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The synthesis of water hyacinth cellulose acetate membrane as a membrane synthesis to filter carbon monoxide (CO) gas from motor vehicle exhaust emissions based on *Eichhornia crassipes* cellulose acetate

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ABSTRACT

The Synthesis of cellulose acetate membrane water hyacinth to filter the motor vehicle exhaust emissions. Research methodology was conducted by making cellulose acetate from water hyacinth, then it would be processed by producing the membranes with acetone and formamide solvents, and the last, the membrane would be synchronized with the motor vehicle exhaust gases. The results of cellulose acetate were characterized using FT-IR. After that, the membrane synthesis products would be tested by emission test process to filter motor vehicle exhaust emissions. As a result, one of the exhaust gases that had been successfully filtered was CO (carbon monoxide) which still widely existed in motor vehicle exhaust gases. The results of FT-IR were proven by the formation of diacetate cellulose as a membrane material in the presence of a typical absorption band, the carbonyl group (C = O) at wave number 1749.2 cm-1. The membrane would be the best cellulose acetate ratio if its membrane had a ratio of cellulose acetate= 16%, formamids= 8%, acetone= 76%, and gas emissions for CO= 0.26%. The microstructure test also showed the comparison obtained by high pore density and thickness. Membrane that had cellulose acetat = 16%, and acetone = 76%, had the potential to filter Co in the air.

Key words: *Cellulose acetate, Membrane, Eichhornia crassipes, Co (Carbon Monoxide).*

Introduction

Water hyacinth (*Eichhornia crassipes*) is an aquatic plant growing in freshwater. Many people classify water hyacinth into aquatic plants as its rapid growth, and it also accelerates the siltation and inhibition of the aeration process. Water hyacinth is considered as aquatic weeds though its role as a buffer in aquatic ecosystems is less popular. Many efforts have been conducted to reduce the water hyacinth population such as by utilizing its fiber in which contains a high percentage of cellulose fiber. It can be used as a basic Ingredient, (Ahmad, 2012).

Membrane is a selective barrier between two phases. Membranes are classified into natural membranes and synthesis membranes. Natural membranes are such as pulp and cotton), while synthetic membranes are such as membrane which are made

Table 1. Water hyacinth content (Ahmad, 2012)

Content	Percentage
Cellulose	60%
Lignin	17%
Hemicellulose	8%

from chemicals such as polymers.

Membrane is used to separate materials based on their size and shape of the molecules. It also used to hold component from bait which has bigger size to pass through smaller components membrane. One example of a membrane that is widely used by society today is air masks for road users.

Air pollution from motor vehicle exhaust emissions is a major cause of air pollution. At present Jakarta as the capital of Indonesia is the 3rd Most Polluted City in the World Version of Air Visual, (detik.com, 2019).

One of the gases produced by motorcycle emissions is CO (carbon monoxide). Carbon monoxide (CO) from the exhaust will exist in the air. In addition, if it is inhaled by humans, it will enter the respiratory tract. The higher the concentration of CO that is inhaled by humans, the more fatal the risk that is received by humans, it also can cause death. From this research background, this research focused to examine the synthesis of water hyacinth cellulose acetate membrane as a membrane synthesis to filter Carbon Monoxide (CO) gas from motor vehicle exhaust emissions based on *Eichhornia crassipes* cellulose acetate.

In this work, Fresnel Lens is utilized to enhance heat. The usage of Fresnel Lens was to concentrate solar energy, and increasing the energy density. Fresnel lenses are used as solar concentrator due to its high optical efficiency with minimal weight and low cost production. The effect of Fresnel lenses is further enhanced by copper material laid on the reactor basin. Copper-based material has excellent conductivity to transfer heat generated by concentrated solar energy to seawater inside the reactor.

Materials and Methods

Materials

Dry fiber of water hyacinth collected from Lamongan River contained Natrium acetate (CH_3COONa), acetic acid (CH_3COOH) Aquades, $Ca(OH)_2$, NaOH, Glacial Acetic Acid (CH_3COOH), acetic anhydride (CH_3CO) 2O, sulfuric acid (CH_3COOH) H_2SO_4), acetone = 99.8%, and $(CH_3CO)_2O$ (acetic anhydride)= 98.5%.

Methods

Cellulose acetate membrane from water hyacinth is created by combining the cellulose acetate and acetone solvent with formamide addictive material. As showed in the following Table 2.

Table 2. Variation material for making cellulose acetate membranes.

Sampel	CA(% b/b)	Formamida (%b/b)	Aseton (%b/b)
A	8	8	84
B	10	8	82
C	12	8	80
D	14	8	78
E	16	8	76

Scheme of research implementation can be seen in Figure 1.

