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Utilization Of Durian Skin (*Durio Zibethinus*) For Biobriket Production Using Pyrolysis Method As An Alternative Energy

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ABSTRACT

Durian peel (Durio zibethinus) is one of the organic wastes that is abundant, especially during harvest season, and is often not utilized, causing environmental problems. The high lignocellulose content in durian peel makes it a potential raw material for making bio-brickets. This study aims to utilize durian peel waste to produce bio-brickets using the pyrolysis method as an environmentally friendly alternative energy source. The pyrolysis method is chosen because it can break down organic compounds in biomass into charcoal with a relatively high calorific value. The research stages include preparation of materials, carbonization process through pyrolysis, pulverization, mixing with a binder, molding, and drying of the briquettes. The results of the study show that bio-brickets from durian peel have good characteristics, including low water content, moderate ash content, high density, as well as calorific value that meets biomass briquette standards. The utilization of durian peel waste into biobriquettes not only has the potential to reduce environmental pollution, but also becomes an economical and sustainable solution for renewable energy diversification.

Keywords: durian skin, biobriquette, pyrolysis, alternative energy, biomass

1. INTRODUCTION

The current global energy problem has become a major challenge for human survival. The high dependence on fossil fuels has caused various negative impacts, such as environmental pollution and global warming [1]. In efforts to find solutions to these problems, the development of renewable energy becomes a strategic step towards sustainability. One effort that can be made is to utilize organic waste as an alternative energy source [2]. Indonesia, as one of the largest tropical countries, produces a large amount of organic waste every year. One type of waste that is often overlooked is durian peel (Durio zibethinus) [3]. Durian is known as the "King of Fruits" and is highly favored by the public, especially in Southeast Asia. The high durian consumption generates abundant durian peel waste, but until now, its utilization is still limited [4].

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Durian skin has a high lignocellulose content, making it a potential raw material for processing into alternative fuels [4]. One of the products that can be produced from durian skin is bio-briquettes, which are solid fuels made from biomass. By using pyrolysis technology, organic raw materials such as durian skin can be converted into cleaner and more efficient energy products [5].

Pyrolysis is a thermal decomposition process carried out at high temperatures in the absence of oxygen. This process not only increases the calorific value of the raw material but also reduces emissions generated during combustion. Therefore, pyrolysis is an environmentally friendly method and is suitable for application in processing organic waste into energy [6].

The use of bio-briquettes from durian peels has various benefits, both economically and environmentally. Economically, the utilization of durian peel waste can create value-added products that have the potential to increase community income, especially in durian-producing areas. Meanwhile, environmentally, processing this waste can reduce the accumulation of organic waste, which often becomes a source of pollution [7].

In addition, durian peel bio-briquettes can become an affordable alternative fuel, especially for rural communities. With a more economical price and lower emission levels compared to fossil fuels, bio-briquettes offer a practical solution to meet household and small industry energy needs [8].

Research on the utilization of durian peel as a raw material for biobrickets is also in line with global efforts to reduce dependence on fossil fuels. This supports Indonesia's vision in developing renewable energy and realizing a sustainable circular economy. By processing waste into energy products, this research contributes to the creation of a more effective waste management system [9].

Furthermore, this research is expected to serve as a foundation for the development of biomass-based renewable energy technologies. Through the study of the pyrolysis process and the characteristics of the biobrickets produced, this research aims to provide practical and sustainable solutions. Thus, the results of this research not only provide benefits to the energy sector but also support environmental conservation and the improvement of community welfare.

Therefore, this study focuses on exploring the potential of durian skin as a raw material for bio-brickets, aiming to produce environmentally friendly, efficient, and economical alternative energy.

2. EXPERIMENTAL

2.1. Chemicals and Equipment

The equipment used in this study included Briket printing tool, Saringan 60 mesh, Cawan porselen, Drum pembakaran, Hot plate, Loyang aluminium, Neraca analitik, Oven, Termometer, Alu, Mortir.

