The effect of Addition of Active Carbon Made from Palm Oil Palm Empty Fruit Bunch and Iron Powder on Ceramic Membrane Charactreristic

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The Effect of Addition of Activated Carbon Made from Oil Palm Empty Fruit Bunch and Iron Powder on Ceramic Membrane Characteristics

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Abstract – The purpose of this study is to determine the effect of the addition of an activated carbon made from oil palm empty fruit bunch as an additive on the characteristics of ceramic membranes. The sintering temperature effects to visible pores and surface texture of the membrane. More addition of the activated carbon OPEFB content, the pore will be more numerous, asymmetric and random. Decreasing of activated carbon content in the ceramic membrane will decrease average pore diameter and porosity of the ceramic membrane, but the surface area of the ceramic membrane will be increased. The ceramic membranes produced in this study is characterized by microfiltration membranes type

1. INTRODUCTION

Sustainable development is an effort and approach in the utilization of natural resources. Polluted water or wastewater resulted by human activity or industry should be treated before entering the environment. One of some technologies to treat polluted water or wastewater is the application of ceramic membrane [1]. Porous ceramic membranes with their various advantages, such as better thermal, chemical and mechanical resistance, controllable microstructure and little pollution to our environment [2]. With the increase in activated carbon concentration in the membrane composition, the membranes exhibited excellent characteristics [3]. Activated carbon can be made from oil palm empty fruit bunch (OPEFB).

2. METHOD

2.1 Chemical

Chemical substances used in this works were oil palm empty fruit bunch (OPEFB), clay and iron powder (IP), aquabidest, aquadest, $ZnCl_2$, HCl,

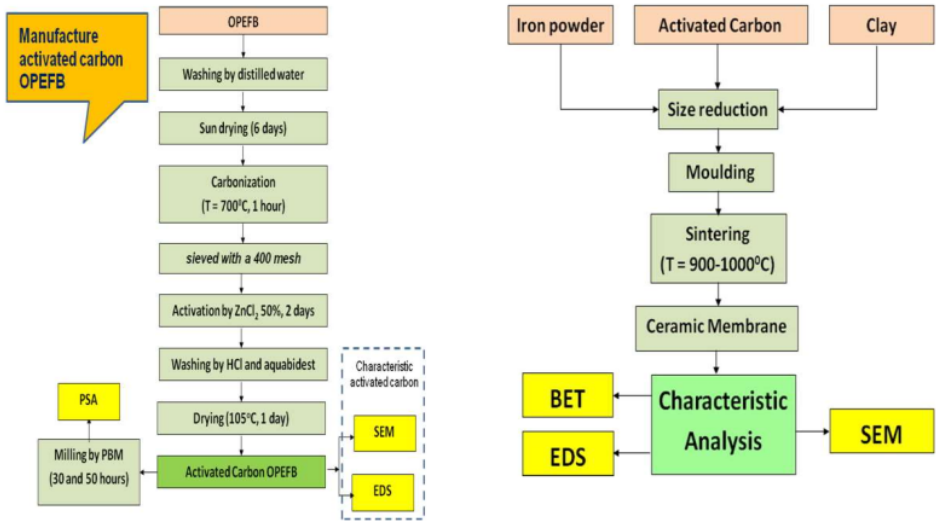
2.2 Procedures

Preparation of Activated Carbon from OPEFB: OPEFB were washed with distilled water and then dried using sunlight for six days. Carbonization of OPEFB was carried out in a furnace at a temperature of 700 °C for 1 hour. Then, samples sieved with a 400 mesh sieve to obtain uniformity of shape and size. The activation process was done by immersing samples of carbonization in a solution of $ZnCl_2$ 50% for two days. Then it was washed with HCl and aquabidest then dried in the oven at a temperature of 105 °C for one day. Morphological characterization of the surface of activated carbon OPEFB was determined by the analysis of Scanning Electron Microscopy (SEM) and the characterization of the elements contained in the activated carbon OPEFB was carried out by using an analysis Energy Disperse Spectroscopy (EDS). Activated carbon OPEFB was put in a planetary ball mill to get a finer particle size again for 30 and 50 hours. The particle size was then analyzed using Particle Size Analyzer (PSA).

Manufacture of ceramic membrane: Clay thinly was sliced and dried for two days. Then it was sieved with a 400 mesh sieve size. Iron powder was sieved at 400 mesh sieve. Clay, activated carbon OPEFB and iron powder thoroughly mixed with a ratio of 77.5%: 20%: 2.5% ; 82.5%: 15%: 2.5% ; and 87.5% : 10% : 2.5%. Add a little water to the dough constituents of the membrane to form a paste (gel). Then it was molded with a molding tool of ceramic membrane. Once molded, the dough was removed from the mold membrane, then

dried at room temperature for seven days. After drying, the membrane was burned (sintered) at a temperature of 900^0C for 9 hours. Finally, the ceramic membrane was characterized by SEM, EDS and BET.

Figure 1 showed the schema of manufacturing of (a) activated carbon from OPEFB, and (b) ceramic membrane respectively.



