Analysis of Water and Ash Content in Biomass Briquettes from Durian Fruit Peel Waste and Sawdust

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Abstract
Briquettes are used to convert biomass energy sources into other forms of biomass by compressing them so that their shape becomes even. One of the materials for briquettes uses durian peel waste and sawdust as raw materials using molasses (molasses) as adhesive. The results of this study are to bring briquettes as an alternative fuel with biomass raw materials from durian peel and sawdust using molasses adhesive, which has good quality, so that the community can utilize that. This study aimed to determine the moisture and ash content of biomass briquettes as preliminary studies. The analysis was done with carbonation and drying processes, and the resulting weight was recorded after the procedure can be known. Based on these results, the sample with 20 mesh sieves has the lowest water and ash content percentage, about 1.74% and 0.77%. Then, the sample with 30 mesh sieves has the lowest water and ash content percentage, about 1.87% and 0.78%. This value still meets the SNI 01-6235-2000 standard, where both are a maximum of 8%. Combustion the higher the coal ash content, the lower the calorific value obtained.

Keywords: *Briquettes, Biomass, Durian Peel Waste, Sawdust, Alternative Fuel.*

Abstrak
Briket adalah salah satu cara yang digunakan untuk mengkonversi sumber energi biomassa ke bentuk biomassa lain dengan cara dimampatkan sehingga bentuknya menjadi lebih teratur. Salah satu bahan briket dapat dilakukan dengan memanfaatkan limbah kulit buah durian dan serbuk gergaji sebagai bahan baku dengan menggunakan perekat tetes tebu (Molase). Hasil dari penelitian ini adalah menghadirkan briket sebagai bahan bakar alternatif dengan bahan baku biomassa dari kulit durian dan serbuk gergaji menggunakan perekat molase yang memiliki kualitas yang baik sehingga dapat dimanfaatkan oleh masyarakat. T*ujuan dari penelitian ini untuk mengetahui kadar air dan abu dari briket biomassa, sebagai dasar untuk dilakukan kajian lanjutan. Pengujian dilakukan dengan proses karbonasi dan pengeringan*

sehingga didapatkan berat sampel untuk dilakukan analisis. Berdasarkan hasil perhitungan, untuk ayakan 20 mesh diperoleh persentase kadar air dan abu terendah adalah 1,74% dan 0,78%. Sedangkan untuk ayakan 30 mesh diperoleh persentase kadar air dan abu terendah adalah 1,87% dan 0,77%. Hasil dari analisis tersebut masih memenuhi standar SNI 01-6235-2000 dimana keduanya maksimal bernilai 8%. Pembakaran dari briket dengan nilai kadar abu yang tinggi, maka nilai kalor yang dimiliki semakin rendah.

Kata Kunci: *Briket, Biomassa, Limbah Kulit Durian, Serbuk Gergaji, Bahan Bakar Alternatif.*

1. Introduction

The potential of biomass in Indonesia which can be used as an energy source, is abundant. Wastes originating from animals and plants are all the potential for development. Food crops and plantations generate a sizable amount of waste, which can be used for other purposes, such as biofuels. Biomass is a complex mixture of organic materials. The composition can vary in some plants. Biomass energy can be an alternative energy source to replace fossil fuels (petroleum) because of its several beneficial properties; namely, it can be used sustainably because it is renewable, relatively does not contain sulfur elements, so it does not cause air pollution, and can also increase efficient utilization of forest and agricultural resources (Widardo & Suryanta, 1995).

The utilization of waste as biofuel provides three direct advantages. First, an increase in overall energy efficiency because the energy content contained in waste is quite large and will be wasted if not utilized. The second is cost savings because it is often more expensive to dispose of waste than use. Third, reduce the need for landfills because providing landfills will become more complex and expensive, especially in urban areas (Anonymous, 2022). Some waste/garbage is also a source of biomass that can be used as a source of materials, food ingredients, or alternative energy sources. Biomass can be used directly as a source of heat energy for fuel, but it is less efficient. The fuel value of biomass is only around 3000 cal, while the bearing can produce 5000 cal (Yudanto & Kusumaningrum, 2009).

