DETERMINATION OF ACTIVATED CARBON LEATHER SPAECIFIK CAPASITANCE KEPOKBANANA (*Musa paradisiaca*) MODIFIED BY HNO_3, H_2SO_4, H_2O_2 AND USING CYCLIC VOLTAMMETRY

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Abstrak. Penelitian tentang modifikasi permukaan karbon aktif yang berasal dari pisang kapok dengan HNO_3, H_2SO_4 dan H_2O_2 telah dilakukan melalui metode cylic voltametri. Hasil modifikasi permukaan karbon aktif memberikan spektrum dengan peningkatan intensitas serapan. Karbon aktif dari kulit pisang kapok diaktivasi dengan aktivator H_3PO_4. Area permukaan karbon aktif sebelum dan setelah aktivasi adalah 64,75 m^2/g, dan 148,01 m^2/g. Analisis yang didasarkan pada pengukuran cycic voltametri menunjukkan bahwa modifikasi permukaan dengan asam oksida dapat meningkatkan nilai kapasitansi spesifik. Kapasitansi spesifik sebelum dan setelah modifikasi dengan HNO_3, H_2SO_4, dan H_2O_2 adalah 1133,71 nF/g, 1009,72 nF/g, dan 412,67 nF/g.

Kata kunci: Modifikasi permukaan, kapasitansi spesifik, karbon aktif, dan cyclic voltametri

Abstract. This research has been carried out on surface modification of activated carbon with a banana peel kepok HNO_3, H_2SO_4 and H_2O_2 were then measured using cyclic voltammetry. The result of this modification surface of active carbon in banana kepok peel HNO_3, H_2SO_4 and H_2O_2 give as spectrum alteration with the increasing of absorption intensity. Active carbon of banana kepok peel is activated with H_3PO_4 activator. The surface area of activated carbon before and after activation is 64,75 m^2/g, and 148,01 m^2/g. The analysis is based on cyclic voltammetry measuring showed that the surface modification which oxidative acid can increase specific capacitance values. The specific capacitance from the result before and after modification of HNO_3, H_2SO_4 and $H_2O_2$is not measurable, 1133,71 nF/g, 1009,72 nF/gdan 412, 67 nF/g.

Keywords: Surface modification, specific capacitance, activated carbon, and cyclic voltammetry

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INTRODUCTION

Capacitor and battery electric energy storage is commonly used in electronic devices, electrochemical capacitors is one of supercapacitors that have high energy storage density and a long cycle. One of the supercapacitor electrode material that is currently widely used is through the use of activated carbon pore size scale of nanometers. The surface of large pores in activated carbon will produce electrodes with a large surface area [9].

In the manufacture of activated carbon used banana peels as raw materials for banana peels contain enough carbon about 41.37% [7]. The process of making activated carbon is done in two stages. The first stage is the carbonization process raw materials to produce charcoal. The second stage is the activation process of charcoal to remove the hydrocarbons that coat the surface of the charcoal thus increasing the porosity of charcoal [6].

Activated carbon surface modification done to increase the active group. Active group to be added is an oxygen group. On activated carbon modification nitric acid, pores appear more clean and flat. It is assumed that the impurities have been lost because of the treatment using nitric acid at the time of modification [2].

Surface modification can increase the value of specific capacitance. Additionally, the increased specific surface area, the specific capacitance values obtained will rise. Specific capacitance measurement can be done using the method Cyclic voltammetry Cyclic voltammetry measurement is done by giving a certain potential in electrochemical cells tested, from potential high to low and back to high [1][10].

Based on the above explanation we conducted this study to modify the surface of activated carbon with a banana peel HNO_3, H_2SO_4 and H_2O_2 using Cyclic voltammetry method to determine the value of the capacitance of activated carbon.

RESEARCH METHODS

a. Making Activated Carbon

Banana peelkepok cleaned both ends, then cut into 3-4 parts [8]. Cut into pieces of dried banana peels in the sun and then put it in the oven at 110 ° C for 2 hours. Banana skin was clean and dry carbonized at a temperature of 277 ° C for 30 minutes. After that, cooled in a desiccator for 1 hour. Then crushed and sieved with a 100 mesh sieve [5]. Carbon banana peel inserted into the container and then soaked with a solution of activator H3PO4 7% by volume ratio H_3PO_4 / carbon mass 10: 1, before soaking stirring for 30 minutes. Then allowed to stand for 24 hours. After that, the carbon that has been silenced filtered using a Buchner funnel. The precipitate obtained is then ditanur with a temperature of 600 ° C for 30 minutes. Then the carbon that has been heated, washed with hot distilled water several times until neutral pH. Samples were obtained dried in an oven at 110 ° C for 1 hour [5][8].

