**CEJOTER: Chelo Journal of Technology Development of Engineering**
Vol. 02, No. 01, December 2024, pp. 95 – 102
ISSN (print) 3026-3395 ; ISSN (online) 3026-5223

# MAKING BRIQUETTES FROM ORGANIC WASTE, COFFEE GROUNDS AND TEA GROUNDS USING SAGO FLOUR ADHESIVE

**Lamkaruna Putra[1*], Teuku Rihayat[1], M. Yunus[1]**

1Chemical Engineering Department, Lhokseumawe State Polytechnic,
Jl. Banda Aceh-Medan Km. 280, Buketrata, Mosque Punteut, Blang Mangat,
Lhokseumawe City, Aceh 24301, Indonesia
[1]lamkarunaputra17@gmail.com

## ABSTRAK

To meet Indonesia's current energy needs, most of its oil and gas resources are utilized. Biomass is one of the renewable energy sources due to its abundant availability, environmental friendliness, and affordability for the public. This research aims to develop biomass briquettes as an environmentally friendly alternative fuel made from organic waste. The primary raw materials used in this study are coffee grounds and tea waste, with sago flour as the binder. The research was conducted at the Pilot Plant Laboratory and Unit Operation of the Chemical Engineering Department at Politeknik Negeri Lhokseumawe from May to June 2024. The research procedure includes raw material preparation, combustion process, briquette molding, and testing, including moisture content analysis, ash content, volatile matter, and flame test. The results showed that briquettes with a 40:60 mixture of coffee grounds and binder at 20 grams exhibited the best characteristics, with a moisture content of 65.5%, ash content of 23.4%, an ignition time of 6 minutes, and a burn duration of 64 minutes. This research contributes to the development of efficient and environmentally friendly biomass briquette production technology, as well as opens opportunities for the utilization of organic waste in the

**Keywords**: Biomass briquettes, coffee grounds, tea waste, sago flour, alternative energy, carbonization.

## INTRODUCTION

In an effort to meet Indonesia's energy needs, oil and natural gas are still the main sources, but their availability is increasingly depleting and cannot be renewed. Therefore, the development of renewable alternative energy sources, such as biomass, is needed. Biomass is organic matter resulting from photosynthesis, which includes plants, agricultural waste, forest waste, and livestock manure. As an energy source, biomass has great potential because it is abundant, renewable, environmentally friendly, and affordable [1].

Vol. 02, No. 01, December 2024, pp. 95 – 102
ISSN (print) 3026-3395 ; ISSN (online) 3026-5223

One of the biomass wastes that has not been widely utilized is coffee and tea grounds. Indonesia, as a country with a high level of coffee and tea consumption, produces a large amount of waste grounds every year [2]. The manufacture of briquettes from this biomass requires natural adhesives, such as sago flour, which can increase the density and durability of briquettes [3]. The quality of briquettes is also affected by particle size and moisture content, which plays an important role in increasing their combustion duration and efficiency [4].

This research aims to develop briquettes from coffee and tea grounds waste with sago flour adhesive to produce alternative fuels that are environmentally friendly, solid, flammable, and have a long flame resistance.

Based on the background that has been described, the formulation of the problem in this study is about how the mixture of raw materials is affected on the characteristics of briquettes made from coffee grounds and tea grounds, as well as how the weight of the adhesive affects the characteristics of the briquettes produced. This study will analyze these two variables to determine the best combination in producing high-quality briquettes.

Based on the description above, this study aims to determine the effect of a mixture of raw material ratios on the characteristics of briquettes made from coffee grounds and tea grounds. In addition, this study also aims to determine the influence of adhesive weight on the characteristics of the briquettes produced, so that briquettes with optimal quality can be obtained.

## METHOD

The research begins with the preparation of raw materials, namely the collection and drying tea grounds and coffee grounds for 3 days to lower the moisture content. After that, the pulp is burned on the stove for 30 minutes, mashed, and sifted. The mixture of ash and sago flour adhesive is molded using a cylindrical mold and dried for 3 days in the sun.

