Characteristics of Briquettes from Bagasse Charcoal Using XRD and FTIR Analysis

by Nanik Astuti Rahman

Characteristics of Briquettes from Bagasse Charcoal Using XRD and FTIR Analysis

N.A. Rahman[1, a)], D.A. Anggorowati[1, b)], F.E.K. Rastini[2, a)], L. Mustiadi[2, b)], M.Ajiza[3)]

[1)]Dept. of Chemical Engineering, Faculty of Industrial Technology, National Institute of Technology Malang,
[2)]Dept. of Mechanical Engineering, Faculty of Industrial Technology, National Institute of Technology Malang,
[3)]Dept. of Geodetic Engineering, Faculty of Industrial Technology, National Institute of Technology Malang,
Jl. Bendungan Sigura-gura No. 2, Malang 65145, Indonesia
[1,a)] Corresponding author : nanik.astuti@lecturer.itn.ac.id

Abstract. The briquettes produced from bagasse charcoal have been successfully. The particle size of bagasse charcoal used as raw material for the manufacture of briquettes significantly affects the resulting briquettes' calorific value. Mesoporous particle size provides a higher calorific value when compared to micropore sized particles. To clarify the effect of particle size and the use of adhesive in the process of making briquettes from bagasse charcoal. In this study, XRD (X-Ray Diffraction) and FTIR analysis were studied on the resulting briquette samples. XRD analysis will provide information about briquettes' pore structure, while FTIR analysis offers information on the success of the type and amount of adhesive used. The type of adhesive in this study uses starch and molasse from sugar factory waste. Besides, treatment of the compressive strength of briquettes is also carried out with several variations in pressure.

Keywords: briquettes; XRD and FTIR analysis

INTRODUCTION

Charcoal briquettes are charcoal, which is further processed into briquettes (a more attractive appearance and packaging), which can be used for daily alternative energy purposes as a substitute for kerosene and LPG gas[1]. Charcoal briquettes have many advantages. When packaged attractively, they will have a higher economic value with wood charcoal sold in traditional markets; briquettes have a higher heat, are odorless, clean, and durable [2,3]
The pretreatment of bagasse charcoal dramatically affects the characteristics of the resulting briquettes. Apart from adding starch as an adhesive, pressing under absolute pressure also affects the briquettes' calorific value. Rahman et al. 2019 [4], in their research, explained that the size of bagasse charcoal affects the calorific value of briquettes. The synthesis of briquettes from mesoporous sized particles provides a higher calorific value than briquettes synthesized from micropore sized particles.

XRD analysis provides particle structure information to investigate how the entry mechanism of flour or molasses into the bagasse charcoal matrix so that it forms a homogeneous structure[5,6]. Meanwhile, FTIR analysis provided information on the presence of starch in the bagasse charcoal matrix. A high heating value indicates briquettes with superior characteristics [7]. Thus, it can be explained the effect of adhesive and pressure on the resulting briquettes' calorific value scientifically.

MATERIALS AND METHOS

Materials

Bagasse used as a raw material in this study comes from PG. Kebon Agung Malang. Starch and molasses are used as adhesives in the synthesis of briquettes from bagasse charcoal.

Synthesis Briquette

Produce briquettes from bagasse charcoal was adopted from previous research [4].In this research, besides starch, molasses was also used as an adhesive. They were pressing pressure to obtain a briquette structure with a homogeneous density, varied at 2, 5, and 8 kg / cm^2, with a drying time of 24 hours at a 120°C temperature. The ratio of starch and molasses used as adhesive is 1: 1.The ratio of adhesive and bagasse charcoal is 1 - 5%.

Crystallinity changes of the treated substrate were characterized using XRD (PANalytical, Type: Xpert Pro), FTIR (SHIMADZU, type: IR PRESTIGE 21), and surface morphology was described by SEM (FEI, Type: Inspect S50). The XRD measurement has started the angle (2θ) at 10.01° and ends at 59.9° and is carried out at 25 °C. The current flowing into the circuit is 35mA, and the voltage difference is 40kV. The K-alpha wavelength is 1.54Å because the K-Beta is set at 1.39Å. While the wavelength constants used for FTIR characterization are changed from 500 to 4000 / cm. The XRD patterns shown were compared to the starch and molasses variables, while the bond vibrations were analyzed through fingerprints shown by the FTIR spectrum [8].

RESULTS AND DISCUSSION

Starch or cassava starch ($C_6H_{10}O_5$) x is composed of two types of molecules, namely linear amylose molecules (20-30%) and amylopectin (70-80%) branched molecules. The two molecules form two regions, namely the crystalline region and the amorphous region. More crystalline areas are formed by amylopectin molecules, while crystalline regions are mostly created by amylose molecules [9]. The addition of adhesive in the form of starch and molasses gives a different structure to the compound, as seen in Fig.1.

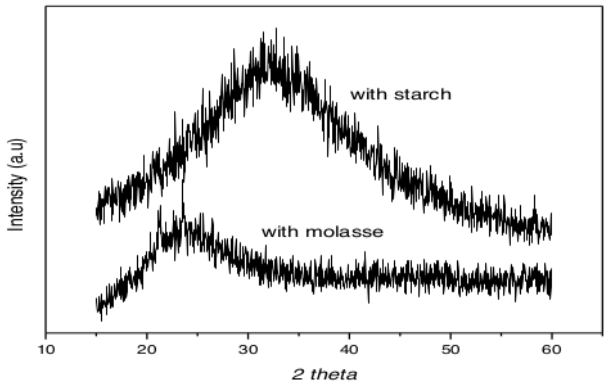

FIGURE 1. XRD analysis on the synthesized briquettes using starch and molasses as adhesive

Based on the results of the XRD spectrum analysis in Fig. 1 shows that the sample forms a soft peak in the 20° - 30°θ spectra, namely in the *23 θ* spectra, indicating that the sample is amorphous. Similar to previous research by Saptadi[10]and Iguchi [11,12] that the peak of the X-ray diffractogram on wood charcoal is amorphous in the form of a broad curve at the *22θ* position.

