
CHARACTERISTICS OF BRIQUETTES PRODUCED FROM KEPOK BANANA PEEL AND RICE HUSK WASTE AS ALTERNATIVE ENERGY

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Abstract

Kepok banana peel and rice husk are classified as biomass waste that has not been fully utilized, where the biomass waste contains contents that can be converted into alternative fuels. One use of biomass is making briquettes. This study aims to identify the characteristics of briquettes used banana peels and rice husk based on the Indonesian National Standard (SNI), that are an innovation that uses biomass waste to become renewable energy. The making of briquettes in this study was carried out in a simple way, the variables in this study were the ratio between banana peels and rice husks, namely 70:30 and 50:50 with 80 mesh. The adhesive using is tapioca flour with concentration used of 5%, 10% and 15 %. The results obtained were the best a variation of 70:30 using variations adhesive concentration of 15%, a calorific value of 4580.82 cal/g, the water content of 3.95%, and the ash content of 8.98% the characteristics that did not meet SNI. It can be concluded that making briquettes using kepok banana peel and rice husk as raw materials can be used as a renewable alternative fuel to support sustainable energy.

Keywords: Banana peel, Biomass, Briquettes, Renewable energy, Rice husk,.

INTRODUCTION

Balikpapan City is located in East Kalimantan province, Indonesia. With rapid population growth, there has been an increase in food production consumption. One of the dominant consumptions is bananas, a production of 6,188 tons in 2022. The amount of banana production is equivalent to the amount of waste from bananas, with the processing of banana peels still not being utilized properly. Banana peels contain organic compounds, such as cellulose (approximately 14.4%), hemicellulose (approximately 23.2%), and lignin (approximately 21.29%) (Sulistyaningarti & Utami, 2017).

In addition to banana peel waste, rice husk is also part of the waste processing problem in East Kalimantan. With a rice production of 215,290.58 tons in 2023, this production will certainly result in large amounts of waste. The processing of rice husk waste in East Kalimantan is only limited to burning, and the processing of rice husk waste into useful products is still minimal. Rice husk contains organic compounds such as cellulose (38%), hemicellulose (18%), lignin (22%), and silica (Gurusinga, 2023).

The compound content of banana peel and rice husk can provide a fairly good calorific value if utilized as a biomass feedstock. Biomass is one of the alternative energies, energy derived from biomass is more environmentally friendly, does not contain sulfur so it does not cause air pollution, and can increase efficiency in utilizing agricultural and forest resources. Currently, the energy sources used are non-renewable energy.

Fossil fuels are non-renewable energy that still dominates to use, such as the use of petroleum, coal, and natural gas. With limited quantities, it is necessary to develop renewable energy. Alternative energy that can be utilized comes from solar energy, wind energy, geothermal energy, hydroelectric power, hydrogen, and biomass. The utilization of biomass as an alternative energy is one form of briquettes.

Briquettes can be classified as an alternative fuel, the basic material for making briquettes comes from biomass waste. In Indonesia, the quality standard for briquettes is regulated by SNI 01-62352000. This standard includes the provision that briquettes must have a maximum moisture content of 8%, a maximum ash content of 8%, and a minimum calorific value of 5000 cal/g. The utilization of banana peel waste, especially kepok bananas, and rice husks from food waste is expected to overcome problems in food waste processing and can be one of the alternatives that can be utilized as renewable energy.

LITERATURE REVIEW

Referring to the quality standard SNI-01-6235-2000, which sets a calorific value of 5000 cal/g, water content of < 8%, and ash content of < 8%, these values are influenced not only by the main material but also the adhesive it used. There are two types of adhesive in making bio-briquettes: smoky adhesive (tar, pitch, clay, and molasses) and less smoky adhesive (starch, dextrin, and tapioca flour). Among the best binders that can be used is tapioca flour (Zarkati Kurdiawan & Ir Sri Rachmania Juliastuti, 1959)

In research on banana peel briquettes with tapioca starch as the adhesive, the water content was found to comply with the standard, with the highest value found in the 15% adhesive variation at 7.56%. However, there are still shortcomings in terms of ash content and calorific value. The lowest ash content was found in the 15% adhesive variation at 16.73%, which exceeded the SNI limit. The highest calorific value was found in the 15% binder variation at 4345.04 cal/g, which did not meet the SNI value (Marali *et al.*, 2023).

Other research discusses the results obtained, showing that the best adhesive concentration to use is 5%. Through testing, several characteristics that meet the SNI were obtained, including a calorific value of 10.815.9437 cal/g. Meanwhile, characteristics that did not meet the SNI were the water content of 8.465% and ash content of 27.850% (Supriadi *et al.*, 2022).

