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Improving The Heat Value of Biobriquettes Made From Rice Husk and Cabbage with The Addition of Palm Oil

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***Abstract*—Biobriquette can be used as an alternative fuel because it is made from inexpensive materials and uses simple technology, and it is expected to help overcome the energy (fossil) crisis. The problem is determining how to boost the calorific value of briquettes made from waste biomass materials. Cabbage contains approximately 18.80% fiber, so there is cellulose content that can be processed into high-value products such as briquettes, and using rice husks as fuel can increase the calorific value. The goal of this study is to determine the best calorific value of bio briquettes by varying the method of adding coconut oil and the composition of rice husks and cabbage. The stages of making cabbage and rice husk bio briquettes are raw material preparation, carbonization, adhesive manufacture, briquetting, and quality testing. The variables used are variations in the composition of rice husks: cabbage in ratios of 40:60, 50:50, 60:40, 70:30, and 80:20, as well as the variable method of giving palm oil by mixing with ingredients and dyeing after it becomes briquettes. According to the findings of this study, the best bio briquette mixing ratio resulted in the highest calorific value found in a mixture of 40% rice husk and 60% cabbage with the method of adding palm oil by dipping, with a calorific value of 6.283 kcal/g, a combustion rate of 0.0616 g/minute, and the duration of the flame is 60.26 minutes.**

Keywords: Biobriquette, Carbonization, Cabbage, Calorific value, Rice Husk

I. INTRODUCTION

The people of Indonesia are currently facing difficulties in meeting their kerosene and gas needs. The earth's availability will eventually run out. As a result, alternative energy sources are deemed necessary and urgent. One solution to this problem is to maximize the country's renewable energy potential (Mandey, 2015).

Cabbage vegetable waste is abundant due to its short shelf life, so it decomposes quickly, and it contains approximately 18.80 percent fiber, so this natural cellulose content has great potential to be processed into high-value products such as briquettes, which can be used as an alternative energy source (Arjuna, 2018). Following that, rice husk waste, which has relatively low moisture and ash content, can be used as additional material to increase the calorific value in the manufacture of biochar briquettes (Gunawan, 2018). Rice husk has a high calorific value, approximately 4,000 kcal/kg. If Indonesia generates about 6.5 million tons of rice waste per year, the amount of heat energy that can be extracted from this waste is about 26 trillion kcal/year (Siswanto, 2018).

Figure 1. Types of Biobriquette Raw Materials (a) Cabbage and (b) Rice Husk

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Briquettes are one of the alternative fuels expected to help the world overcome the energy (fossil) crisis. Briquettes can be made from waste biomass that has been underutilized by the community (Sembiring, 2015). Even when not fanned, organic biomass briquettes ignite steadily. The benefit of this jam is that the amount of smoke produced by biomass briquettes is less than that produced by wood or kerosene (Fitriyah, 2010)

This research developed charcoal briquettes with a high calorific value from cabbage market waste by adding rice husks to a previous study titled "The application of rice husk and cabbage market waste for fuel briquette production." Cabbage crop (Brassica olerancea L. var. caitata L), also known as white cabbage, is used. The ratio of rice husks to cabbage (60:40; 55:45; 50:50; 45:55; and 40:60) was used as the independent variable in a briquette machine at a temperature of 250–270 C. Briquettes made from 60% rice husks and 40% cabbage market waste was found to be the most efficient due to their higher calorific value (5,026.7 cal/g) (Supakata, 2015).

In a previous study titled "Hydrothermal Carbonization and Torrefaction of Cabbage Waste," variables in the hydrothermal carbonization process at temperatures of 180 °C and 225 °C and the torrefaction carbonization process at temperatures of 225 °C, 250 °C, and 275 °C were tested for 30 minutes each. The study's findings demonstrate the procedure.The best is carbonization at 275°C, which increased the net calorific value by an average of 3 MJ kg-1 to 20.89 MJ kg-1 (Tamelova, 2019).

The previous study, "Determination of Optimal Conditions for Carbonization Temperature and Time in Making Charcoal from Rice Husk," seeks to identify the best conditions for rice husks. The carbonization temperatures used were 400 oC, 500 oC, and 600 oC, with time variations of 30 minutes, 60 minutes, 90 minutes, and 120 minutes. The best optimum conditions for rice husks were found to be at a temperature of 400 C for 120 minutes, with a bound carbon content of 41.3 percent, water content of 6.1 percent, ash content of 32.6 percent, and volatile matter content of 20.5 percent (Siahaan 2013).

