Physical Characteristic **Analysis** *of Shells Coconut Briquette*

Ansar*), Diah Ajeng Setiawati, Murad, and Baiq Sulasi Muliani

Department of Agricultural Engineering, Faculty of Food Technology and Agroindustry, University of Mataram

ansar72@unram.ac.id

Abstract. Briquettes can be used as an alternative fuel to replace fuel oil. The method of making briquettes can be done in several ways, one of which is using the hydraulic system compression force method. The physical characteristics resulting from this method have advantages and disadvantages. Therefore, this study aims to analyses the physical characteristics of coconut shell briquettes using tapioca flour as an adhesive. The process of making briquettes was done by compression force. Parameters observed were hardness and briquette flame. The results showed that the higher the compression force, the higher the hardness of the briquettes and the flame was also very good. The best coconut shell briquettes are found in a compression force of 12 kg/cm^2 with a hardness of 27.7 kg/cm^2 and a flame of 112.61 minutes. While the worst quality was obtained at a compression force of 4 kg/cm^2 with a hardness of 16.5 kg/cm^2 and a flame of 111.34 minutes. The development of the method of making briquettes still needs to be developed as a cheap alternative energy source.

Keywords: briquettes, coconut shell, compression force, and flame

1 Introduction

Liquified Petroleum Gas (LPG) which is often used as a source of fuel for the needs of the community, receives a very large subsidy from the State Budget, reaching 31.58 trillion per year [1]. If the government continues to run this subsidy program, it will automatically burden the state budget. One strategy to overcome the high subsidy burden is to create alternative fuel sources in the form of briquettes from coconut shell waste [2].

Making briquettes from coconut shell waste as an alternative energy source is the right choice to reduce energy subsidies from petroleum. According to Ansar et al. [3], the use of briquettes as fuel is 65% cheaper when compared to kerosene, gas, and wood. The same thing was also revealed by Ansar et al. [4] that fuel becomes cheap if the raw

Q. D. Utama et al. (eds.), *Proceedings of the 7th International Conference on Food, Agriculture, and Natural Resources (IC-FANRES 2022)*, Advances in Biological Sciences Research 35,
https://doi.org/10.2991/978-94-6463-274-3_20

materials used are widely available and abundant in nature and the technology used for its manufacture is also simple.

Briquette is a fuel that can be made from biomass waste [5]. Briquettes contain a high enough calorific value, so they can burn for a long time [6]. Several researchers have previously developed briquettes from various types of raw materials. Brunerova [7] has developed briquettes from sawdust waste. The results show that briquettes have a high heating value, but no further explanation on the physical characteristics of briquettes such as hardness, percentage of destruction, and flame has not been explained. The method of making briquettes can be done in several types, one of which is using the hydraulic system pressing method [4]. The pressing method has advantages and disadvantages. As explained by Ansar et al. [8] that too high pressure during pressing can result in the product being too hard. On the other hand, too low a pressure can cause the product to break easily. These two contradictory characteristics require the determination of the pressing force to produce the characteristics of briquettes in accordance with the requirements of SNI [9]. Based on the arguments above, it is important to conduct research on the physical characteristics of coconut shell briquettes using tapioca flour as an alternative energy source.

2 Material And Method

2.1 Tools and Materials

The tools used in this research are hydraulic system press machine, tray, mash tool, spoon, stove, pan, siever, stopwach, moisture analyzer, UTM Adventast 9. While the materials used are coconut shell, mineral water, and tapioca flour.

2.2 Research Procedure

This research begins with drying coconut shells using sunlight to obtain moisture content ranging from 20-25%. Furthermore, it is done at a temperature of 300-400 °C [10]. The charcoal obtained is mashed and then filtered using a 20 mesh sieve. Furthermore, powdered charcoal is mixed with tapioca starch solution in a ratio of 1:3 to produce a dough. The dough that has been mixed well is then weighed with each weight in one mold, namely 80 g and printed on a briquette press (Figure 1).

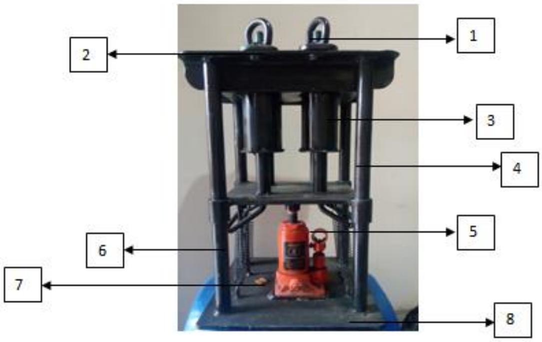

Fig. 1. Hydraulic system briquette moulding machine

Caption:
1. The lock is useful as a lock when closing the material in the compression.
2. The felt cover is useful as a cover and retainer of the material on the tool so that the material does not come out when pumped.
3. The tube is useful as a place to enter the material to be printed.
4. Support to support the briquette press during operation.
5. Place to install the lever is useful for attaching the lever as a pump.
6. The spring functions to raise and lower the material more easily.
7. A jack to provide a downward force so that the press touches the cylinder containing the briquette dough to be moulded.
8. Alas as a footrest tool so as not to shift.