Briquettes are used to convert biomass by compressing them so that their shape becomes more regular. The well-known briquettes are coal briquettes, but not only coal can be made into briquettes (Anonymous, 2022). One of the briquette materials can be made using durian fruit skin waste and sawdust as raw materials using molasses (molasses) adhesive.

Apart from obtaining durian peel from durian fruit plantations, there are many restaurants, eateries, and seasonal street vendors selling fresh durian fruit or processed into various types of food or drinks. There are also many places to eat in urban areas, specializing in durian dishes and other processed durians. The use of durian peel waste has yet to be utilized optimally because it is still being thrown away. Converting durian peel waste into briquettes can increase the economic value of the material and reduce environmental pollution.

Compared to ordinary charcoal, Briquettes have more advantages because they have a higher heat power and last longer (Kemenkes RI, 2011). Identify good quality in the resulting briquettes, which can be seen from the test results, including water content, ash content, calorific value, compressive strength, and flame test produced from the briquettes (Jamilatun, 2011). The advantages of briquettes include (Saparin & Wijianti, 2018):

1. Cheaper and economical,
2. High and continuous heat, so it is suitable for long burning,
3. No risk of explosion/burn like kerosene stove or LPG gas stove,
4. Briquette raw materials are abundant,
5. Environmentally friendly because it is processed without chemicals and is safe for health because when used, the ashes do not fly and do not smoke.

Sawdust, for some people, may be meaningless, and many also throw it away or burn it. Using raw materials for briquettes as an alternative fuel will provide many benefits. The chemical components of wood vary significantly because it is influenced by growth factors, climate, and its location in the trunk or branches, and wood sawdust has a calorific value of 4,046 cal/gram (Billah, 2009). Therefore, further utilization of durian peel waste and sawdust using molasses as an alternative fuel is necessary to conduct research.

The calorific value greatly determines the quality of the briquettes—the higher the calorific value, the better the quality of the briquettes produced. The high and low calorific values of a briquette depend on the value of water, ash, and carbon content (Putri & Andasuryani, 2017).

This is the beginning of further research to determine the water and ash content of the materials tested. In addition to the calorific value, moisture and ash content are essential in evaluating the quality of the briquettes produced (Faizal et al., 2015). Suppose the selected base material has a value that meets SNI standards; then further studies can be done. In that case, a complete proximate analysis will be done, including a compression test to ensure the quality of the briquettes.

2. Method

This research activity went through the preparation, implementation, and reporting stages. The first step begins with formulating the problem and is followed by a literature study. Furthermore, research preparations will be accomplished by preparing tools and materials and then carrying out the research. The research was done in some stages, namely making briquettes and testing the briquettes. After testing, the data obtained from the test results were for analysis. The results of the data analysis will produce conclusions and suggestions.

The raw materials prepared are durian peel waste and sawdust. The durian peel waste and sawdust dried in the sun before being processed and cut the durian peel smaller for the carbonation process. Reducing the size of the material is done by using a mortar. After the carbonation process, the reduction of the material was sifted with 20 mesh and 30 mesh sieves for durian peel and sawdust. The variables of this study consist of fixed variables (dependent variables) and independent variables (independent variables). The Briquette sample for each composition variation is shown in Figure 1. The expected results in the manufacture of briquettes are the water content and ash content as the dependent variables by setting the carbonization temperature at 450 ºC for 60 minutes, the temperature for removing moisture content at 105ºC for 10 hours, and the total weight of the briquette dough is 150 grams. The independent variable is the composition variation ratio for durian peel waste and sawdust shown in Table 1.