Results and Discussion

Calculation of Cellulose acetate levels

Cellulose acetate membrane is created by dissolving cellulose acetate with acetone and formamide. This process created a brittle cellulose acetate membrane because of the low percentage of cellulose content. It is related to this following equation:

$$Cellulose\ Level\,(\%) = \frac{Cellulose\ mass\,(gram)}{pulp\ mass\,(gram)} x100\% \quad .. (1)$$

Results of FTIR Test

FTIR test results showed a comparison between cellulose and cellulose acetate of water hyacinth. It can be concluded that cellulose acetate is synthesized into cellulose diacetate. The spectrum of cellulose diacetate appears with a wavelength of 1950-1600 cm^{-1} which is a functional cluster C = Oester. Whereas in cellulose there is no band on the wave number, as shown in Table 4.

Emission Test

Vehicle exhaust emissions test showed the Carbon Monoxide (CO) levels before and after being given cellulose acetate membrane can be seen in Table 5.

From Table 5. The percentage of CO emissions

absorbed from several samples is shown in Figure 2.

Based on the result shown in Figure 2, it can be concluded that the sample membrane can filter Carbon Monoxide (CO). It can be seen from the results of the emissions before using a filter versus and after using a filter. The results of the emission test are filtered using sample E because the pores obtained from sample E are smaller than the other sample.

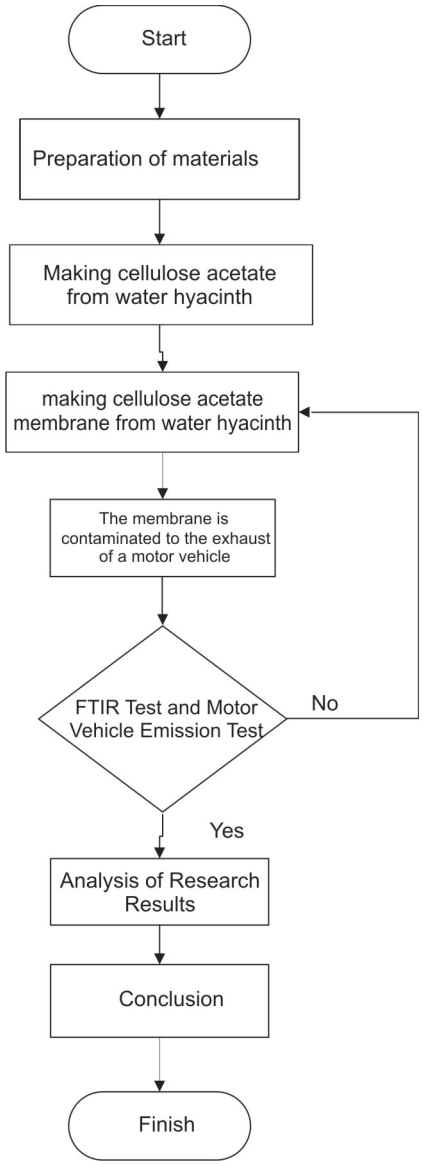

Fig. 1. Scheme of research implementation

Table 4. Result of FTIR Test

Functional cluster	Cellulose	Cellulose diacetate from water hyacinth as a result of synthesis V (cm^{-1})
O=H ulur	3444.24	3479.92
C-H ulur	2903.31	2960.2
C=O	-	1749.12
C-H tekuk	1374.03	1375
C-Oasetil	1254.97	1238.08
C-O ulur	1061.62	1046.19

Table 5. Result of Emisiion test

Sample	Before	After	% Absorbed CO emissions
A	4.04	3.39	0.16
B	4.04	3.31	0.18
C	4.04	3.28	0.19
D	4.04	3.22	0.20
E	4.04	3.01	0.25
Filter mask	4.04	3.38	0.16

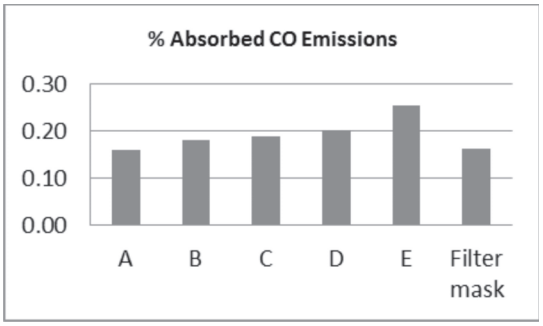

Fig 2. Percentage Absorbed CO Emissions

Table 3. The result of cellulose content

No	Water hyacinth mass	Obtained pulp mass	The mass of cellulose produced	Cellulose Level	Average
1	20.015	3.127	1.506	48%	48%
2	20.023	3.424	1.627	47%	
3	20.012	3.116	1.487	47%	
4	20.009	3.074	1.407	45%	
5	20.023	3.327	2.697	51%	
6	20.027	3.341	1.782	53%	
7	20.012	3.242	1.524	47%	

Conclusion

This study show that Cellulose acetate membrane synthesis of water hyacinth can reduce the carbon monoxide (CO) gas in the motor vehicle exhaust. The emission test showed the percentage of CO emissions absorbed = 0.16%, cellulose acetate composition= 16%, and acetone= 76%.

Acknowledgement

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