The materials used in this study include tea grounds, coffee grounds, sago flour adhesive, and water. The tools used include a gas stove, a 70/60 mesh sieve, a briquette mold, a blender, a mixer, a scale, and an MX-50 Moisture Analyzer tool. The data was analyzed based on the influence of the comparison of raw materials (coffee and tea grounds) and adhesive weight on moisture content, ash content, flame test, and evaporation content. The results of each variable are compared to determine the optimal quality of the briquettes produced.

CEJOTER: Chelo Journal of Technology Development of Engineering
Vol. 02, No. 01, December 2024, pp. 95 – 102
ISSN (print) 3026-3395 ; ISSN (online) 3026-5223

## RESULTS AND DISCUSSION

### Research result

A. Results The following is a table of data results from Moisture Content, Ash Content, Calorific Value, and Evaporating Substance Content based on the data that has been obtained.

Table 1 Research Results

| Run | Adhesive (Gram) | Moisture content (%) | Ash Rate (%) | Flame Test | | Evaporative Substance Levels (%) |
|---|---|---|---|---|---|---|
| | | | | Ignition Time (minute) | Duration of Burning (minute) | |
| 1 (50:50) | P = 10 | 71.0 | 24.2 | 5 | 55 | 25.0 |
| 1 (50:50) | P = 15 | 72.0 | 23.7 | 6 | 50 | 24.5 |
| 1 (50:50) | P = 20 | 71.0 | 23.9 | 4 | 60 | 24.7 |
| 1 (50:50) | P = 25 | 72.0 | 24.1 | 5 | 57 | 24.8 |
| 2 (40:30) | P = 10 | 64.29 | 21.8 | 5 | 54 | 27.0 |
| 2 (40:30) | P = 15 | 62.86 | 22.0 | 4 | 53 | 26.8 |
| 2 (40:30) | P = 20 | 65.71 | 22.1 | 6 | 55 | 27.1 |
| 2 (40:30) | P = 25 | 66.43 | 21.9 | 5 | 52 | 27.2 |
| 3 (40:60) | P = 10 | 65.0 | 23.5 | 3 | 65 | 23.0 |
| 3 (40:60) | P = 15 | 66.0 | 23.6 | 4 | 66 | 22.9 |
| 3 (40:60) | P = 20 | 65.5 | 23.4 | 6 | 64 | 23.1 |
| 3 (40:60) | P = 25 | 64.5 | 23.3 | 5 | 63 | 23.2 |
| 4 (50:70) | P = 10 | 65.83 | 22.5 | 3 | 70 | 25.5 |
| 4 (50:70) | P = 15 | 65.42 | 22.7 | 5 | 68 | 25.6 |
| 4 (50:70) | P = 20 | 66.25 | 22.8 | 4 | 69 | 25.8 |
| 4 (50:70) | P = 25 | 67.5 | 22.6 | 6 | 67 | 26.0 |

From the table of calculation results above, the results of the analysis are shown in Table 2.

Table 2. Analysis Results

| Variable | Adhesive Mixtures | Adhesive Mixtures |
|---|---|---|
| Up to Air (%) | Decreases with higher adhesive mixtures | Decreases with longer drying time |
| Kadar Abu (%) | Tends to increase with higher adhesive mixtures | Stable with drying time |
| Evaporation Rate (%) | Decreases with higher adhesive mixtures | Decreases with longer drying time |

CEJOTER: Chelo Journal of Technology Development of Engineering
Vol. 02, No. 01, December 2024, pp. 95 – 102
ISSN (print) 3026-3395 ; ISSN (online) 3026-5223

## Discussion

1. Up to air

The moisture content in the briquettes indicates the percentage of water content left after the drying process. The results showed significant variations in moisture content based on the mixture ratio and the warming period. The effect of adhesive weight on moisture content can be seen in Figure 1.