Table 1. Variable of Experimental Study

Sieve Size (mesh)	Ratio	Sieve Size (mesh)	Ratio
	1:1		1:1
	1:2		1:2
Composition Ratio	1:3	Composition Ratio	1:3
(Durian Skin: Sawdust)	2:1	(Durian Skin: Sawdust)	2:1
with 20 Mesh sieve size	2:3	with 30 Mesh sieve size	2:3
	3:1		3:1
	3:2		3:2

Figure 1. Briquettes Sample

Briquettes have a high hygroscopic characteristic which is quickly absorbing water from the surroundings, so the calculation of water content aims to determine the hygroscopic properties of charcoal briquettes as a result of research (Putri & Andasuryani, 2017). The lost water content (%) is determined using equation 1 (Ikelle et al., 2014).

$$MC (\%) = [(w1 – w2)/wm1] \times 100\% \quad (1)$$

Remark:
MC: Moisture/Water Content in Percent (%)
W1: Initial Weight
W2: Weight after Drying

The ash content has an unfavourable effect on the quality of the briquettes, where a high ash content can reduce the calorific value of the resulting briquettes. So that the lower the ash content of a briquette, the better the quality of the briquettes (Hamidah & Rahmayanti, 2017). The ash content is determined in the oven with a temperature of 600-900 °C within 5-6 hours. The formula for calculating the ash content is shown in equation 2 (Ikelle et al., 2014).

$$AC\ (\%) = \frac{W1}{W2} \times 100\% \qquad (2)$$

Remark:
AC: Ash Content in Percent (%)
W1: Original weight of the dry sample
W2: Weight of ash after cooling

3. Result and Discussion

This implementation activity is done by processing materials in the form of durian peels and sawdust into briquettes with the help of molasses as an adhesive. Using sawdust as a mixture is by considering its high calorific content. The biomass from sawdust has a calorific value of up to 6603.4 cal/gr (Arman & Munira, 2019). When processing the material into briquettes, the water and ash content are analyzed by controlling the briquette size, carbonation temperature, and water removal. At the same time, the independent variables that were treated were the ratio of durian peel and sawdust and variations in sieve size for 20 mesh and 30 mesh.

The results achieved in this study were at the stage of obtaining water content and ash content from making briquettes made from durian peel and sawdust. At the stage of completing the process of making briquettes and conducting briquette testing to find and obtain data on water and ash content. So in this process, results related to water content are obtained in the form of water content and ash content which are the parts that do not burn during the combustion process. The following are the results of the analysis and calculation of water and ash content with various comparisons of durian peel and sawdust waste materials.

In this study, each sample has the same weight, around 150 grams. As mentioned before, there are some variables, namely:

a. Variation in sieve size.
b. Composition ratio for durian peel waste and sawdust.

Based on the variation of the sieve and the composition ratio of the ingredients to the initial weight of each briquette, it can be seen:

1. The weight of water is based on the initial weight of the sample and the final weight of the sample after the drying process.
2. The weight of ash is based on the remaining sample that is not burned after the combustion process from the dry sample.

3.1 Water Content

Water content analysis is used to determine the water content contained in briquettes. This analysis was done by heating the briquette samples in an oven at 105°C. Water will evaporate at 100°C, so it is estimated that at 105°C, the water contained in the briquettes will completely evaporate.

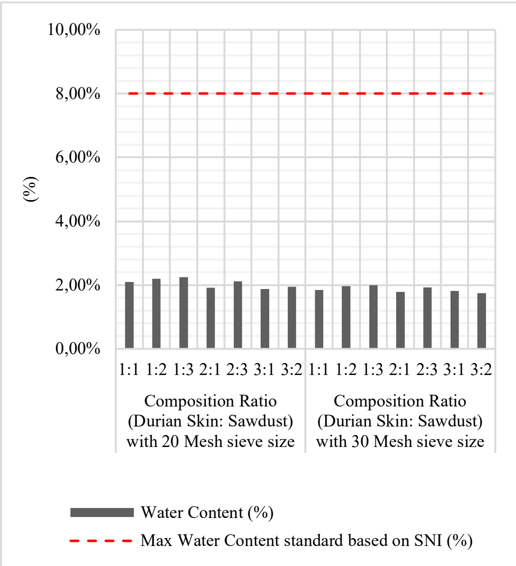

Figure 2. Briquette from Durian peel Waste and Sawdust Water Content (%)

In this study, as shown in Figure 2, the lowest percent content of 20 mesh sieve sizes with a ratio of durian peel and sawdust of 3:1 has a water content of 1.87%. As for the water content of a 30 mesh sieve with a ratio of durian peel and sawdust of 3:2, it has a water content of 1.74%. At the same time, the highest percentage of water content is in the ratio of durian peel and sawdust of 1:3 for 20 mesh and 30 mesh sieve sizes.

