-360 model "Bomb Calorimeter" (Figure 4). The
treatment and selection of characteristic test samples is focused on the measurement of the combustion
heat energy or calorific value. In the analysis of each type and composition of the mixture and the
treatment parameters will be recorded and tabulated in a table that is designed as needed. According to
ASTM D5865 standard [9] the calorific value is determined in the standard bomb calorimeter test.

Figure 4. Calorimeter Bomb Equipment

Analysis of each type of areca fiber briquettes with the composition of the percentage between
raw materials and adhesives as well as the treatment parameters will be recorded and tabulated in the
data collection table that is designed as needed. Data analysis and calculation using existing standard
equations and processing data with computational aids. The calorific value of fuel (N_{bb}) areca fiber
briquettes can be calculated using the equation:

\[ N_{bb} = \frac{(H \cdot \Delta T)}{m_{bb}} \ (kJ/kg) \]

Information:

- \( N_{bb} \) : Calorific value of fuel (kJ/kg)
- \( H \) : Calorimeter head value (11.5664 kJ/°C)
- \( \Delta T \) : Changes in temperature on the calorimeter bomb (°C)
- \( m_{bb} \) : Mass fuel test (kg)

3. Result And Discussion

In this study, areca fiber was prepared as needed for the manufacture of briquettes. The need for
research raw materials is calculated by predicting the number of variations of the concentration of
areca nut fiber with the adhesive used. In accordance with the technical thinking flow of briquette
making in order to obtain the physical model of briquette product development results (Figure 5).

Areca fiber briquettes which are produced as a result of the development are tested for their
quality characteristics. Based on the procedure of using the Bomb Calorimeter tool so that the
combustion values obtained for each type of briquette variant. The value of a number of physical quantities that can be derived is based on a standard formula by entering data from the measurement results on the test equipment used.

Figure 5. Areca Fiber Briquettes Produced

From the test results of the heating value of areca fiber briquettes on all concentrations of variant mixtures, obtained analysis data that fluctuate according to the composition of the composition. Areca fiber briquettes which have the highest value can be found in the 80% variant concentration of areca fiber that is equal to 12352.9 kJ/kg. In Figure 6 it can also be seen that the lowest calorific value of areca fiber briquettes with tapioca adhesive at 90% concentration of areca fiber and 10% tapioca adhesive is 9923.97 kJ/kg.

Figure 6. Areca Fiber Briquette Calorific Value Test Graph

Figure 7. Areca Fiber Briquette Density Graph
In Figure 7 shows the density value of areca fiber briquettes for various variations of the mixture concentration. Variation concentration of 90% of areca nut fiber with 10% tapioca produces the lowest briquette density which is 270.09 kg/m$^3$. The highest briquette density was obtained in the variation of 80% mixture of areca nut fiber with 20% tapioca adhesive in the amount of 318.71 kg/m$^3$.

From the results of this study, it was shown that the areca fiber briquette with a mixture ratio of 80% areca fiber with 20% tapioca as the adhesive had higher characteristics compared to other concentration variants, both in the calorific value and briquette density. Of course, from this condition, it can be stated that variants of 80% areca fiber concentration as an optimal mixture ratio in the manufacture of areca fiber briquettes. Furthermore, this variant is very appropriate to be recommended to the public for its use. In line with research recommendations for the development of briquette products made from agricultural waste with tapioca adhesives that the composition of the mixture of 80% main ingredients and 20% adhesives is the optimal ratio in the manufacture of briquettes [10]. When compared with other solid fuels such as charcoal and coal, areca fiber briquettes have advantages, namely: raw materials and adhesives easily found around the community. Where areca nut is the end result of the production of areca nuts which are not utilized and become waste, while tapioca is an easily obtained material and a relatively cheaper price. This reason makes areca fiber briquettes can be realized in the midst of people's lives, because in making briquettes is not difficult because it does not require special treatment. Thus the making of this briquette can be applied in people's lives as an alternative fuel.

In making briquettes followed by the use of adhesives. The impact of using adhesives is likely to affect the heating value as a briquette characteristic. In accordance with its function, that the adhesive becomes the binding material of the main ingredients, besides that the adhesive also makes a good combustion rate effort on the briquette so that it is easily ignited. In addition, the concentration of the use of adhesives also affects the characteristics of the heating value. The amount of adhesive used against the number of main ingredients is a concern in getting the best quality betel nut fiber briquettes. The physical properties of tapioca glues are easily attached to room temperature, flammable, not volatile if not decomposed. In addition, other factors that can affect the heating value of briquettes as an alternative fuel include the quantity of particles, compressive forces (compacting).

With the development of areca fiber briquette products as an alternative fuel, it has also developed national energy security.

4. Conclusion
This study concludes the success of achievement in utilizing areca fiber waste as a candidate for solid fuel in the form of briquettes as alternative energy. The process of making briquettes by mixing areca fiber particles and tapioca adhesive. Characteristics of areca fiber quality briquettes with 80% concentration variants of areca fiber and tapioca adhesive 20% have a calorific value of 12352.9 kJ/kg and density of 318.71 kg/m$^3$. The ratio of the mass of the main raw material (filler) to the adhesive used, the amount of grain, the compressive force (compacting), affects the quality of the quality characteristics including the density of the briquettes and at the same time this variable will determine the heating value it causes. Development of briquettes made from areca fiber into an alternative fuel product that can be applied in the community. Implementation as a concrete manifestation in the development of briquettes in the community reflects the achievement of national energy security.

5. References
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