JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 7, ISSUE 02, 2020

IMPROVEMENT QUALITY OF ACTIVATED CARBONS OF MANGROVE BY VARYING THE ACTIVATION TEMPERATURE

Masthura, Abdul Halim Daulay

Universitas Islam Negeri Sumatera Utara, Medan, Indonesia

Corresponding Author: masthura@uinsu.ac.id

Abstract. A research has been carried out that aims to determine the effect of activation temperature on the yield and quality of mangrove activated carbon from which it is produced. The activation temperature was varied from 500 ^{o}C to 900 ^{o}C with a holding time of 60 minutes. The tested carbon qualities were moisture content, volatile matter content, ash content, and carbon content based on SNI (Indonesian National Standard) No. 06-3730-1995. The results showed that the water content was 4.25%, the volatile matter content was 9.88%, the ash content was 2.44%, and the carbon content was 87.68% which was close to the SNI obtained at an activation temperature of 500 ^{o}C.

***Keywords**:* Activation temperature, Mangroves and Activated Carbon

INTRODUCTION

Activated carbon is a carbonaceous amorphous material that has a large surface area which is built up by its internal pore structure through the carbonization process and activation. Activated carbon has a large surface area of about 500 m^2/gram and can even reach 1500 m^2/gram. Activated carbon that is made activated by heating is usually used to develop the cavity structure in the charcoal so that it expands its surface and removes volatile constituents and removes the production of tar or impurity hydrocarbons in charcoal (Swiatkowski 1998 in Anton P 2011).

In this study, research was conducted on the manufacture of activated carbon from mangroves. This research was conducted by varying the temperature in the activation process to see the optimum temperature and testing the activated carbon based on technical activated charcoal in accordance with SNI No. 06-3730-1995. The test analysis carried out included testing of water content, volatile matter content, ash content and carbon content. In this study, the heating temperature variations were carried out from 500 ^{o}C to 900 ^{o}C. The results of this study are expected to utilize mangrove wood in the community.

The quality of activated carbon depends on the type of raw material, processing technology, working method and the accuracy of its use. Various versions of the quality standard for activated carbon have been made by developed countries such as America, England, Korea, Japan and Germany. Indonesia has also made a quality standard for activated carbon according to the Indonesian Industrial Standard, namely SII 0258 - 79 which was later revised to SNI 06 - 3730 - 1995.

Table 1. Technical activated charcoal quality standard SNI No. 06 -3730 -1995

Description	Requirements	
	Granules	Powder
1. Water Content	Max. 4.5%	Max. 15%
2. Volatile matter Content	Max. 15%	Max. 25%
3. Ash content	Max. 2.5%	Max. 10%
4. Carbon Content	Min. 80%	Min. 65%

Source: Technical Activated Charcoal SNI 06-3730-1995.

Mangrove wood in mangrove forests produces good quality wood, so it can be used for building construction and firewood. As firewood, all parts of the mangrove, which consist of trunks, twigs and roots are taken. Mangroves are of high quality, that is, they produce excellent heat, are durable when burned and produce good charcoal.

Testing Analysis of Activated Carbon

1. Water content

The water content of coconut shells greatly determines the quality of the carbon produced. Activated carbon with a low water content value will have small pores, so the carbon produced from this type of coconut shell has a low water content. Determination of the water content of activated carbon aims to determine the amount of water content evaporated on the activated carbon produced after going through the activation process. The procedure for calculating the water content of coconut shell activated carbon uses the SNI No. 06-3730-1995 with the formula:

$$\text{Water content } (\%) = \frac{a-b}{b} \text{ x } 100\% \text{ ....(1)}$$

where :

a = Initial sample (gram)
b = Shrinkage sample (gram)

2. Volatile matters content

The amount of temperature used in the process of making activated carbon will affect the levels of volatile matters. The higher the temperature used, the lower the levels of volatile matters in the carbon produced. Determination of volatile matters content aims to determine the amount of substances or compounds that have not yet evaporated in the carbonization and activation processes. Calculation of volatile matter content uses SNI No. 06-3730-1995 with the formula:

$$\text{volatile matter content } (\%) = \left[\frac{(a-b)}{a} \text{ x } 100\%\right] \text{..........................(2)}$$

Where :

a = the mass of the sample before heating (gram)
b = the mass of the sample after heating (gram)