The data above shows that the more durian peel waste, the lower the water content. Vice versa, the more sawdust added, the more water content will increase. Based on Picture 3, briquettes with a ratio of sawdust mixture that is more than durian peels contain a high water content compared to the ratio of the composition of durian peel briquettes which is more.

The water content affects the quality of the resulting briquettes because the lower the water content, the higher the calorific value and combustion power; conversely, the higher the moisture content, the lower the heating value and combustion power. The high water content in the briquettes will make it difficult to ignite them and reduce the combustion temperature. The low water content in the briquettes will affect the quality of the briquettes; the lower the water content contained, the higher the calorific value of the briquettes (Rahmadani et al., 2017).

Water content in the briquettes will cause the time needed to remove the water content. So, if the briquette has more water in it, then it will make the ignition of the briquettes longer because the existing heat will be used to evaporate the water first and then followed by burning the material. As in Rahmadani et al. (2017) research, a water content of 9% produced 1,995 cal/g, while briquettes with a water content of 13.40% produced a calorific value of 1,615 cal/g.

Furthermore, in the research of Rahmadani et al. (2017) for biomass briquettes from oil palm leaves, the water content was obtained with a percentage of 3.21 and 3.88, which had a calorific value of 5114 cal/g and 5071 cal/g, which met the requirements of SNI 01- 6235-2000

3.2 Ash Content

Combustion with higher ash content of the coal has a lower calorific value (Muchjidin, 2006). Ash is the remaining part of the combustion products; in this case, the ash in question is left over from burning briquettes. One of the ash constituents is silica, which negatively affects the calorific value of the resulting briquettes.

In this study, the lowest percent content of 20 mesh sieve sizes with a ratio of durian peel and sawdust of 3:1 has an ash content of 0.78%. As for the ash content of a 30 mesh sieve with a ratio of durian peel and sawdust of 3:2, it has an ash content of 0.77%. At the same time, the highest percentage of ash content is in the ratio of durian peel and sawdust of 1:3 for 20 mesh and 30 mesh sieve sizes. Ash content in briquettes is found in the mixture for 20 and 30 mesh, which is the same for the 1: 3 composition ratio, where the ash content is 1.32% and 1.35%.

This shows that briquettes mixed with sawdust have a high ash content among other briquettes, while briquettes mixed with durian peel waste have the least ash content. Ash is the non-combustible component of biomass, and the higher the ash content, the lower its calorific Value (Tamilvanan, 2013). So, a low ash content has a good value because a high ash content can complicate the process of operation and maintenance of the stove.

With the data in Figure 3, it can be shown that briquettes containing more sawdust as raw materials have a high ash content. In contrast, briquettes containing more durian peel waste raw materials have a low ash content. In combustion, the higher the ash content, the lower the heat from burning the briquettes. The problem also increases for the handling and disposal of combustion ash (Muchjidin, 2006).

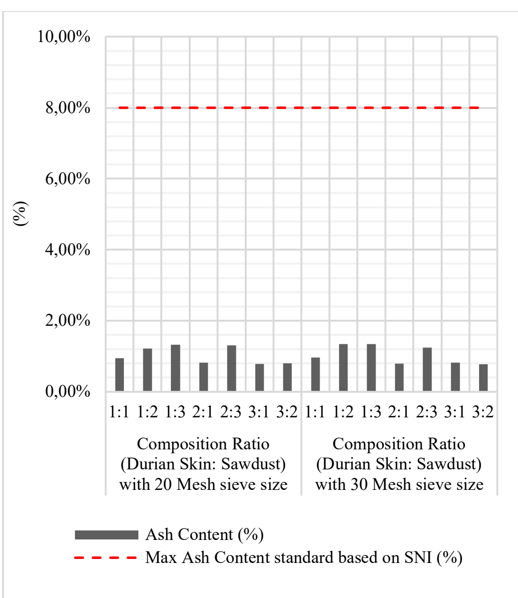

Figure 3. Briquette from Durian peel Waste and Sawdust Ash Content (%)