b. Surface Characterization of Activated Carbon

Activated carbon as much as 0.2 grams of banana peel mixed with 50 mL of methylene blue solution then distirer 300 ppm for 30 minutes. Subsequently the mixture was filtered, and the filtrate was measured absorbance at the wavelength of maximum [8].

c. Surface Modification of Activated Carbon

Carbon that has been activated mixed with chemical agents HNO_3 65%, H_2SO_4 95%, H_2O_2 30% by mass ratio of 5:1 (mass chemicals (mL): mass activated carbon (g), and then shaken at a constant rate (120 oscillations per min) for 24 hours. After it was washed with distilled water repeatedly until it gets pH neutral, then dried in an oven for 24 hours at a temperature of 110 ° C [8].

d. Characterization of Activated Carbon by Method Boehm

Activated carbon as much as 0.5 grams of banana peel put in a 50 mL volumetric flask 4, each of which contains 0.05 N Na_2CO_3, $NaHCO_3$ 0.05, 0.05 and 0.05 N NaOHHCl then the mixture dishaker 24 hour. Afterwards the solution is separated from the carbon decantation. The solution that has been separated, respectively taken as many as 10 mL is Na_2CO_3, $NaHCO_3$, NaOH, then added a solution of HCl and then ditirasi indicators PP using 0.05 N NaOH solution which has been standardized to a solution of oxalic acid and HCl taken as 10 mL and added a solution of NaOH and indicators MM, then titrated using standardized HCl using Na_2B4O_7[4].

e. Capacitance Measurement Specification

Carbon modified by HNO_3, H_2SO_4 and H_2O_2 respectively mixed with paraffin wax with a mass ratio of carbon / mass of paraffin wax is 1: 2 and stirred until homogeneous using a spatula on a petri dish. Body connecting wire electrode is made with copper and platinum soldering using steam, a wire is inserted into the pipette and glued using parafilm. Thereafter, a carbon paste electrodes inserted into the body with pressed using a spatula in order to solidify and equitable [11][12].

Carbon paste electrodes measured specific capacitance of energy storage by using cyclic voltammetry technique. These measurements use the tool Potentiostats EA161 with three electrodes, Pt electrode, an electrode Ag / AgCl and carbon paste electrodes. Tests carried out at a rate of scan electrodes 250 mV / s using 0.1 M H_2SO_4 solution thus obtained voltammograms voltage and current, then the calculated value of specific capacitance of energy storage [3].

RESULTS AND DISCUSSION

a. Surface Characterization of Activated Carbon

Adsorption of methylene blue is one method used to determine the surface area based on the absorption of methylene blue. The amount of methylene blue adsorbed is proportional to the surface area.

Furthermore, it can calculate the surface area of the carbon by the following equation.

$$S = \frac{Xm \,.\, N \,.\, a}{Mr}$$

The surface area of activated carbon before and after activation can be seen in Table 1.

b. Surface Modification of Activated Carbon

Surface modification of activated carbon in this study conducted using HNO_3, H_2SO_4 and H_2O_2. The presence of oxygen groups such as carbonyl, carboxyl, hiroksil and quinones of the modified surface with HNO_3, H_2SO_4 and H_2O_2 characterized using FT-IR.

Table 1. Surface Carbon

Samples	Surface Area (m^2/g)
Carbon non Activation	64,75
Carbon Activation	148,01

Table 2. Surface Functional Groups Activated Carbon by titration Boehm

Samples	GugusAsam (meq/g)				Gugus Basa (meq/g)
	Karboksil	Lakton	Fenol	Total	
Karbon aktif non treatment	0,282	0,000	0,111	0,393	1,793
Karbon aktif hasil modifikasi HNO_3	1,23	0,074	0,0595	1,3635	4,6435
Karbon aktif hasil modifikasi H_2SO_4	0,605	0,00	0,00	0,605	3,77
Karbon aktif hasil modifikasi H_2O_2	0,707	0,00	0,159	0,866	1,82

In Table 2 illustrates that the active carbon HNO_3 modification results show increased concentrations of acid and basic groups. Activated carbon modified H_2SO_4 showed an increased concentration of the acid carboxyl and an increase in basic groups. Activated carbon modified H_2O_2 showed increased concentrations of the carboxyl acids and phenols and improvement of basic groups.