3. Ash content

Ash is the material that remains when carbon is heated to a constant mass. This ash content is proportional to the content of inorganic materials in activated carbon. Determination of ash content aims to determine the content of metal oxides in activated carbon. Ash content is the residue from combustion that no longer has carbon elements. The ash content value shows the amount of residue from the end of the combustion process in the form of mineral substances that are not lost during the combustion process (Sudrajat R, 2002 in Moh Ashari Y, 2013). The calculation of the ash content of activated carbon uses the SNI No. 06-3730-1995 with the formula:

$$\text{Ash content } (\%) = \frac{b}{a} \text{ x } 100\% \text{ ....(3)}$$

Where :

a = Initial sample mass (gram)
b = Total mass of ash (gram)

4. Carbon content

The carbon fraction in activated charcoal is the result of a curing process other than ash, water and volatile matters. The type of shell is very influential on the value of carbon in activated charcoal, due to the difference in chemical content in the type of coconut shell. Determination of bound carbon content aims to determine the carbon content after carbonization and activation processes. Calculation of carbon content uses SNI No. 06-3730-1995 with the formula:

$$\text{Carbon content}(\%) = 100\% - (\%\text{ substance evaporates} + \%\text{ ash}) \text{.................(4)}$$

RESEARCH METHODOLOGY

Materials and Tools

The material used in this research is mangrove wood. The equipment used is furnace, digital balance, oven, porcelain cup, beaker glass and 100 mesh sieve.

Research procedure

Mangrove wood is cleaned of its skin and cut into cubes. Then charcoal (carbonization stage) of coconut shells is carried out with a furnace at a temperature of 300 ^{o}C for ± 3 hours. The carbonized charcoal is mashed and then sieved with a 100 mesh sieve. The charcoal held in a 100 mesh sieve is then heated with temperature variations of 500 ^{o}C, 600 ^{o}C, 700 ^{o}C, 800 ^{o}C and 900 ^{o}C with a holding time of 60 minutes. Furthermore, the activated carbon of mangrove wood is cleaned from ash by washing it using aquadest water and drying it. The process is complete, then testing for activated carbon includes: moisture content, ash content, volatile matters content and carbon content.

RESULTS AND DISCUSSION

The characteristics of activated carbon in this study were carried out to determine and analyze the quality of activated carbon produced through the activation process by varying its activation temperature. Activated carbon characteristic testing is carried out based on SNI No. 06-3730-1995 which includes physical and chemical properties such as moisture content, volatile matters content, ash content, and carbon content

Table 2. Test results of activated carbon

No.	Description	Variation in activation temperature (^oC)					SNI No. 06-3730-1995 (%)
		500	600	700	800	900	
1	Water content (%)	4.25	7.75	10.27	13.32	15.84	Max. 4.5
2	Volatile matter (%)	9.88	30.12	38.60	52.52	55.80	Max. 15
3	Asch content (%)	2.44	7.32	10.88	15.32	18.32	Max. 2.5
4	Carbon content (%)	87.68	62.36	50.52	52.16	23.88	Min. 80

1. Water Content

One of the properties that affect the quality of activated carbon is water content. The purpose of determining the water content is to find out how much water can be evaporated so that the water bound to the activated carbon of mangroves does not cover its pores. The water content of the resulting coconut shell activated carbon can be seen in Figure 1.

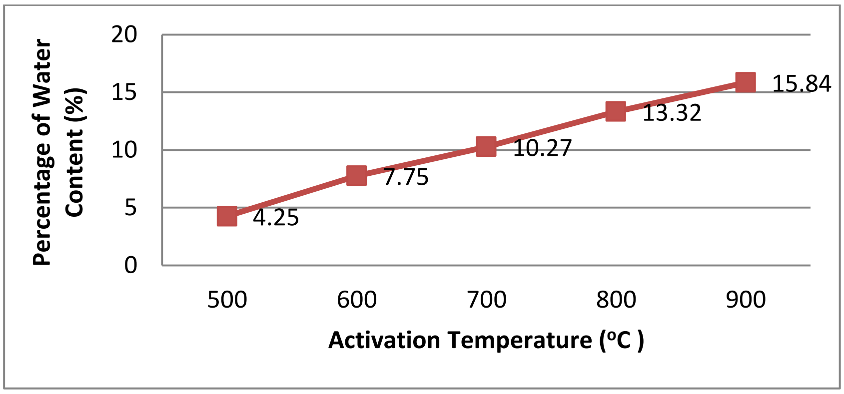

Figure 1. Graph of water content against activation temperature

Table 1 shows that the water content increases with higher temperature. At a temperature of 500 ^oC, it can be seen that the percentage of the lowest water content is 4.25%, while the highest percentage of water content is at 900 ^oC, which is 15.84%. Quality requirements for activated carbon according to SNI No. 06-3730-1995 for the water content is 4.5% while the results of the analysis of the water content of the activated carbon of mangrove wood which is closest to SNI Number 06-3730-1995 of 4.25% are obtained at an activation temperature of 500 ^oC.