3.3 Briquette Standard

The analysis results above have shown that more than 95% of the briquette sample was burnt in each composition ratio. The quality of briquettes can be affected by testing the ash content in manufacturing briquettes. The lower the ash content, the better the quality of the briquettes. The faster the process of burning the briquettes, the higher the ash content produced; the ash content also affects the remaining combustion (Sunartaty & Yulia, 2017).

The quality standard of wood charcoal briquettes in SNI 01-6235-2000 concerning Wood Charcoal Briquettes can be used as a reference for briquettes using sawdust. The following quality of wood charcoal briquettes based on SNI 01-6235-2000 can be seen in Table 2. Analysis of ash content in the resulting briquettes meets the standards set by SNI no. 01-6235-2000, which is ≤ 8% for each briquette. Because all the results of briquette research show in the range of <1% for ash content and around 1-2 % for water content, which is undoubtedly below the set standard of 8% for each briquette produced.

Table 2. Quality of Wood Charcoal Briquettes Based on SNI 01-6235-2000

No.	Parameter	SNI Standard*	Briquette Sample for 20 Mesh sieve size	Briquette Sample for 30 Mesh sieve size
1.	Water Content (%)	≤ 8	1,87% - 2,24%	1,74% - 1,99%
2.	Ash Content (%)	≤ 8	0,78% - 1,32%	0,77% - 1,35%
3.	Carbon Content (%)	≥ 77	-	-
4.	Calorific Value (Cal/gr)	≥ 5000	-	-

*Source: SNI 01-6235-2000

The entire water content in the briquettes is an average of 1% to 2%. This also proves that the durian peel and sawdust waste from the analysis results can already show that the two elements of the raw material meet the requirements according to the standards set. The water content affects the calorific value and efficiency of briquette combustion. As mentioned before, the biomass from sawdust has a calorific value of up to 6603.4 cal/gr. So using a mixture of waste materials with a high calorific value, one of which is sawdust, can help reach a high combustion temperature and the optimum temperature for a long time.

This preliminary study is to determine that the water and ash content meet the SNI standard because if the briquette has more water, it will make the ignition of the briquettes longer. Furthermore, one of the ash constituents is silica, which negatively affects the calorific value of the resulting briquettes. In addition to the characteristics above, which need further analysis, it is also planned to analyze a compression strength test of briquettes. The compression strength test determines the strength of the briquettes in holding the load with a certain pressure. The level of strength is known when the briquettes can no longer withstand the load. According to Triono (2006) on Putri & Andasuryani (2017), the higher the value of the compressive strength of the briquettes, the better the durability of the briquettes

4. Conclusion

Based on the results of proximate analysis specific for the water and ash content of durian peel and sawdust, the result is lower than SNI 01-6235-2000 which the entire water and ash content in the briquettes is an average of 1% to 2%. The water content affects the calorific value and efficiency of briquette combustion. So using a mixture of waste materials with a high calorific value, one of which is sawdust, can help reach a high combustion temperature and the optimum temperature for a long time. As data obtained in this study, it can be seen that raw materials from durian peel waste and sawdust have a good value as briquette based on water and ash content. The influence of some of the essential briquette parameters on the combustion and thermal properties of briquettes will be studied in detail for the next stage in the second year. Flame test, calorific value, and pressure test of the briquettes made from durian peel and sawdust can be continued to ensure the value of other parameters. This is done to determine the complete quality of the condition of the briquettes so that they can be used as alternative fuels in the future.

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