(a) (b)

Figure 1 Schema of manufacturing of (a) activated carbon from OPEFB, and (b) ceramic membrane

3. RESULTS AND DISCUSSION

Figure 2 shows the characterization of Scanning Electron Microscopy (SEM) activated carbon OPEFB (a), characterization of Energy Dispersive Spectroscopy (EDS) of activated carbon OPEFB (b) and Spot sampling of the levels of carbon in the charcoal OPEFB (c).

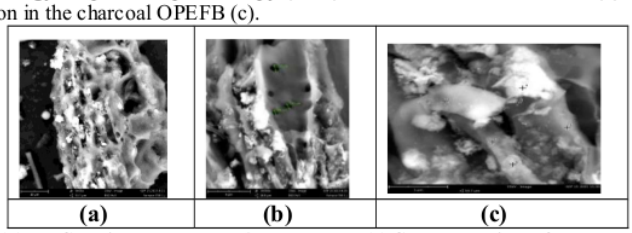


Figure 2 (a) SEM, (b) EDS activated carbon OPEFB and, (c) Spot sampling of the levels of carbon in the charcoal OPEFB

The Figure 2a shows the results of the analysis of SEM (Scanning Electron Microscopy) with 5000x magnification. The morphology of the surface of this activated carbon from OPEFB by using $ZnCl_2$ has a porous surface morphology. This is very important because it is closely related to the nature of adsorption. The Figure 2b indicates that the activated carbon from OPEFB after activated with a solution of $ZnCl_2$ has a diameter size of micropores.The pore distribution almost evenly, wherein the pore size is almost the same with each other. The activation process has been done at a temperature of 700 °C, so that the pores on the surface of the activated carbon OPEFB are open. By activating solution of $ZnCl_2$, it can reduce hydrocarbon coating on the surface of activated carbon from OPEFB. The Figure 2c represents the spot sampling of the levels of carbon in the charcoal OPEFB and gives the carbon, silicon, oxygen, calcium and aluminum contents as shown in Table 1 as following:

Table 1 The concentration of active element in activated carbon OPEFB in each spot

Element Number	Element Name	Concentration, % wt							Error
		Spot 1	Spot 2	Spot 3	Spot 4	Spot 5	Spot 6	average	
6	Carbon (C)	52.6	51.5	62.6	50.5	60.0	53.4	55.1	0.8
14	Silicon (Si)	5.5	-	6.2	4.3	2.7	-	3.12	4.5
8	Oxygen (O)	38.0	48.5	26.9	45.2	34.6	46.6	39.97	4.0
20	Calcium (Ca)	4.0	-	-	-	-	-	0.67	4.1
13	Aluminium (Al)	-	-	4.3	-	2.7	-	1.17	4.8

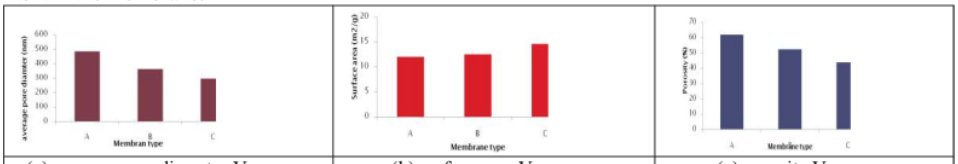
Based on Table 1 above, the results of EDS analysis showed that the main elements of OPEFB charcoal are carbon (C) with the percentage of the average weight of 55.1% wt. The existence of the elements oxygen, aluminum, calcium and silicon can also be observed from the analysis of the composition on the surface of activated carbon OPEFB but that have a very low weight percentage

Table 2 represents the properties of activated carbon OPEFB particles in the process. It appears that the nature of activated carbon OPEFB particles has varying diameters. The longer time ball mill process will produce smaller particle (smooth). This proves that during the process ball mill cavitation phenomenon which has occurred rupture of microparticles into nano because of the influence of friction and collisions between particles.

Table 2 the properties of activated carbon OPEFB particles in the process

Size Reduction Time in Ball mill	30 hours		50 hours	
Property	Median	Average	Median	Average
Circle equivalent diameter	2.21 µm	2.5 µm	234.33 nm	361.33 nm
Major axis	3.04 µm	3.42 µm	345 nm	525.67 nm
Minor axis	2.19 µm	2.2 µm	195 nm	255 nm
Area	5.99 μm^2	6.73 μm^2	500.73 nm^2	810.67 nm^2
Volume by area	11 μm^3	14.7 μm^3	765.47 nm^3	3.19 μm^3

Figure 3 shows the BET analysis of ceramic membrane. The average pore diameter of the membrane A, B and C were 487 nm, 365 nm, and 298 nm respectively. So, the ceramic membranes produced this study was characterized by microfiltration membranes type. Porosity is decreased by the reduction of activated carbon content in the membrane. It appears that there is an increasing membrane surface area with a reduction of activated carbon OPEFB content. Porosity is decreased by the reduction of activated carbon content in the membrane.



(a) average pore diameter Vs composition	(b) surface area Vs composition	(c) porosity Vs composition

Figure 3 BET Analysis of membrane type.

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