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Kinetical Study of Adsorption Active and Non Activated Carbon from Chocoa Skin in Methyl Violet Solution

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***Abstract* - Methyl violet solution has particular color and mostly used to coloring in textiles industry and traditional cloth making. The liquid wastes containing this color can be reduces or removed by several methods, one of which is by adsorption using carbon as an adsorbent. The chocoa plant is abundant in Indonesia while its fruit consists of 60.67% lignin, 36.47% selulosa and 18.90% hemiselulosa [1]. Hartono et al. [2 &3] reported cassava's skins contain protein, cellulose and crude fiber can be used as basic material (similarly with chocoa skin) of producing active carbon. This research is to develop more on reducing methyl violet (as particular color) containing in liquid waste by adsorbent from chocoa skin with variation of reaction time between active carbon and non-activated carbon for constant particle sizes of 48 Mesh (-425/+250 μm), and also to study the kinetical reaction of chocoa skin active carbon and non-activated carbon for adsorbing methyl violet in term of Freundlich and Langmuir isotherm equations. The result shows the kinetical adsorption of both active and non-activated carbon from chocoa skin as adsorbent follows Langmuir isotherm equation with adsorption capacity of 579.91 mg/g and 338.94 mg/g respectively.**

Keywords: Chocoa Skin Wastes, Carbon, Adsorption, Kinetical Study.

I. Introduction

Chocolate industry generally produces by-product in the form of chocoa skin solid waste containing 70% from their fruit. These solid wastes is mostly disposed, in fact it can be converted into carbon and hence has more added values. Carbon or graphite is widely used as adsorbent for removal organic acid and anorganic matter [4, 5, 6 & 7].

Most of textiles industry also produces liquid waste containing organic and anorganic pollutant. Therefore this pollutant in liquid waste must be treated before dispose it to environment. One of several dyes color pollutant in the liquid waste is deep violet color. To reduce or remove this color, adsorption method using adsorbent can be applied.

Based on previous experimental result [2 & 5], active carbon derived from solid waste (by-product) is able to decrease organic and anorganic matters in liquid waste. Similarly, carbon derived from chocoa skin is highly possible to be applied as an adsorbent.

In this work, we report an investigation of adsorbent (non activated carbon and active carbon from chocoa skin) for removal violet color in industrial liquid waste and to find its maximum adsorption capacity through Freundlich or Langmuir isotherm equations.

II. Research Methodology

A. Producing charcoal from solid waste of chocoa skin and activating it into active carbon.

Chocoa skin was oxydised by burning without excess of oxygen and activated using KOH of 0.5N solution for 24 hours. The product was filtered out and neutralized by washing it with distilled water until neutral pH, dried in an oven for 100 ^{o}C, grinded and sieved to obtain particle size of 48 Mesh.

B. Preparing liquid waste containing methyl violet

1 litre of methyl violet solution with concentration of 2N was made and diluted to be 0.5N in concentration as simulated liquid waste.

C. Adsorption tests

1g gram of non-activated carbon with particle size of 48 Mesh was placed into each six 250 ml erlenmeyer flasks. 50 ml simulated sample (concentration of 30

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ppm) was added into each flasks and shaked it for 5, 10, 15, 45, 75, and 105 minutes. Each solution was then filtered out from the solid using filter paper and each filtrate is determined its absorptivity using Uv-Vis Spectrophotometer and finally its final concentration was calculated. The similar procedure is repeated but using active carbon as an adsorbent with particle size of 48 Mesh.