The study "The Effect of Variations in Pressing Pressure and Material Composition on the Physical Properties of Charcoal Briquettes" makes use of waste biomass by investigating the effects of variations in pressing pressure and material composition on the physical properties of charcoal briquettes. Carbonization for 15 minutes on the coconut shell at 450 C. For 4-5 hours, sawdust was carbonized in a drum clinker. The following is a comparison of the composition of coconut shell material and sawdust. 75 percent: 25%; 25 percent: 25%; 50 percent: 50%; and 100 percent: 0% with pressing pressures of 50 N/cm2, 100 N/cm2, and 150 N/cm2. Briquettes were dried in an oven set to 60 °C for 24 hours. 5 cm in diameter, cylindrical briquettes The study's findings show that the most optimum briquette with a composition ratio of 100 percent coconut shell using a pressure between 100-150 N/cm2 with the following test parameter values: density of 0.634 gr/cm3, the mechanical strength of 43,167 N/cm2 and burning time of 64.39 minutes (Setiowati, 2014).

Based on the previous research, this study was conducted to improve the efficiency of biomass waste as a renewable alternative energy source and to increase the calorific value of bio briquettes.

II. RESEARCH METHODOLOGY

This study employs an experimental method and was conducted at the ITN Malang Bioenergy Laboratory and the MIPA Chemistry Laboratory at the State University of Malang. The following variables are used: cabbage crop, charcoal flour size 40 mesh, drying temperature 110 C, and drying time (6 hours cabbage, 30 minutes rice husk, 3 hours bio briquette). The cabbage carbonization temperature is 275 degrees Celsius, and the cabbage carbonization time is 30 minutes, 450°C, 120-minute carbonization of rice husk, 100 bar press pressure, cylindrical briquette shape (2 cm high, 1-inch diameter), 10-gram tapioca flour, 75 mL water, 100°C water temperature While the variable changes are variations in the composition of rice husks and cabbage, namely 40%:60%, 50%:50%,

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60%:40%, 70%:30%, and 80%:20%, and the method of giving palm oil to briquettes, namely method (1) the oil is mixed with the ingredients first and method (2) the briquettes that have been molded are immersed in oil.

A. Materials and tools used:

Water, cabbage, rice husk, and tapioca are the ingredients. Meanwhile, the following tools are used: press tool, 40 mesh sieve, briquette mold, furnace, and oven.

Research procedure :

