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Influence of Adhesive Type on The Calorific Value of Biobriquette from Coconut Pulp and Rice Husk Mixture

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Abstract

One of the solutions to reduce dependence on fossil energy is fuel derived from organic materials (biomass), namely biobriquettes. In this study, biobriquettes were made from a mixture of coconut pulp and rice husks using two types of adhesives; tapioca and arpus. The purpose of this study was to determine the quality of biobriquettes and to determine the effect of the adhesive type on the calorific value. This study used an experimental method, namely making biobriquettes and conducting laboratory tests of the biobriquettes that had been produced with variations in the types of adhesives used. The calorific value of biobriquettes with tapioca adhesive is 5692 cal / g and the calorific value of biobriquettes with arpus adhesive is 6415 cal / g. From these results, it can be seen that the calorific value of biobriquettes using arpus adhesive is greater than the calorific value of biobriquettes using tapioca adhesive.

Keywords: Coconut Pulp, Adhesive, Biobriquette, Rice Husk.

1. Introduction

The need for energy is increasing along with the development of population growth, and the largest energy source utilized in Indonesia is fossil energy (Agus et al., 2022). Fossil energy is cannot be renewed and not environmentally friendly. Therefore, sustainable alternative energy sources are needed to reduce dependence on fossil energy. One of the uses of alternative energy that has long been developed and continues to increase is the use of new and renewable energy (Fitriana & Febrina, 2021). The solution that can be offered is to diversify energy sources that develop the potential for renewable energy obtained from resources available in nature (Kholiq, 2015). The types of renewable energy include PLTS, PLTA, PLTP, PLTMH, PLTG, microhydro, and Biomass (Masrur A, 2024).

Renewable energy is a source of energy that comes from nature that can be directly utilized freely. In addition, the availability of this renewable energy is unlimited and therefore utilized continuously. One of the potential sources is the utilization of agricultural and plantation waste as biobriquettes to reduce the use of fossil energy sources as fuel (Kalvianto, 2020). Plants that thrive in Indonesia have benefits in certain fields, one of which is the coconut tree. Coconut plants are used by almost all parts of them by humans so they are considered multipurpose plants. Apart from coconut trees, rice is an agricultural plant that is no less related to its increasingly widespread growth (Febrina & Kartika, 2024).

Biobriquettes are charcoal that is further processed into briquettes that can be used for daily alternative energy as a substitute for kerosene and LPG gas. Biobriquettes are one way used to apply biomass energy sources into fuel by compressing them so that their shape becomes more regular. For example, biomass that is made into biobriquettes is rice husks, rice husk charcoal, sawdust, sawdust, and other biomass wastes (Parinduri et al., 2020). Biobriquettes have many advantages, namely if packaged attractively, they will have more economic value than charcoal in traditional markets. Briquettes have higher heat, are odorless, and are durable.

The manufacture of biobriquettes generally requires the addition of adhesives to improve the physical properties of the briquettes. The addition of the appropriate level of adhesive in the manufacture of briquettes will increase the calorific value of the briquettes (Siregar et al., 2019). The effect of using adhesive types from palm shell briquettes, namely adhesives from tapioca flour, sago aren, and arpus, shows that the calorific value obtained is tapioca adhesive 6328 kcal/kg, sago aren 6330 kcal/kg and arpus 6366 kcal/kg, water content is tapioca adhesive 6.0%, sago aren 6.7% and arpus 5.5%, ash content is tapioca adhesive 7.70%, sago aren 6.74% and arpus 7.11%. The results of the study stated that the use of adhesive types affects the quality standards of briquettes.

This study is the manufacture of biobriquettes from a mixture of rice husks and coconut pulp using two types of adhesives tapioca flour and arpus. Coconut pulp is organic waste from the squeezing of coconut flesh from which the coconut milk has been extracted from the coconut oil processing industry or food processing facilities. The pulp produced from coconut processing has quite high nutrition. Analysis of dry coconut pulp (fat-free) contains 93% carbohydrates consisting of 61% galactomannan, 26% mannose and 13% cellulose. The article also explains the comparison of the content that coconut pulp contains 12.2% fat, 18.2% protein, 20% crude fiber, 4.9% ash, and 6.2% water content. The results of the coconut pulp content can be used as raw materials for energy (Adi H et al., 2018).