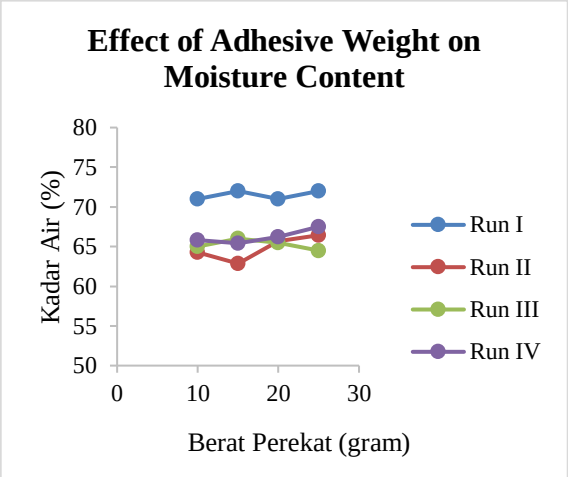


Figure 1. Effect of Adhesive Weight on Moisture Content

- **Run 1 (50:50)** shows the moisture content ranges from 71.0% to 72.0%. This moisture content is relatively high and may be due to the high initial moisture level of coffee and tea grounds, as well as the possibility of a drying process that has not been fully effective.
- **Run 2 (40:30)** shows moisture content between 62.86% to 66.43%. This decrease in moisture content suggests that the ratio of coffee grounds and tea grounds mixture may affect the drying ability of the briquettes, with a lower ratio helping to reduce the moisture content.
- **Run 3 (40:60)** shows the moisture content ranges from 64.5% to 66.0%. The moisture content was slightly higher than that of Run 2, which suggests that the increased proportion of coffee grounds in the mixture may affect the moisture content.
- **Run 4 (50:70)** shows moisture content between 65.83% to 67.5%. The highest moisture content was found in this blend ratio, probably because tea grounds absorb more moisture than coffee grounds.

2. Up to Abu

Ash content measures the percentage of material left after combustion at high temperatures, which is an indicator of the unburned mineral content. The effect of adhesive weight on ash content can be seen in Figure 2.

CEJOTER: Chelo Journal of Technology Development of Engineering
Vol. 02, No. 01, December 2024, pp. 95 – 102
ISSN (print) 3026-3395 ; ISSN (online) 3026-5223

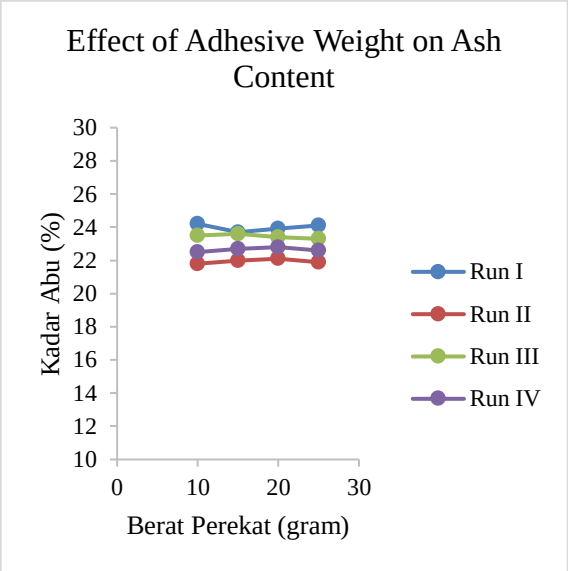


Figure 2. Effect of Adhesive Weight on Ash Content

- **Run 1 (50:50)** shows ash levels ranging from 23.7% to 24.2%. This ash content indicates that a mixture of coffee grounds and tea grounds in this ratio provides a stable ash yield, with slight variation depending on the heating period.
- **Run 2 (40:30)** shows ash levels ranging from 21.8% to 22.1%. The decrease in ash content in this ratio indicates that the change in the mixture ratio affects the mineral content remaining after combustion.
- **Run 3 (40:60)** shows ash levels range from 23.3% to 23.6%. The increased proportion of coffee grounds caused the ash content to increase slightly compared to Run 2, suggesting that coffee grounds may have a higher mineral content.
- **Run 4 (50:70)** shows ash levels ranging from 22.5% to 22.8%. Ash levels were relatively stable with a slight decrease compared to Run 3, suggesting that a higher ratio of tea grounds might be lowering ash levels.