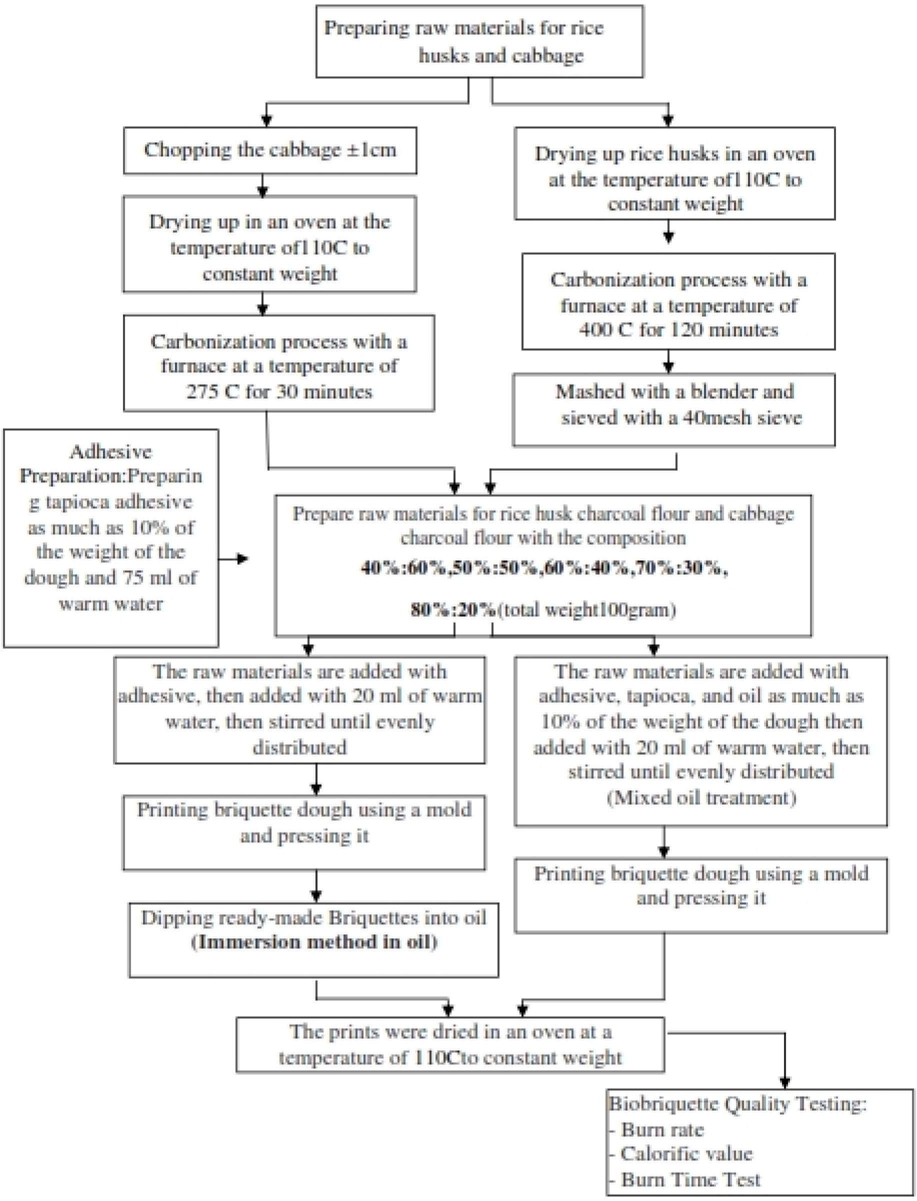

Figure 1 Research procedure

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III. RESULTS AND DISCUSSION

- **Combustion Rate**

The rate of combustion is a test in which briquettes are burned to determine the length of a fuel's flame, and then the mass of the briquettes is weighed first, minus the mass of the burned briquettes. A stopwatch was used to calculate the ignition time, and a digital scale was used to weigh the briquettes. The graph below shows the value of each sample's bio briquette burning rate:

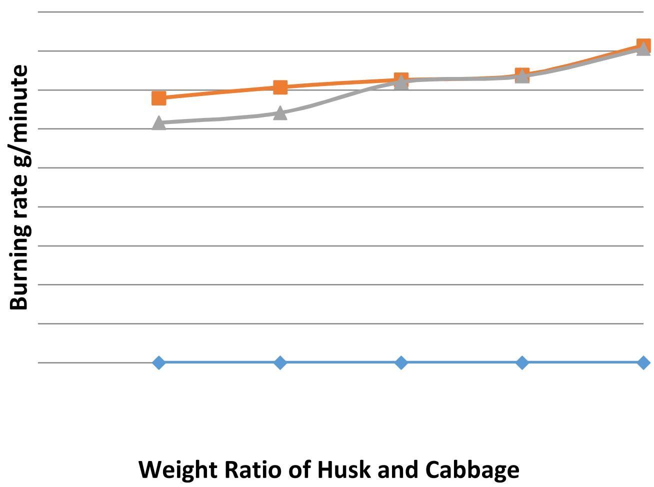

Figure 2. Graph of Relationship Between Biobriquette Composition and Palm Oil Administration Method on Combustion Rate

In Graph 2, the highest combustion rate is obtained from the composition of 80% rice husk and 20% cabbage with the mixed method of giving oil, which is 0.0814 g/min. While the composition of 40% rice husk and 60% cabbage with the method of dipping oil has the lowest burning rate at 0.0616 g/minute.

Figure 3. Combustion Rate Test on Biobriquettes

Because it is known from the data that the bio briquettes for all samples are flammable, there is no provision in SNI for standardization of the burning rate of bio briquettes. Furthermore, the type of raw material used influences the combustion rate; the graph shows that the more cabbage composition is added, the lower the combustion rate. The addition of more rice husks, on the other hand, increases the rate of burning. This is because cabbage contains more carbon than rice husks. The lower the combustion rate, the higher the carbon content of the raw material. The lower the combustion rate, the higher the briquette quality, implying that the briquettes will take a long time to burn out (Gunawan, 2018).

- **Burning Time**

The rate of combustion is a test that uses briquettes to determine the duration of a fuel's

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flame. A stopwatch is used to calculate the length of the ignition time, which begins with the flame and ends when the fire is extinguished. The graph below depicts the time required to burn bio briquettes from each sample:

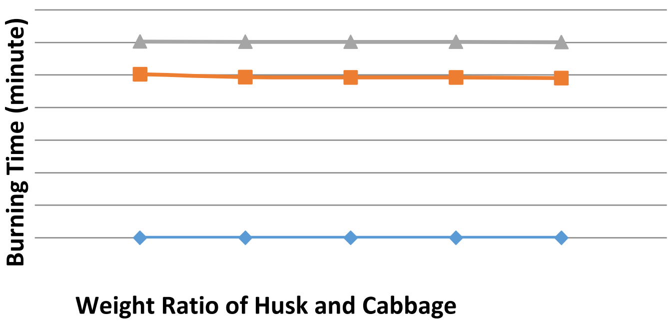

Figure 4. Graph of Relationship Between Biobriquette Composition and Palm Oil Administration Method on Burning Time

In Figure 4, the burning time graph shows that the composition of 40% rice husk and 60% cabbage by the method of dipping oil produces the longest burning duration with a time of 60.26 minutes. With a time of 49.03 minutes, the composition of 80 percent rice husk and 20 percent cabbage with the method of giving oil in a mixed manner has the fastest burning duration.