Rice husk is a hard layer of rice husk that includes caryopsis consisting of lemma and palea that are interconnected. The calorific value of rice husk has an average value of 3,410 kcal/kg so it can be used as a source of new renewable energy (Ola, 2015). On the other hand, rice husk also has a fairly high cellulose content, making it possible to accelerate the combustion process evenly and consistently as a source of heat energy (Binar, 2021).

Adhesives have other names that are commonly known as glue, mucilage, paste, and cement. Adhesives can bind charcoal powder that is separated from each other to make charcoal particles unite, then biobriquettes can be formed according to desire (Pratama et al., 2018). Tapioca is flour made from cassava root tubers that are extracted the same as starch (Wijayan & Rahmadhia, 2021). Arpus is a type of sap that comes from pine trees. Pine trees are a type of wood that has quite good quality so many Indonesian people become pine farmers. Arpus production varies depending on the age of the pine tree. Punis trees are plants that have high enough quality sap to be utilized. Pine sap comes from old trees and gets around 30-60 kg of sap which is then used as an organic adhesive (Evayanti, 2018).

The quality of the biobriquette is determined by the amount of calorific value during combustion. The calorific value is the calculated value of the heat energy in a fuel after testing to obtain the amount of heat energy. The higher the calorific value of the biobriquette, the better the quality of the biobriquette produced. According to Cholilie et al. (2021), the calorific value was created in the bomb calorimeter test. The higher the calorific value, the better the quality of the biobriquette.

The study aims to determine the effect of adhesive types on calorific value. Therefore, this study was conducted to attract public opinion on biomass development to increase the use of environmentally friendly energy.

2. Materials and Method

The research method used is the experimental method, namely making biobriquettes and laboratory tests. This research method aims to determine the factors that affect the calorific value of biobriquettes. In the research process, it was carried out by making biobriquettes from a mixture of coconut pulp and rice husks with variations in the composition of tapioca and arpus adhesives. Laboratory tests were carried out on each biobriquette sample.

The materials prepared are 1 kg of rice husk and coconut pulp**, t**apioca flour adhesive, arpus, and water. The mixture of coconut pulp and rice husk is 50 grams: 50 grams with variations in the composition of tapioca adhesive (PT) 10%, 15%, 20% and variations in arpus adhesive (PA) 10%, 15%, 20%. k) Mass of material and adhesive composition with sample PT1 100 g: 10%, PT2 100 g: 15%, PT3 100 g: 20% and mass of material and adhesive composition with sample PA1 100 g: 10%, PA2 100 g: 15%, PA3 100 g: 20%.

The equipment used in the research are pyrolysis reactor, stove, pot with a capacity of 1000 ml, matchstick, frying pan, mortar and scales, and Mold size 3 cm x 3 cm x 3 cm. Biobriquettes are made with the following steps:

a) Prepare the materials; coconut pulp and rice husk
b) Prepare the tools to be used.
c) Carbonize the raw materials until they become charcoal.
d) Crush the charcoal and then sift the crushed charcoal powder to get finer grains.
e) Mix the adhesive material (variations: tapioca, arpus) and water then heat it to produce glue as a briquette adhesive.
f) Mix the adhesive glue into the fine charcoal grains and then stir it according to the variations in the composition of the adhesive and pure charcoal that have been determined.
g) Put the mixture (f) in the briquette mold that has been provided.
h) Dry the biobriquettes for 3 days manually (sun heat).

Data collection is done by testing several parameters produced by biobriquettes of coconut pulp and rice husk mixture using tapioca and arpus adhesives in the laboratory.

3. Analysis And Discussion

The calorific value obtained from the results of testing the biobriquette samples can be seen in the graph in Figure 1.