3. Flame Test

The results of the flame test show that in the use of adhesives with different weights and the composition of coffee and tea grounds have a significant effect on the characteristics of briquettes. On runs with a higher composition of coffee grounds (such as in Run 4 with a 50:70 ratio), the flame time varies from 3 to 6 minutes, with a burn duration of between 67 to 70 minutes. This indicates that coffee grounds have a higher carbon content, which speeds up the ignition process and extends the duration of combustion.

CEJOTER: Chelo Journal of Technology Development of Engineering
Vol. 02, No. 01, December 2024, pp. 95 – 102
ISSN (print) 3026-3395 ; ISSN (online) 3026-5223

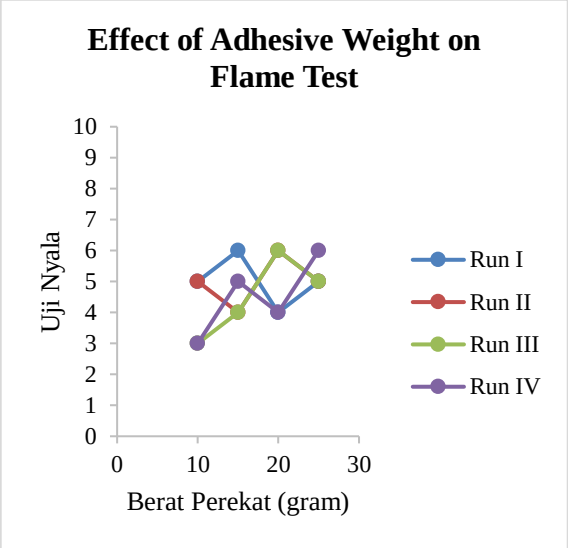


Figure 3. Effect of Adhesive Weight on Briquette Flame Test

Meanwhile, on a run with a ratio of 40:30 (coffee tea grounds), the flame time ranges from 4 to 6 minutes, with a burning duration of between 52 to 55 minutes. On a run with a ratio of 40:60, the flame time ranges from 3 to 6 minutes, with a burn duration of between 63 to 66 minutes. Meanwhile, in a run with a ratio of 50:50, the flame time ranges from 4 to 6 minutes, with a burning duration of between 50 to 60 minutes.

From the data, it can be seen that the increase in the proportion of coffee grounds in the mixture tends to increase the duration of combustion, indicating higher fuel efficiency. The use of adhesives also showed variations in flame time and burning duration, but the difference was not as large as the influence of the proportion of coffee grounds.

Overall, the flame test results indicate that briquettes with a higher coffee grounds content have better potential as an alternative fuel, as they can produce faster and longer combustion. Further research is suggested to explore other combinations of materials and drying conditions to optimize the quality of briquettes.

4. Levels of Evaporative Substances

The volatile substance content measures the percentage of the material that evaporates during heating and has an effect on the quality of the briquettes in terms of combustion.