There is no standard combustion duration in SNI for testing bio briquettes over time. According to the available data, the type of raw material used influences the length of the burning time. The graph shows that the longer the burning duration increases, the more cabbage composition is added. However, the more rice husks added, the longer the duration of burning decreases. The longer the duration of burning, the higher the quality of the briquettes, implying that the briquettes will last longer and will not burn out quickly. This is because cabbage contains more carbon than rice husks. The lower the combustion rate, the higher the carbon content of the raw material. This is based on preliminary raw material observation data, which shows that cabbage has a 17.4 percent carbon content and rice husks have a 12.2 percent carbon content.

- **Calorific Value Test**

The calorific value has a significant impact on the quality of charcoal briquettes. The higher the calorific value of the charcoal briquettes, the higher the quality of the produced charcoal briquettes. The graph below depicts the test of the calorific value of bio briquettes from each sample:

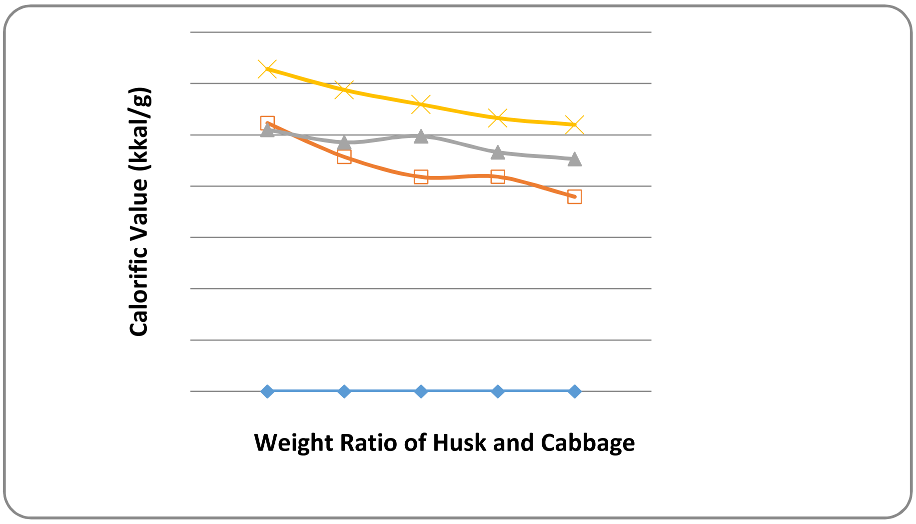

Figure 5. Graph of Relationship Between Composition of Biobriquettes and Method of Giving Palm Oil compared to without giving oil to the Calorific Value of Biobriquettes

Figure 5 shows that the composition of 40% rice husk and 60% cabbage with the oil dipping method yielded the highest calorific value of 6.283 kcal/gram. The composition of 80 percent rice husk and 20 percent cabbage with the method of adding mixed palm oil has the lowest calorific value, which is 4,532 kcal/gram. This is because the carbon content of cabbage is higher than that of rice husks.

According to the study's findings, only calorific values greater than 5,000 kcal/gram met the quality requirements for briquette quality (SNI 01-6235-2000). Meanwhile, some samples have a lower calorific value than the required standard.

According to the research data, the briquettes that were not given additional palm oil had a calorific value that did not meet the SNI standard; only one treatment had a calorific value that met the SNI standard, namely with variations in the composition of rice husks and cabbage, 60 percent:40 percent, namely of 5.230 kcal/g. When comparing the treatment of briquettes that have not been added to briquettes that have been added with palm oil, it is clear that the calorific value increases. As a result, the addition of palm oil and the composition of the ingredients had a significant impact on the calorific value produced. The calorific value of the resulting briquettes is also affected by variations in the method of adding oil. Because each raw material has a different bonded carbon value, each type of charcoal briquette raw material has a different calorific value (Sidiq, 2017).

According to the findings of this study, bio briquettes made of 40% rice husk charcoal and 60% cabbage charcoal with the method of adding palm oil by dipping have a significant effect on the increase in calorific value and meet the SNI standard for bio briquettes (SNI 01-6235-2000).

IV. CONCLUSION

This study concludes that the addition of palm oil using various methods and variations in the composition of the material from rice husk charcoal to cabbage charcoal affects the quality of bio briquettes. The best bio briquette mixing ratio results in the highest calorific value, which is found in a mixture of 40% rice husk charcoal and 60% cabbage charcoal by using palm oil by the dipping method, with a calorific value of 6.283 kcal/g, a burning rate of 0.0616 g/minute, and a burning time of 60.26 minutes.

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