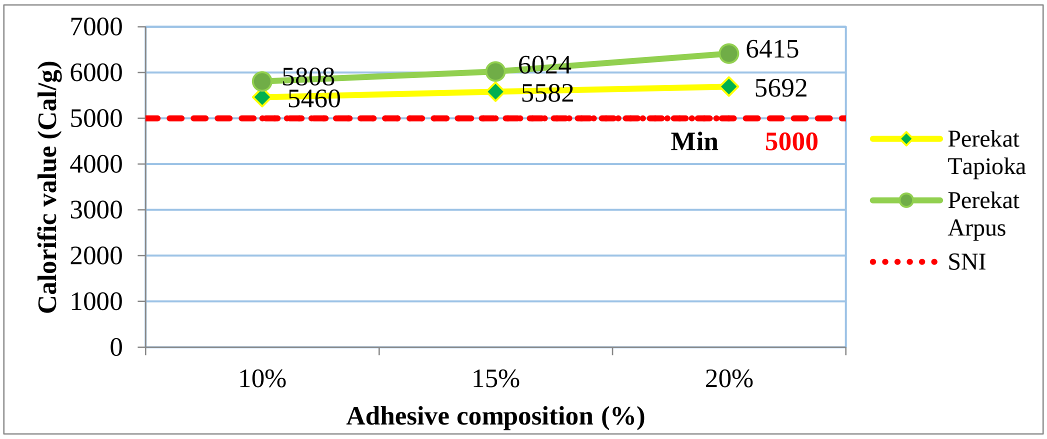

Figure 1. The calorific value of biobriquettes

Figure 1 shows that biobriquettes produce the highest calorific value of 6415 cal/g from the 20% PA sample and the lowest calorific value is found in the 10% sample, which is 5460 cal/g. The calorific value of biobriquettes from the highest to the lowest has met the SNI quality standard, which is above ≥ 5000 calor/g. It can be seen from the overall calorific value produced that the use of arpus adhesive in the biobriquette sample has a higher average calorific value.

The calorific value produced by biobriquettes is in line with the research of Aziz et al. (2019) that the use of the type of adhesive greatly affects the calorific value of biobriquettes. In the results of this study, variations in calorific value can be seen in biobriquettes, which shows that the type of adhesive used can affect the calorific value. Therefore, choosing the right type of adhesive is very important in improving the quality of biobriquettes.

Biobriquettes with arpus adhesive have a higher calorific value than biobriquettes with tapioca adhesive, due to the characteristics of arpus adhesive which is flammable and contains diterpene acid which affects the high calorific value of biobriquettes. While tapioca adhesive has a high water content in the dilution process tapioca flour must be mixed with water so that it can thicken. This greatly affects the quality of the calorific value of biobriquettes. The calorific value of biobriquettes made from a mixture of coconut pulp and rice husks has a calorific value above the SNI standard, biobriquettes with arpus adhesive type are in the range of 5808 cal/g – 6415 cal/g and with tapioca adhesive type have a value of 5460 cal/g – 5692 cal/g.

The analysis of the effect of adhesive type on calorific value was continued using simple linear regression analysis. This analysis was conducted to determine the effect of the relationship between adhesive content (X) and calorific value (Y). Regression analysis is a calculation of significance with the regression equation formula Y = a + bX. The regression equation functions to predict variables that affect other variables. This calculation can identify and determine the value of the effect of adhesive type on calorific value. The results of the linear regression analysis on tapioca adhesive (PT) are directly presented in Figure 2.

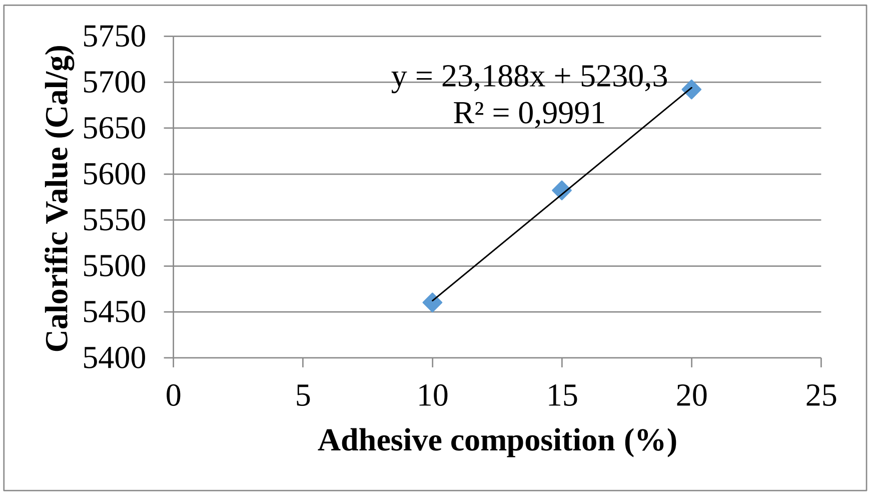

Figure 2. Regression analysis graph of calorific value of Tapioca Glue

Based on the figure 2, the regression line shows a linear relationship between adhesive content and calorific value. The regression line equation obtained is y = 23.188x + 5230.3, this value indicates that the relationship between tapioca adhesive content and calorific value is very positive. Then getting an R^2 value of 0.9991 shows that the tapioca adhesive content and calorific value have a strong relationship, meaning that the higher the R^2 value, the stronger the relationship between the adhesive content and calorific value. It can be concluded that tapioca adhesive can affect the calorific value of biobriquettes.