The working principle of this briquette printing machine uses a hydraulic system which is done by pumping. The material is put into the tube then closed and locked. Furthermore, the material is pumped with 4 pumping variations. After that the material is removed and dried. The dried coconut shell briquettes were then tested for hardness, percentage of destruction, moisture content, and flame.

The procedure for testing the hardness value of briquettes is carried out using UTM, with the following procedures:
1. The briquettes are placed on the UTM machine test mat.
2. The machine is started, so that the press slowly touches the surface of the briquettes.
3. The machine is run with constant power (load) until the briquettes are crushed.
4. Note the reading of the load (F) given
5. Performed calculations using the equation:

$$\sigma = \frac{F}{A}. \quad (1)$$

where, σ = Hardness (MPa), F = force (N), A = Surface area (mm^2)

The flame test was carried out to determine the length of time the briquettes burned by burning the briquettes like burning charcoal. Timing starts when the briquettes are ignited until the briquettes have turned to ashes [11].

3 Result And Discussion

3.1 Hardness

The hardness of the resulting briquettes ranged from 1.65-2.77 MPa (Table 1). This hardness is influenced by the amount of pumping used at the time of printing. The higher the number of compression, the higher the hardness of the briquettes. Compression can cause compaction of the briquette volume, so that the contact area becomes larger and there is a stronger bond between the particles. The results of this study are in line with the data reported by Ansar et al. [8] that the higher the pressing force, the denser the bonds between the particles as a result of changes in shape during pressing, so that each grain locks with each other.

Table 1. Briquette hardness results

No.	Compression quantity	Average hardness (kg/cm^2)
1	4	16,5
2	6	21,6
3	8	23,1
4	12	27,7

Based on the data in Table 1, it can be seen that the highest hardness of the briquettes was obtained at pumping 12 times and the lowest at pumping 4 times. This shows that the higher the pumping amount, the higher the hardness of the briquettes. The same thing has been revealed by Yuliza et al. [12] that the hardness of briquettes is strongly influenced by compression pressure. The greater the hardness value, the higher the durability of the briquettes. Hendra and Winarni [13] also reported that the increased mechanical strength when the pressing pressure was added indicated the number of granules coalescing, so that the composition of the briquettes became denser.

The hardness value of the briquettes obtained in this study is smaller than the requirements for charcoal briquettes made in Japan (60-65 kg/cm2) and America (62 kg/cm2), but greater than the requirements for briquettes made in England (12.7 kg/cm2) [10]. Indonesian National Standard (SNI) No. 01-6235-2000 does not require the hardness value of a charcoal briquette [14]. However, the hardness value of the briquettes that have been produced can anticipate to prevent damage in packaging during the transportation and storage process.

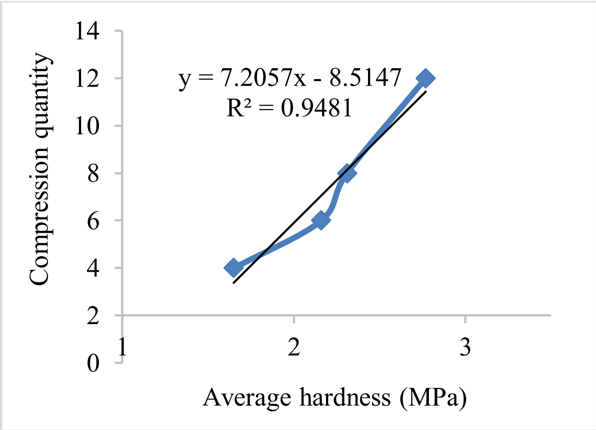

Fig. 2. Graph of the relationship between compression quantity and the hardness value of briquettes

Figure 2 graphs the relationship between the amount of pumping and the hardness value of the briquettes with the determination coefficient (R2) = 0.9481. This shows that the higher the pumping amount, the higher the hardness of the briquettes.

3.2 Flame Test

This flame test is a briquette performance related to 2 aspects, namely ignition time and combustion rate. Ignition time is related to the time it takes to ignite these shell briquettes until coals appear on the surface, while the rate of combustion is the time to ignite the briquettes until the fire goes out and then turns to ashes (Table 2).