c. Capacitance Measurement Specification

Cyclic voltammetry testing aims to determine the value of specific capacitance of activated carbon modified. In the manufacture of copper wire electrode body measuring 6 cm connected with a 4 cm platinum wire soldering using steam. Grafting with vapor soldering solder because it has a stable temperature and does not damage the wire. The connection wire is inserted into the pipette measures 7 cm, then glued with parafilm. Making carbon paste, paraffin wax mixed with activated carbon at a ratio of 1: 2. Mixing is done above the hotplate, after mixing occurs evenly, carbon paste electrodes inserted into the body and glued together using a spatula. capacitors which have been so measured capacitance using a potentiostat with techniques Cyclic voltammetry (CV). CV testing is done by using a potentiostat. The data obtained from testing CV is the current curve (A) -potensial (V). CV test results on activated carbon modified by HNO3, H2SO4 and H2O2 can be seen in image2.

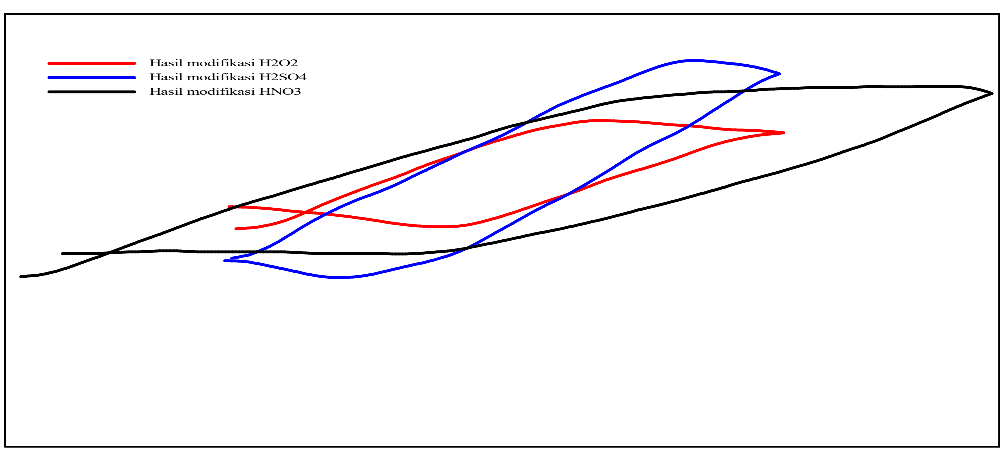

Figure 2. Modified Activated Carbon Voltammogram HNO_3, H_2SO_4 and H_2O_2

Based on the above it can be seen that the voltammogram activated carbon modified lasted HNO_3 stable since the magnitude of the current density remained almost concomitant increase in the potential difference and at the time of discharge, the charge that came out was almost stable, compared with activated carbon modified H_2SO_4 and H_2O_2. Specific capacitance value of carbon paste electrodes modified HNO_3, H_2SO_4 and H_2O_2 can be seen in Table 2. From the data in Table 2, it is known that the electrochemical capacitor capacitance of activated carbon modified by HNO_3 1133.71 nF / g, the activated carbon modified H_2SO_4 amounting to 1009.72 nF / g, and activated carbon modified by H_2O_2 412.67 nF / g. HNO_3 modified activated carbon has a better ability into electrochemical capacitors compared with activated carbon modified H_2SO_4, H_2O_2.

Table 2. Data Cyclic voltammetry of carbon paste electrodes

Elektroda Pasta Karbon	Ic	Id	V (v/s)	m (g)	Cs (nF/g)
Karbon non modifikasi	-	-	0,25	0,07	-
Hasilmodifikasi HNO_3	9,93	-9,91	0,25	0,07	1133,71
Hasilmodifikasi H_2SO_4	9,50	-8,17	0,25	0,07	1009,72
Hasilmodifikasi H_2O_2	9,24	3,05	0,25	0,06	412, 67

CONCLUSION

The conclusion of the research that has been done is the surface area of activated carbon kepok banana skin before and after activation with H_3PO_4 consecutive activator is 64.75 m2 / g, and 148.01 m2 / g. Based on the image of the spectrum that the functional groups on activated carbon kepok banana skin before and after surface modification provides absorption spectrum changes in the form of increased absorption intensity. Values specific capacitance of activated carbon kepok banana skin before and after modification with HNO_3, H_2SO_4 and H_2O_2 in a row is not measurable, 1133.71 nF / g, 1009.72 nF / g and 412,67nF / g.

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