Meanwhile, for research on rice husk briquettes with paper pulp as an adhesive, the water content was found to comply with the standard, with the highest value found in the 1:1 ratio of rice husk to adhesive at 4.55%. However, there are still similar shortcomings, where the ash content with the highest value was 20.41% with a 1:0.5 ratio of rice husk to binder (Amin *et al.*, 2022). It was also found that rice husk briquettes have an ash content of around 17-25%. The water content is around 5-8% and the calorific value is around 4430.94-6779.55 cal/g (Sofyana *et al.*, 2021). This indicates that both raw materials can be processed into briquettes, although there needs to be improvement in several aspects.

RESEARCH METHOD

In this study, the researcher uses an experimental method, using kepok banana peel waste and rice husks as the main materials with ratios of 70:30 and 50:50, and tapioca starch as the adhesive. The briquette-making process involved selecting raw materials, namely banana peel

waste from a local fried food business near the Polytechnic State of Balikpapan, and rice husk obtained from farmers inenggarong city.

The waste of banana peel and rice husk were sun-dried until completely dry, as shown in Figure 1.



Figure 1. Dried banana peel waste (a) and Rice husk (b)

The next process involved making charcoal from banana peel and rice husk. The following step was to grind the charcoal from banana peel and rice husk using an 80-mesh sieve. After grinding, the charcoal from banana peel and rice husk were mixed with tapioca starch adhesive at various percentages: 5%, 10%, and 15%. The process of making the binder can be seen in Figure 2. The next step was to mix the charcoal with the composition as shown in Table 1, using 20 grams of charcoal.



Figure 2. Binder production process

After mixing the charcoal with the binder to form briquettes, the briquettes were not molded. Instead, after mixing, the briquet samples were dried until they were completely dry. Then, the dried briquette samples were ground into a fine powder and tested in a laboratory to determine their calorific value, moisture content, and ash content. Figure 3 shows the briquette samples that were ready for laboratory testing.



Figure 3. Sample briquettes

The variations of the briquette samples are shown in Table 1, as follows;

Table 1. Briquette sample composition

Ratio	Sample code	Concentration of Binder (%)	Mass of the binding material (g)
70:30	Sample 80-5%	5	3,75
	Sample 80-10%	10	7,5
	Sample 80-15%	15	11,25
50:50	Sample 80-5%	5	3,75
	Sample 80-10%	10	7,5
	Sample 80-15%	15	11,25

RESULTS AND DISCUSSION

The results of the tests conducted on the briquette samples for calorific value, ash content, and water content are as follows;

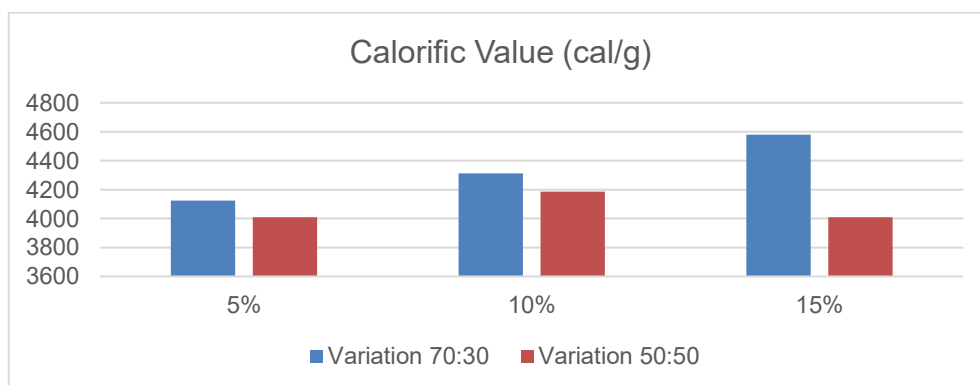


Figure 4. Graph showing the calorific value of different briquette samples

Figure 4. presents the results of sample testing conducted to determine the calorific value of the briquettes using the IKU/7.2/BC-01 bomb calorimeter method. The results show that the calorific values obtained were below the SNI standard. The highest value was found in the 70:30 ratio with 15% adhesive at 4580.82 cal/g, while the lowest value was found in the 50:50 ratio with 5% adhesive at 4010.22 cal/g. The calorific value is a parameter of the quality of a briquette; the higher the calorific value, the better the quality.

