ELECTROLYTE
Vol 2 No 2 2023, pp 55-64
e-ISSN 2828-3147
https://doi.org/10.54482/electrolyte.v2i02.200

RUBBER FRIUT SHELL CARBON APPRIXIMATE TESTING (*Hevea brasilliensis*)

Liza Okta Afnel*, Ananda Putra

Department of Chemistry, Faculty of Matchematics and Natural Science, Universitas Negeri Padang
Padang, Indonesia
*Coresponding email: anandap@fmipa.ac.id

ARTICLE INFO

Submit
03 November 2022
Received
04 November 2022
Revised
30 November 2022
Accepted
15 December 2022
Published
30 December 2023
(IN PRESS)

ABSTRACT

This research aim to investigate evaluate carbon active materials as functionalized thermoelectric materials. The carbon approximation test of rubber fruit shell has been successfully carried out. Carbon made at a temperature of 370 ºC with variations in the length of time of 30, 45, 60 and 75 minutes was found to meet the test levels of SNI No. 06-3720-1995 and the best carbonization time for 60 minutes. Rubber fruit shell is the unused part of the rubber tree so that it becomes waste. Most of the rubber plantations in Indonesia are owned and managed by the community, but only latex is used while the rest are not. Processing of other parts of the rubber tree that have not been utilized such as rubber fruit shells, therefore proper handling is needed to manage rubber fruit shells so that they are more beneficial to the environment and can have economic value later. Namely processing rubber fruit shells into activated carbon because it contains the main composition of cellulose and lignin.

Keywords: Approximate test; Carbon; Rubber Fruit.

1. INTRODUCTION

Drying the sample in the sun aims to lose water content. Or called dehydration can also be done by heating the sample in the oven. Until a constant weight is obtained on the sample [1-3]. The purpose of burning the sample is to increase the carbon content by removing other non-carbon elements. The temperature at the time of combustion can affect the quality of carbon. High combustion temperatures can result in an increase in the rate of release of liquids and gases and a decrease in carbon yield. High temperatures will increase the carbon content and ash content and reduce volatile matter [4-6] . A high temperature during carbonation is very important, but too high a temperature can also result in a high ash content of the carbon. Therefore, it is necessary to limit the temperature at the time of carbon combustion. The presence of high ash content in carbon results in the surface area of the carbon that is blocked by the ash.

Carbon has many diverse carbon sources. One of them comes from agricultural waste such as rice husks, candlenuts, almonds and coconut shells [7-9]. The use of agricultural by-products or waste has also been proven to be a sustainable, economical and environmentally friendly alternative [10-12]. And another advantage of using this agricultural waste is the availability of materials that are always available at no cost and are renewable without requiring maintenance [13] .

The quality of activated carbon will go through several tests whose requirements have been set in the Indonesian National Standard (SNI) in the following table [14] :

Table 1. Activated charcoal quality requirements according to SNI No. 063720-1995 (LIPI, 2000)

	Type of Test Level				
	Water%	Ash%	Steam%	Bound%	Iodine Absorption mg/g
Details	< 4.5	<2.5	<15.0	>80.0	>750
Powder	<15.0	<10.0	<25.0	>65.0	>750

One example of agricultural waste that can be used as a carbon source is rubber fruit shells. Rubber fruit shells are the unused part of the rubber tree. Most of the rubber plantations in Indonesia are owned and managed by the community, but only latex is used, while the rest are not. That is processing rubber fruit shells into activated carbon because it contains the main composition, namely cellulose and lignin [15]. The content is grouped called lignocelluose. Content that's a lot found in agricultural waste like shell fruit rubber to carbon through combustion process [16]. The following compounds make up lignocellulosic in oil palm fronds, including lignin (33.5 %) and cellulose (48.6%) .

Rubber fruit shells can be used as raw material for making activated charcoal, but some use them as materials for making various handicrafts. Rubber fruit shells can also be used as a material for making activated carbon without spending too much money. The use of rubber fruit shell waste can also be a solution for handling the accumulation of rubber fruit shell organic waste from wastewater treatment [17]. The raw material in this research comes from rubber fruit shells which will be used as a carbon source and will be tested for quality.

One of the effective materials used in thermoelectric is activated carbon because of its high surface area. Activated carbon itself is an amorphous and carbon-based material. The surface area between particles in activated carbon is very large and the porosity is high. Activated carbon is the covalent bonding of a carbon atom in a hexagonal side which gives activated carbon its graphite structure. The van der Waals force is the bond between the layers on the activated carbon so that the porosity on the surface of the activated carbon becomes high[18].

Carbonization aims to increase the carbon content by removing other non-carbon elements. The carbonization temperature can also affect the quality of the carbon. High carbonization temperatures can result in an increase in the rate of release of liquids and gases and a decrease in carbon yield. High temperatures will increase the carbon content and ash content and reduce volatile matter [19].

High temperatures are very important in carbonization, but temperatures that are too high will also result in the presence of ash content in the carbon, so in this case it is necessary to limit the temperature. The presence of ash during carbonization will result in clogging of the carbon pores so that the surface area decreases.