The materials used in this study consisted of Durian skin, Wood glue, Paper pulp, Lamp oil.

2.2. Research Procedure

2.2.1 Process of Turning Materials into Charcoal

Durian skins are cleaned from dirt that is present and carried during the process of taking the durian skin. The cleaned durian skins are then sun-dried for 3-4 days. After the durian skins are dried, the roasting process is carried out using a furnace at a temperature of 350°C for 30 minutes. After being removed from the furnace, the rice husk biochar is ground using a pestle and mortar.

2.2.2 Preparation of Adhesive

The adhesive used is wood glue and paper pulp. First, wood glue that has been weighed according to the ratio is prepared. The wood glue is mixed according to the determined ratio with durian peel material that has been finely ground. Stirred until evenly mixed. For the paper pulp, the pulp is squeezed to reduce its

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water content. Weighed according to the determined ratio. Added 50 mL of distilled water and stirred until evenly mixed.

2.2.3 The Process of Mixing Charcoal with Adhesive

Charcoal from the carbonation process is ground, then a prepared binder is added in predetermined mass ratios, namely 1:0.5; 1:0.75; 1:1; 1:1.25. Then it is stirred until everything is evenly mixed. The mass of durian shell charcoal used is 25g.

2.2.4 The process of Molding biobriquette

Insert the mixed biobriquette material into the biobriquette molding machine. The biobriquette is dried in an oven at 120°C for 60 minutes. The biobriquette is removed from the oven and allowed to cool. Next, the produced biobriquette is tested for quality.

3. RESULTS AND DISCUSSION

3.1. Calorific Value Test

It has been found that the amount of adhesive affects the calorific value quality of the tested briquettes; the higher the proportion of adhesive, the greater the calorific value obtained.

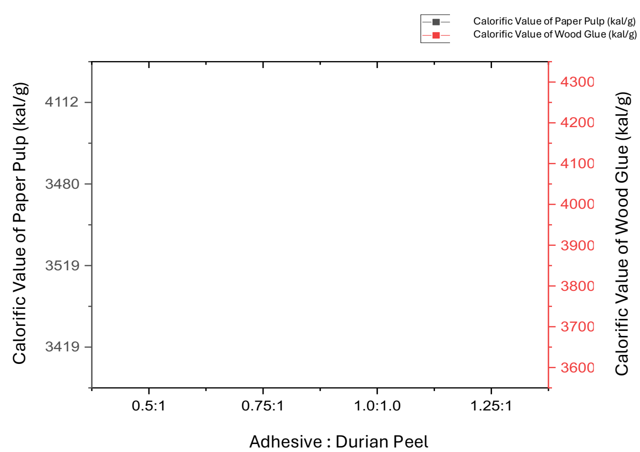

Figure 3.1 The effect of adhesive quantity on calorific value

From the data above, it is known that the amount of adhesive affects the calorific value quality of the briquettes tested, where the higher the adhesive ratio, the higher the calorific value obtained. The highest calorific value was obtained with wood glue as an adhesive with a durian peel to wood glue ratio of 1:1.25, which was 4,251 cal/g. The lowest calorific value was found with paper pulp as the adhesive at a ratio of 1:0.5, with a calorific value of 3,419 cal/g. The comparison between wood glue and paper pulp yielded significantly different results; when comparing these two adhesives, better results were obtained using wood glue. However, this calorific value still does not meet the calorific value of coal briquettes, which have a calorific value of 6,000 cal/g.