Calculations using a simple linear regression equation on the calorific value of Arpus adhesive biobriquettes (PA) can be seen in Figure 3.

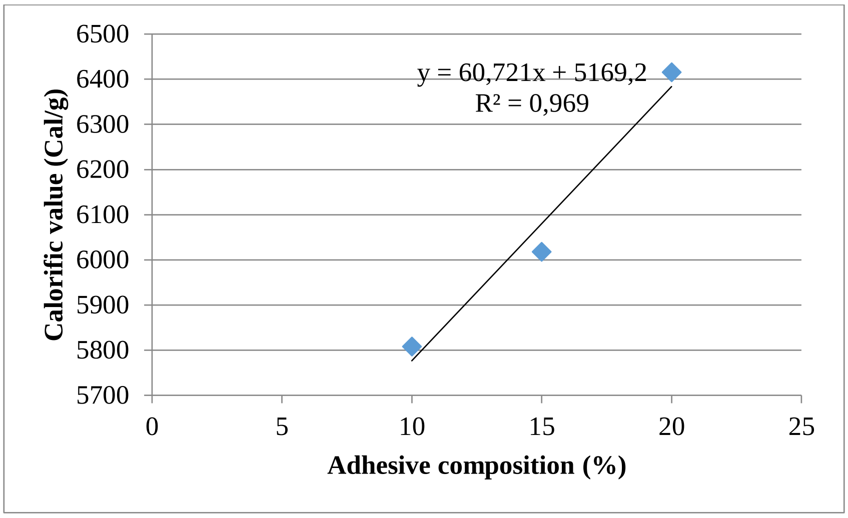

Figure 3. Regression analysis graph of calorific value of arpus adhesive

Based on the graph in Figure 3, it can be seen that the arpus adhesive has an effect on the calorific value of biobriquettes with a regression equation of Y = 23.188x + 5230.3. Positive results on the X-axis value mean that it has a strong effect on the Y-axis value. There is an R2 value of 0.969 indicating that there is a very strong relationship between the adhesive content and the calorific value. The resulting R^2 value can provide the fact that the higher the arpus adhesive content, the higher the calorific value produced.

The effect of the content in the linear regression analysis shows that the adhesive on the biobriquette with tapioca adhesive has a coefficient value of R^2 = 0.9991 and the coefficient value on the biobriquette with arpus adhesive is R^2 = 0.969. In both R^2 values indicate results that are close to the value of 1, meaning that there is an effect of the type of adhesive on the calorific value. Analyzing the quality of biobriquettes can provide added value to alternative energy users. Determining fuel (biobriquettes) that is by economic needs and environmentally friendly requires research that supports the development of renewable energy. Biobriquettes that can be used must prioritize quality along with a good production process to be applied to the community.

Biobriquettes that have higher quality are biobriquettes with arpus adhesive but are less efficient in the manufacturing process because they are more difficult to mold and require a higher arpus content to use. Arpus has a higher price and limited availability of raw materials compared to tapioca. Biobriquettes with tapioca adhesive have lower quality, but their quality has met SNI quality standards. As seen in Table 1, biobriquettes with tapioca adhesive are superior in the manufacturing process, searching for raw materials and producing biobriquettes with strong adhesive power. Analysis of the contents of the table concludes that biobriquettes can be used as alternative fuels and are recommended for community use are biobriquettes with tapioca adhesive because they are easier to make and get cheaper raw materials.

Biobriquettes with tapioca have very potential to be developed further because they have quite good quality, easier production process, and more affordable costs. Although the highest calorific value is found in biobriquettes with arpus adhesive, they have dangerous content if used for the food manufacturing process and are more recommended for use in non-food.

Conclusions

Biobriquettes produced from this study can be used as alternative energy with a calorific value of tapioca adhesive biobriquettes of 5692 cal/g and a calorific value of arpus adhesive biobriquettes of 6415 cal/g. The resulting value is above the calorific value of biobriquettes based on SNI standards. The use of adhesive types can affect the calorific value, there is a linear regression analysis showing the effect of tapioca adhesive content on the calorific value of biobriquettes with a coefficient value of R^2 = 0.9991 and there are coefficient values of R^2 = 0.969. Both coefficient values indicate results that are close to 1, meaning that there is an effect of the type of adhesive on the calorific value.

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