Rubber fruit shell is the unused part of the rubber tree so that it becomes waste. Most of the rubber plantations in Indonesia are owned and managed by the community, but only latex is used while the rest are not. Processing of other parts of the rubber tree that has not been utilized, such as rubber fruit shells, is expected to increase the economic value of rubber plantations.

Rubber fruit shells can be used as raw material for making activated charcoal, but there are also some people use it as an ingredient for making various handicrafts. Rubber fruit shells can also be used as a basic material for making activated carbon which can be used as a thermoelectric material without spending too much money. The use of rubber fruit shell waste can also be a solution for handling the accumulation of organic coir waste and wastewater treatment [20].

Figure 1. Rubber Fruit Shells

X-ray diffraction (XRD) is a technique used to identify the crystalline phase in materials and also to determine the crystal structure and crystal size. The principle of X-ray diffraction is that when X-rays hit a solid object in the form of atoms, the X-rays will be scattered by the electrons in the atom. Constructive or destructive wave interference occurs along different directions because the scattered waves (diffraction patterns) are emitted by atoms at different positions[21]. This research aim to investigate evaluate carbon active materials as functionalized thermoelectric materials.

2. EXPERIMENTAL

2.1 Carbonization and Activation of Rubber Fruit Shells

Carbonization or burning of rubber fruit shells is carried out at a temperature of 370 ^{o}C with time variations of 30, 45, 60 and 75 minutes. The sample was put into an evaporating dish wrapped with *aluminum foil* after carbonization and cooled in a desiccator. After that the test for carbon characterization was carried out in accordance with SNI No. 06-3720-1995. The following are carbon testing methods:

2.1.1 Water content

The activated carbon weighed 1 gram and put into a dry evaporation cup and the weight was known, then heated in the oven for 1 hour at 105 ^{o}C, then removed and put into a desiccator to cool after it was weighed. To determine the water content the following equation is used:

$$\text{Water content} = \frac{\text{a}-\text{b}}{\text{a}} \text{ x } 100\%$$

Description :

a = initial mass of activated carbon (grams)

b = mass of activated carbon after oven (grams)

2.1.2 Ash Level

Put 1 gram of activated carbon into a dry porcelain exchange and the weight is known, then burn it in the *furnace* until it becomes ashes gradually. Increase the temperature to 900 ^{o}C (2 hours). When all the carbon has become ash, then put it in a desiccator to cool and then weigh. The following is the equation for finding the ash content:

$$\text{Ash content} = \frac{\text{ash weight}}{\text{sample wight}} \text{x } 100\%$$

2.1.3 Vapor Level

Activated carbon is heated in a *furnace* from room temperature to a temperature of 380 ^{o}C. After reaching the specified temperature, wait until it cools down without being contaminated with outside air. Then cool it in a desiccator and weigh it. Equation in finding the vapor content:

$$\text{Vapor content} = \frac{\text{a}-\text{b}}{\text{a}} \text{x } 100\%$$

Description :

a = initial mass of activated carbon (grams)

b = mass of activated carbon after *furnace* (grams)

2.1.4 Bonded Carbon Content

To obtain the bound carbon content obtained from the results of the reduction with the part of the carbon lost on heating the ash content and ash content . Here's the equation:

$$\text{Bonded carbon} = 100\% - (A + B)$$

Description :

A = ash content (%)

B = vapor content (%)

2.1.5 Iodine Absorption

The sample was put into an Erlenmeyer as much as 0.25 grams and closed, then added 25 ml of 0.1 N iodine solution, then shaken at room temperature for 15 minutes. After that the solution is filtered, then the filtered filtrate is pipetted 10 ml and titrated with sodium thio sulfate ($Na_2S_2O_3$) 0.1 N. If the solution turns yellow then add 1% starch solution which functions as an indicator. Then titrate the solution again until the blue color of the solution disappears.

$$\text{Iodine absorption mg/g} = \frac{\left(10 - \frac{V \times N}{0,1}\right) \times 12,69 \times FP}{w}$$

Description :

V = volume of $Na_2S_2O_3$ used (ml)

N = normality $Na_2S_2O_3$ (ml)

W = mass of carbon (grams)

FP = dilution factor

12.69 = amount of iodine corresponding to 1 ml of solution $Na_2S_2O_3$ 0.1 N

Carbon characterized by XRD for to identify the results obtained in amorphous form and XRF to analyze the chemical content of the sample.

3. RESULTS AND DISCUSSION

3.1 Carbonization, Activation and Approximate Test

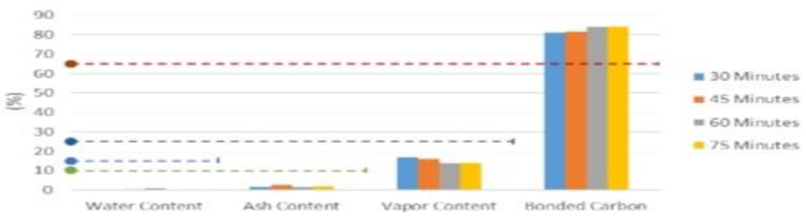

Figure 2. Graph of carbon characterization of combustion time variations

In the graph above, it can be seen that in all variations of time it meets SNI, but the highest value of bound carbon content is at a combustion time of 60 minutes and a temperature of 370 ^{o}C.