2. Volatile matter Content

Determination of volatile matters content aims to determine the amount of substances or compounds that have not yet evaporated in the carbonization and activation processes. The levels of volatile activated carbon of mangrove wood that produce can be seen in Figure 2.

ISSN- 2394-5125 VOL 7, ISSUE 02, 2020

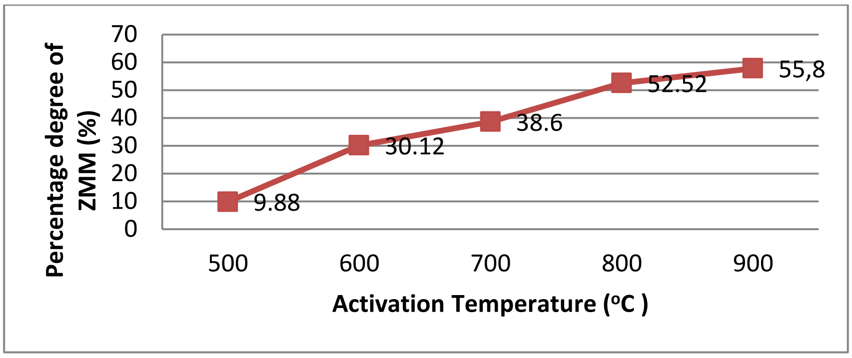

Figure 2. Graph of volatile matter content against activation temperature

Figure 2 shows that the higher the activation temperature, the greater the volatile matter content. The lowest volatile content value was 9.88% at 500 ^{o}C, while the highest volatile matter content was 57.8% at 900 ^{o}C. Quality requirements for activated carbon according to SNI No. 06-3730-1995 for the volatile matter content is 15%, while the results of the analysis of the volatile active carbon activated mangrove wood are the closest to SNI No. 06-3730-1995 is 9.88% at 500 ^{o}C.

3. Ash Content

Determination of ash content aims to determine the content of metal oxides in activated carbon. Ash content is the residue from combustion that has no carbon and value elements. The ash content of coconut shell activated carbon can be seen in Figure 3.

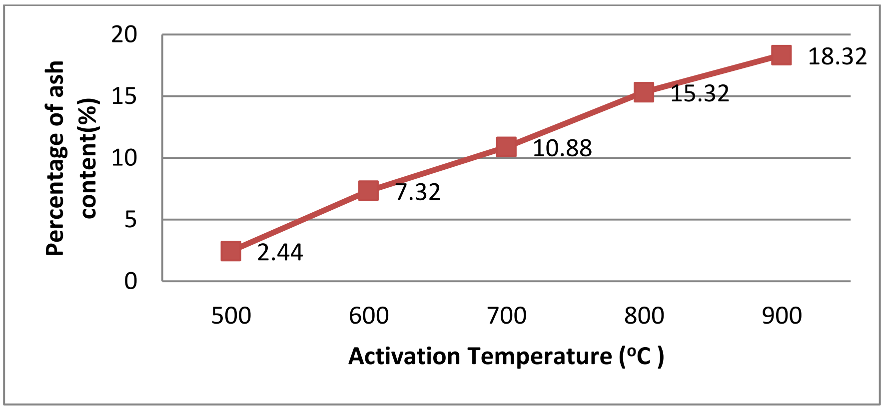

Figure 3. Graph of ash content against activation temperature

Figure 3 shows that the higher the temperature, the higher the ash content. The lowest ash content value is at an activation temperature of 500 ^{o}C of 2.44%, then it increases at a temperature of 600 ^{o}C, 700 ^{o}C, 800 ^{o}C, while the highest ash content is at a temperature of 900 ^{o}C which is 18.32%. Quality requirements for activated carbon according to SNI No. 06-3730-1995 for ash content is 2.5%, from the results of the analysis of the ash content of mangrove activated carbon which is closest to SNI No. 06-3730-1995 is 2.44% at a temperature of 500 ^{o}C.