CEJOTER: Chelo Journal of Technology Development of Engineering
Vol. 02, No. 01, December 2024, pp. 95 – 102
ISSN (print) 3026-3395 ; ISSN (online) 3026-5223

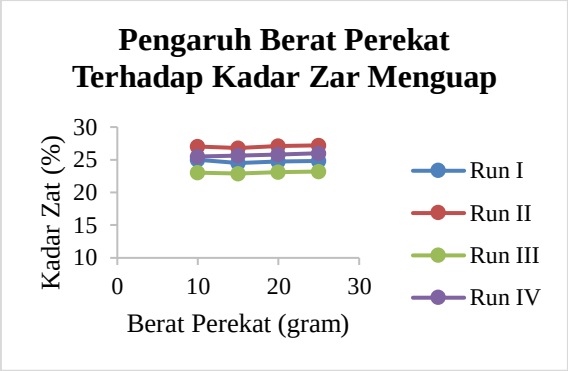


Figure 4. Effect of Weight on Evaporative Substance Levels

- **Run 1 (50:50)** shows the evaporated substance content between 24.7% to 25.0%. The level of this volatile substance indicates that a mixture with this ratio produces briquettes with relatively stable evaporation ability.
- **Run 2 (40:30)** shows the evaporated substance content is between 26.8% to 27.2%. Higher levels of volatile substances at this ratio may indicate more material can evaporate during combustion, affecting the efficiency of the briquettes as a fuel.
- **Run 3 (40:60)** shows evaporated substances between 22.9% and 23.2%. This decrease in the level of volatile substances indicates that an increase in the proportion of coffee grounds can reduce the level of volatile substances in briquettes.
- **Run 4 (50:70)** shows the evaporated substance content between 25.5% to 26.0%. Higher levels of evaporated substances at this ratio indicate that tea grounds contribute more to the evaporated components.

## CONCLUSION

Based on the results of the study, briquettes from coffee and tea grounds waste with sago flour adhesive showed quality variations based on the composition of raw materials and the amount of adhesives. The highest moisture content of 72% was found in briquettes with a composition of 50:50 and adhesive of 15%, while the lowest moisture content of 62.86% was found in a composition of 40:30 and adhesive of 10%. The lowest ash content of 21.8% was found in a 40:30 composition and 10% adhesive, while the highest ash content was 24.2% in a 50:50 composition and 10% adhesive. The highest volatile substance content of 27.2% was found in a 40:30 composition and 25% adhesive, while the lowest level was 22.9% in a 40:60 composition and 15% adhesive. The flame test showed the longest burning duration of 70 minutes on briquettes with a composition of 50:70 and a 20% adhesive. These briquettes meet most of the SNI quality standards, showing the best performance in terms of moisture content, ash content, calorific value, and flame test.

Vol. 02, No. 01, December 2024, pp. 95 – 102
ISSN (print) 3026-3395 ; ISSN (online) 3026-5223

## REFERENCES

[1] I. Salihi, Z. Zohrahayaty, B. Santoso, S. Dunggio, M. Sakir, and E. Z. Solikahan, "Making Briquettes from Corn Cob Waste in Bondawuna Village, Suwawa District, Bone Bolango Regency," *EJPPM*, vol. 1, no. 1, pp. 32–39, Sep 2023, doi: 10.59713/ejppm.v1i1.664.

[2] E. Mossfika, S. Syukri, dan H. Aziz, "Preparation of Activated Carbon from Tea Waste by NaOH Activation as A Supercapacitor Material," *J. Aceh Phys. Soc.*, vol. 9, no. 2, hlm. 42–47, Mei 2020, doi: 10.24815/jacps.v9i2.15905.

[3] S. H. Raharjo, F. N. Etnanta, R. Sipayung, E. Sugondo, and A. Yuliah, "Making Biobriquettes from Leaf and Stem Waste (Malaleuca leucadendron) to Utilize Agricultural Product Waste in Jeruklegi District, Cilacap Regency," *JPPL*, vol. 5, no. 1, pp. 67–75, Apr 2023, doi: 10.35970/jppl.v5i1.1762.

[4] N. Afrianah *et al.*, "Effect of Carbonization Temperature on the Characteristics of Charcoal-Based Briquettes of Rice Husk and Coconut Shells," *JFT*, vol. 9, no. 2, pp. 138–147, Jan 2023, doi: 10.24252/jft.v9i2.25566.