The water content obtained in this study ranged from 0.1 to 0.81 %, in which the data did not exceed the specified carbon limit of 15%. Things that affect the water content of the carbon include the length of the cooling process after carbonization, the amount of water in the air, milling and sifting of carbon [22].

Then the value of ash content obtained is in the range of 1.74 - 2.54 %, which is the maximum limit of 10%. Ash content can also affect carbon which if high ash content can clog the carbon pores.

The value of the vapor content is in the range of 14.00 – 16.00 % in accordance with the specified limit, which is a maximum of 25%. The steam test aims to determine the amount of substances that have not been decomposed during combustion [23].

And the bound carbon content is in the range of 81.23 - 8 4.26 % with a minimum limit of 65%. This test aims to determine how much pure carbon is contained during combustion. What affects the value of the bound carbon content is the value of the vapor content and ash content. In addition, contents such as lignin and cellulose also affect the bound carbon content [24].

From the data above, it can be concluded that carbonization at 60

minutes and a temperature of 370 ^{o}C complies with SNI, this is because at 75 minutes it has a high bound carbon content compared to other times.

The value of iodine absorbed by carbon is related to the surface area. The ability to adsorb can be known by the number of iodine absorbed by the adsorbent. Here are the results of the absorption of iodine:

Figure 3. Carbon iodine absorption data

In the graph above, it can be seen that at 75 minutes the highest iodine absorption capacity is 1 365,61 mg/g. Iodine absorption is directly proportional to the length of carbonization time. This is because the longer the carbonization time the impurities in the sample evaporate [25].

The results of the carbon quality and characterization test showed that the 60 minute cooking time was the optimum result. Because it has a high level of bound carbon.

3.2 XRD Characterization

The characterization using XRD instrument aims to determine the carbon structure. Which in this research does not have a specific peak because carbon has an amorphous structure.

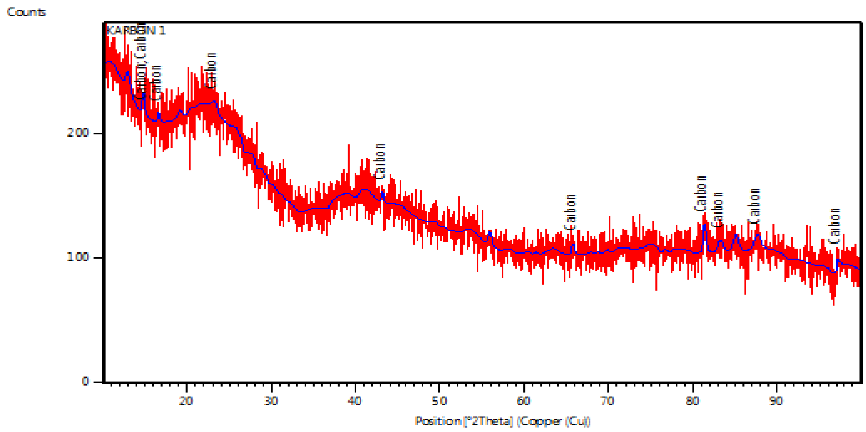

Figure 4. XRD Optimum Carbon

4.3 XRF Characterization

Analysis using XRF aims to identify chemical compounds contained in carbon. The following table is the result of XRF analysis:

Table 2. Carbon Chemical Composition

Composition	Concentration (%)
SiO_2	4.624
P_2O_5	8.146
K_2O	73.279
Cl	0.035
MnO	0.067
Fe_2O_3	0.220
CuO	0.066
ZnO	0.043
Rb_2O	0.031
Ag_2O	4.173
Eu_2O_3	0.014
CaO	0.000
Al_2O_3	0.000
NiO	0.000
ThO_2	0.000
Ag_2O	0.000
PbO	0.000

The results of the optimal carbon XRF analysis above only contain a few dominant compounds such as K2O and SiO_2 while the other elements are only relatively small. This shows that the carbon produced at a temperature of 370 ^{o}C with a carbonization time of 60 minutes is quite good with a small amount of impurities in the XRF analysis results [26].

4. CONCLUSION

Based on the research, it can be concluded that the carbonization of rubber fruit shell at a temperature of 370 °C for 60 minutes is the right temperature and time for making rubber fruit shell carbon. Due to the water content obtained is 0.8 1%, the ash content 1.74 %, vapor content 1 4.00 % and the bound carbon content is 8 4.2 6 % and the iodine absorption value is 1433.84 mg/g.

ACKNOWLEDGEMENTS

The author also expresses his gratitude to the academic and non-academic staff of the Department of Chemistry, Faculty of Mathematics and Natural Sciences, Padang State University and then to all parties who have participated in completing this research.

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