4. Carbon Content

Bonded carbon in charcoal has an important role in determining carbon quality. Determination of bound carbon content aims to determine the carbon content after carbonization and activation processes. The carbon content of the activated carbon of mangroves can be seen in Figure 4.

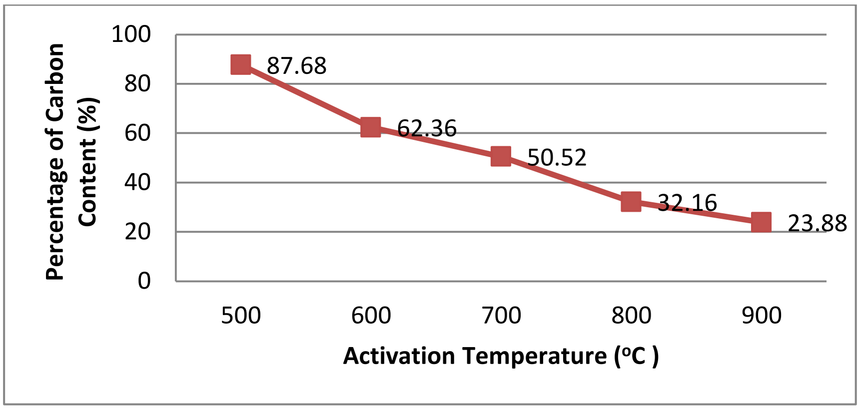

Figure 4. Graph of carbon content against activation temperature

Figure 4 shows the decrease in carbon content as the activation temperature increases. The decrease in carbon content does not decrease constantly due to the influence of volatile matter content and ash content. The higher the volatile matter content and the ash content, the lower the bound carbon content will be. The highest carbon content value at 500 ^{o}C is 87.68% then it decreases to the lowest value of 23.88% at an activation temperature of 900 ^{o}C. Quality requirements for activated carbon according to SNI No. 06-3730-1995 for carbon content is 80%, the results of the analysis of the carbon content of mangroves are closest to SNI No. 06-3730-1995 which is at a temperature of 500 ^{o}C with a yield of 87.68%.

CONCLUSION

The results showed that the water content was 4.25%, the volatile matter content was 9.88%, the ash content was 2.44%, and the carbon content was 87.68% which was close to the SNI obtained at an activation temperature of 500 ^{o}C.

REFERENCES

Anonim, 1995, *Technical Activated Charcoal SNI 06 – 3730 – 1995*, National Standardization, Jakarta

Anton P, Ahmad Y and Rini NA, 2011, *Adsorption of Methylene Blue on Activated Carbon from used Tires with Variation in NaCl Concentration at Activation Temperature of 600^{o}C and 650^{o}C*

Djatmiko B, S. Ketaren and S. Setyahartini.1985. *Charcoal Processing and Its Purpose for the Agro Industry Press*, Department of Industrial Technology of Agriculture. Fateta IPB, Bogor.

Kordi H. K. Ghufran M. 2012. *Mangrove Ecosystem*. Edition 1. Jakarta : Rineka Cipta.

Kustanti Asihing. 2003. *Mangrove Forest Management*. PT. Penerbit IPB Press. Kampus IPB Taman Kencana Bogor.

Pari, G. 2002. *Alternative Technology for Utilization of Wood Processing Industry Waste*. Papers of the Philosophy of Science, Graduate program. IPB Bogor.

Pari, G. 2004. *Study of the structure of activated charcoal from sawdust as adsorbent of plywood formaldehyde*. Dissertation, Graduate program. IPB ; Bogor.

H. Marsh, Francisco R.R, 2006, *Activated Carbon*, Elseiver Science & Technology Books, ISBN : 0080444636

Jannati, Deby and Shona Mazia. 2009. *Activated Carbon as a Water Filter*. Jakarta. Print Edition : 653. Jakarta.

Rosita Idrus, et al., 2013, *Effect of Activation Temperature on Quality of Coconut Shell-based Activated Carbon*, Prisma Fisika Vol I, No.1, page : 50-55

Sembiring, Meilita and Tuti S. Sinaga. 2003. *Activated Charcoal (Introduction and Manufacturing Process)*. Department of Industrial Engineering University of North Sumatera. Page : 1 – 9