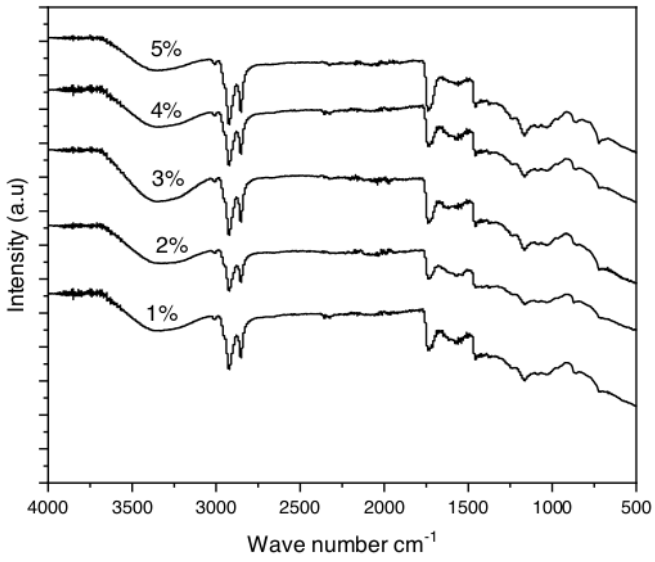

FIGURE 2. Spectrum FTIR of samples with variations in the addition of adhesive

Based on the results of the FTIR spectrum analysis in Fig. 2 of the briquette sample above, it can be seen that there are several specific peaks visible at certain wavelengths such as CO groups at wavelength 1050 - 1300 cm^{-1}, C = C Alkenes groups at wavelength 1610 – 1680 cm^{-1}, the CH Alkane group is present at a wavelength of 2850 – 2970 cm^{-1}. The C = O group of CO_2 is current at a wavelength of 2991.59 cm^{-1}. From these groups, it can be seen that there is element C, which is widely found in starch and molasses compounds

The heat test is carried out to determine the energy that can be produced from bagasse charcoal briquettes. Test heat is done by using the Bomb testing method Calorimeter. The sample used is a sample with a pressure of 5 kg /cm^2 with various compositions adhesive 1% -5%, shown in Table 1.

Tabel 1 . Heating Value of Briquttes

No	Ratio of Adhesive	Heating Value (cal/g)	
		starch[a]	molasses
1	1%	6440,24496	6453, 3238
2	2%	5081,9776	5565,1982
3	3%	5568,2088	5799,2092
4	4%	6925,57616	5765,9872
5	5%	6731,72368	5998,2122

[a,] ***Rahman et al., 2019***

From the test results, it was found that the heating value. The highest is found in 1% adhesive at a pressure of 5 kg / cm^2. This is following SNI standards, where the minimum heat produced is briquettes 5000 cal / g.

CONCLUSION

Bagasse charcoal briquettes with the addition of starch and molasses as adhesive have been successfully carried out. From the XRD results, FTIR analysis and the calorific value of the sample, it can be concluded that different adhesives will give different structures and heating values.

ACKNOWLEDGMENTS

2
This research was funded by the Ministry of Research,Technology, and Higher Education Directorate General Research and Development Directorate of Research and Community Service. Through PTUPT Research Grant FY 2020.

REFERENCES

1. D. Schneider, M. Escala, K. Supawittayayothin and N. Tippayawong, International Energy & Environment Foundation, 2(4), pp. 647-652.
2. G.W. Ignatius, Sutriyana, W.Eko. Jurnal IPREKAS- Ilmu Pengetahuan dan Rekayasa. Mei 2010, pp. 8-13.
3. G. Pari , Jurnal Penelitian Hasil Hutan, 29(1), pp. 33-45.
4. N.A. Rahman, D.A. Anggorowati, F.EK. Rastini, B.S. Jody. Prosiding Seminar Nasional SOEBARDJO BROTOHARDJONO XV, UPN Veteran Jawa Timur, ISSN : 1978 – 0427
5. S.Oluwadayo, H. Tobias and Foley, S.O, Energy 2010, 35, 5347-5353.
6. Kercher, A.K., & Nagle, D.C. Carbon 2003, 41, 15-27.
7. Sevilla, M., & Fuertes, A. Carbon 2009, 49, 2281-2289.
8. Cai, J., Cai, C., Man, J., Yang, Y., Zhang, F., & Wei, C, *Carbohydrate Polymers*,2014, 102, 799-807.
9. Tonukari, NJ, Electron. J. Biotech. 2004, 7 (1), pp. 5-8.
10. S. Darmawan, W. Syafii, NJ. Wistara, A. Maddu, G, Pari . Journal of Forest Products Research, Vol. 33 No. 2, Juni 2015: 81-92
11. Iguchi, M. (1997). Practice of Polymer X-ray Diffraction. Bandung: Bandung Institute Technology.
12. Wang, L., Guo, Y., Zou, B., Rong, C., Ma, X., Qu, Y., Li, Y., & Wang, Z. Bioresource Technology, 102(2), pp. 1947-1950.

Characteristics of Briquettes from Bagasse Charcoal Using XRD and FTIR Analysis

ORIGINALITY REPORT

10%	10%	0%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	www.scielo.br Internet Source	6%
2	eprints.itn.ac.id Internet Source	2%
3	ejournal.stiewidyagamalumajang.ac.id Internet Source	2%

Exclude quotes	On	Exclude matches	< 2%
Exclude bibliography	On		