Table 2. The results of the shell briquette flame test

No.	Number of compression	Time of flame (Minute)	Burn rate (Minute)
1	4	6,16	111,34
2	6	6,16	111,34
3	8	6,00	101,46
4	12	6.20	112,61

Table 2 shows that the fastest ignition time is found in the treatment with 8 pumping times, which is only 6.0 minutes and the longest ignition is found in pumping 12 times, which is 6.20 minutes. The longest running time is found for pumping 12 times, namely

112.61 minutes and the lowest is pumping 6 times, namely 111.34 minutes. The duration of this shell briquette burning is thought to be related to the density of the particle cavity after pumping. The high pumping pressure causes the cavity density to be smaller. This narrow cavity causes the briquette particles to be difficult to burn quickly. This phenomenon is in line with the statement Sengar et al. [15] that the duration of ignition (burning rate) is influenced by the density of the briquette cavity, the smaller the briquette cavity, the longer the ignition time. Other researchers also concluded that briquettes that have a high calorific value with low water content can also produce high combustion rates [16].

4 Conclusion

The best coconut shell briquettes were obtained from the pumping treatment 12 times with an average hardness of 27.7 kg/cm2 and a burning rate of 112.61 minutes. Meanwhile, the worst quality was obtained by pumping 4 times with an average hardness of 16.5 kg/cm2 and a burning rate of 111.34 minutes. The improvement of this briquette moulding machine can be done by adding a tool to measure the pressure value at the time of compression, so that the resulting data can be scientifically justified.

References

[1] S. W. Effendy: The strategy of increasing sales of 12 kg / 5.5 LPG at 3 kg elpji gas agent (PSO), Sustainable Competitive Advantage (SCA) 4(1), pp. 348-354, 19 Januari (2019).

[2] Ansar, Sukmawaty, S. H. Abdullah, Nazaruddin and E. Safitri: Physical and Chemical Properties of a Mixture Fuel between Palm Sap (Arenga pinnata *Merr*) Bioethanol and Premium Fuel, ACS Omega 5(22), 12745-12750 (2020).

[3] Ansar, Nazaruddin and A. D. Azis: The distillation process of palm sap (Arenga pinnata MERR) to produce bioethanol, in Earth and Environmental Science 819 (1), 012051, Jogjakarta, (2021).

[4] Ansar, Sukmawaty, Murad, M. Ulfa and A. D. Azis: Using of exhaust gas heat from a condenser to increase the vacuum freeze-drying rate, Results in Engineering 3(1), 100317 (2022).

[5] Ansar, D. A. Setiawati, Murad and B. S. Muliani: Physical Characteristic of Shells Coconut Briquette using Tapioca Flour, Jurnal Agritechno 13(1), 1-7 (2020).

[6] Ansar, Nazaruddin and A. D. Azis: Caking mechanisms of passion fruit powder during storage, International Journal of Innovation, Creativity and Change 2, p. 618–623 (2020).

[7] A. Brunerova: Waste to briquette biofuel: a briquetting technologies, in *IOP Publisihing*, Lampung (2019).

[8] Ansar, B. Rahardjo, Z. Noor and Rochmadi: Effect of compression force on material temperature change in markisa fruit effervescent tablet, Jurnal Agritech 26(1), 44-48 (2014).

[9] Ansar, Murad, Sukmawaty and L. Ilmaknun, "Comparison of the mass tissue strength of strawberry fruit between vertical and horizontal compaction," Food Research 6(3), 107–114 (2022).

[10] D. Purwanto and Sofyan: The Effect of Carbonization Temperature and Carbonization Time on The Quality of Charcoal Briquette from Oil Palm Shell Waste, Jurnal Litbang Industri 4(1), 29-38 (2014).

[11] Ansar, Nazaruddin, A. D. Azis and A. Fudholi: Enhancement of bioethanol production from palm sap (Arenga pinnata (Wurmb) Merr) through optimization of Saccharomyces cerevisiae as an inoculum, Journal of Materials Research and Technology 14(3), 548–554 (2021).

[12] N. Yuliza, N. Nazir and M. Djalal: The effect of the composition of rice husk charcoal and jatropha seed shell charcoal on the quality of charcoal briquettes, Jurnal Litbang Industri 3(1), 21-30 (2013).

[13] D. Hendra and Winarni, Physical and chemical properties of charcoal briquettes mixed with sawn wood waste and wood chips, Buletin Penelitian Hasil Hutan 21(3), 211-226 (2003).

[14] SNI, Wood charcoal briquettes, Jakarta, SNI, (2000).

[15] S. H. Sengar, A. G. Mohod, Y. P. Khandetod, S. S. Patil and A. D. Chendake, Performance of Briquetting Machine for Briquette Fuel, International Journal of Energy Engineering 2(1), 28-34 (2012).

[16] J. O. Akowuah, F. Kemausuor and j. S. Mitchua, Physico-chemical characteristics and market potential of sawdust charcoal briquette, International Journal of Energy and Environmental Engineering, 20(3), 1-6 (2012).

-