3.2 Proximate Value Test

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3.2.1. Moisture Content Test

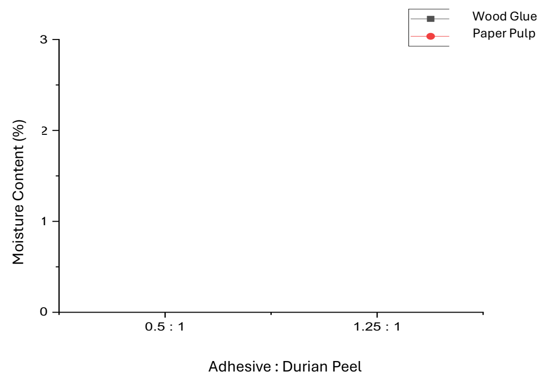

Figure 3.2 The Effect of Adhesive Amount on % Moisture Content

In Figure 3.2, there are two types of adhesive with ratios of 0.5:1 and 1.25:1. The highest moisture content is found in the wood glue with a ratio of 1.25:1, which is 2.6783%, and the lowest moisture content is also found in the wood glue with a smaller ratio of 0.5:1, which is 1.6493%.*3.3 Effect of pH on Bioethanol Yield*

3.3 Ash Content Test

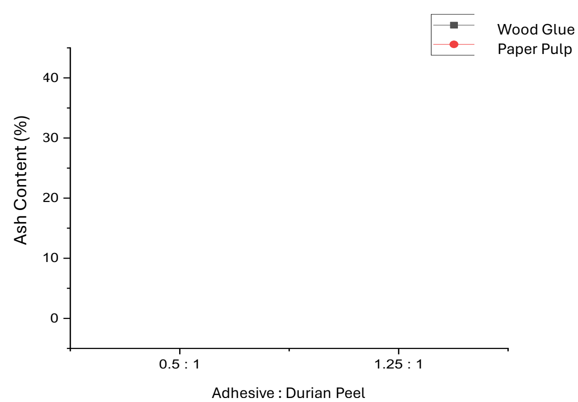

Figure 3.3 The Effect of Adhesive Amount on % Ash Content

In Figure 3.3, it can be seen that the highest ash content is found in the paper pulp adhesive material with a ratio of 0.5:1, which is 40.8976%, and the lowest ash content is found in the wood glue adhesive material with a ratio of 1.25:1, which is 20.7197%. High ash content in a bio-bricket indicates that the quality of the briquette is worse, which is inversely proportional to the calorific value test.

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3.4 Volatile Matter Content Test

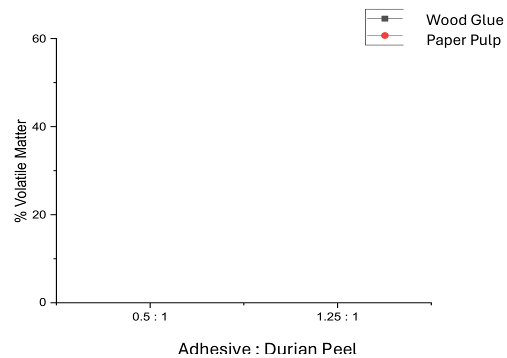

Figure 3.4 Effect of Adhesive Amount on % Volatile Matter

From Figure 3.4, it can be concluded that the lowest volatile matter is found in the paper pulp adhesive with a ratio of 0.5:1, which is 33.4283%, and the highest volatile matter is found in the wood glue adhesive with a ratio of 1.23:1, which is 55.9811%.

4. CONCLUSION

Based on the results of the research conducted, it can be concluded that the variation in the type and amount of binder significantly affects the quality of the produced briquettes. The use of wood glue binder shows better performance compared to paper pulp in increasing calorific value, reducing ash content, and producing moisture and volatile matter levels that are more in line with the characteristics of quality briquettes. The highest calorific value was obtained from a composition of durian peel and wood glue with a ratio of 1:1.25, which reached 4,251 cal/g, while the lowest value was found with paper pulp at a ratio of 1:0.5, amounting to 3,419 cal/g. The highest ash content was found in the paper pulp binder, indicating a decrease in briquette quality, while the best moisture and volatile matter levels were achieved with the use of wood glue binder. Overall, wood glue binder is considered more effective in improving the combustion quality and energy efficiency of briquettes, although the calorific value obtained is still below the standard commercial coal.

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