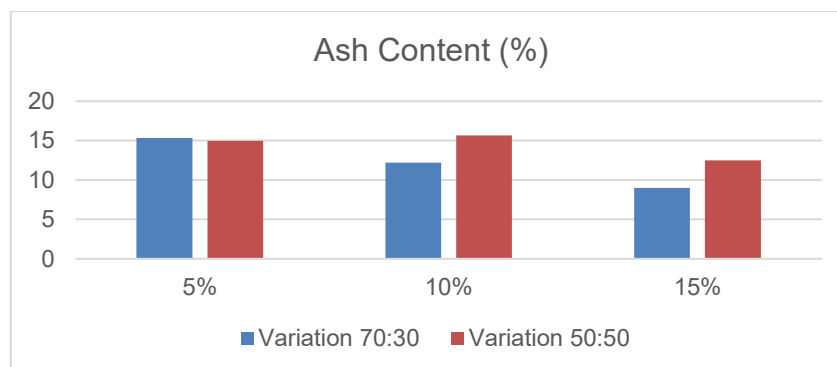


Figure 5. Graph showing ash content test results of briquette samples

Figure 5 presents the results of the ash content test conducted on the briquette samples using the gravimetric method. The obtained results were below the SNI standard. The lowest ash content was found in the 70:30 sample with 15% adhesive variation, at 15.67%. Ash content represents the remaining residue after combustion and affects the calorific value produced. The lower ash content is an indication of good quality briquette, ash content is a material that does not burn after a complete combustion process. With lower ash content, the pollution produced from briquette fuel is also lower, thus reducing pollutants when using briquette fuel.

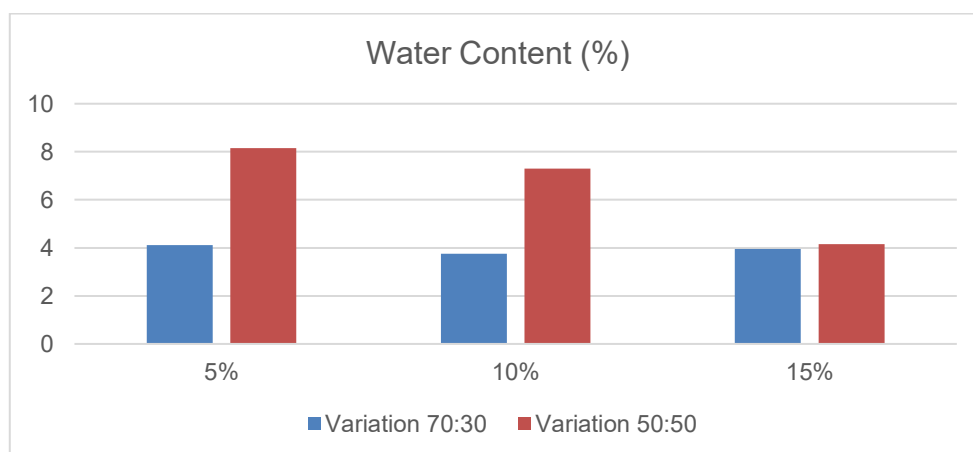


Figure 6. Graph showing moisture content test results for briquette samples

Figure 6 shows the results of the water content test using the gravimetric method. It was found that almost all samples met the SNI standard, except for the banana peel waste and rice husk mixture with a 50:50 ratio and 5% adhesive variation. The highest value was obtained from the 50:50 ratio with a 5% binder variation at 8.15%, and the lowest value was obtained from the 70:30 ratio with a 10% adhesive variation at 3.75%. Water content is a reference for the calorific value produced; the

higher the water content, the lower the calorific value of a briquette. This is because the energy produced will decrease as the water contained in the briquette evaporates.

CONCLUSION

The results of this research show that banana peel waste and rice husk have the potential to be used as raw materials for making briquettes. Banana peel waste and rice husk are renewable energy sources that can be used sustainably, as biomass can help reduce pollution by converting waste into energy. The test results for various compositions of briquette raw materials used in biomass to find the best characteristics that meet the standards of SNI No.1/6235/2000.

The research obtained results to the standard values for briquettes, specifically in the sample with a 70:30 ratio of banana peel waste to rice husk and 15% adhesive. This sample had a calorific value of 4580.82 cal/g, ash content of 8.98%, and water content of 3.95%. Analysis of the characteristics of a briquette significantly affects the quality of the produced briquette, renewable energy can be used for daily life and industries. Further research is needed on the characteristics of briquettes made from banana peel waste and rice husk compositions, so that researchers can continue developing environmentally friendly renewable energy, such as biomass conversion into briquettes.

ACKNOWLEDGEMENT

The researcher extends their gratitude to the researcher team for their cooperation, which made completing this research possible.

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