Kinetical reaction model of adsorption [7] given by the following equations:

Langmuir isotherm:

$$Q = \frac{b\,.K\,.Ce}{1+K\,.Ce} \quad (1)$$

Freundlich isotherm:

$$Q = K \times Ce^{1/n} \quad (2)$$

III. Results and Discussion

A. *Reaction time optimation for both non-activated and activated carbon an as adsorbent in simulated liquid waste (methyl violet solution)*

Table.1 Calculation data of adsorptivity for non-activated and activated carbon

t (min)	Methyl Violet Concentration (ppm)			
	Active Carbon		**Non Activated Carbon**	
	Final	Adsorbed	Final	Adsorbed
0	30.0	0.0	30.0	0.0
1	0.146	29.854	9.131	20.869
3	0.176	29.824	8.342	21.658
5	0.288	29.712	6.745	23.255
10	0.193	29.807	6.870	23.130
15	0.164	29.836	6.063	23.937
45	0.336	29.664	6.941	23.059
75	0.300	29.700	5.369	24.631
105	0.431	29.569	5.505	24.495

Table 1 and Fig.1 show adsorptivity between active and non activated carbon (adsorbent) in simulated liquid waste containing methyl violet solution with reaction time. Active carbon determines higher adsorptivity compared to non-activated carbon. This indicates of active cabon porousity is getting bigger after being activated. The optimum reaction time occurs at about 5 minutes for both active and non activated carbon.

B. *Adsorption Capacity Determination*

Table 2 shows the equilibrium adsorption of active and non activated carbon from chocoa skin at different final concentration of methyl violet solution.

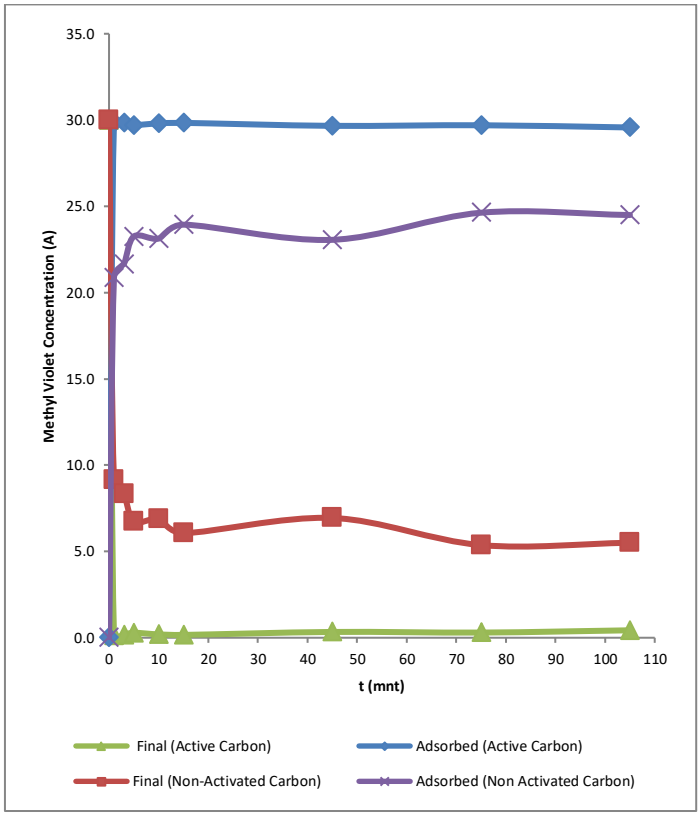

Figure 1. Adsorptivity between active and non activated carbon in methyl violet solution with time

Table 2 Equilibrium adsorption of adsorbent at different final concentration (initial concentration is 30 ppm)

Final Conc., Ce (ppm)		Equil adsorption, Qe (mg/g)		Ce/Qe		log Ce		log Qe	
Active C	Non Activ. C	Active C	Non Activ. C	Active C	Non Activ. C	Active C	Non Activ. C	Active C	Non Activ. C
0.146	9.131	588.0	411.0	2.48E-04	2.22E-02	-0.8357	0.9605	2.769	2.614
0.176	8.342	587.4	426.6	2.99E-04	1.96E-02	-0.7553	0.9213	2.769	2.630
0.288	6.745	585.2	458.0	4.93E-04	1.47E-02	-0.5400	0.8290	2.767	2.661
0.193	6.870	587.0	455.5	3.30E-04	1.51E-02	-0.7134	0.8370	2.769	2.659
0.164	6.063	587.6	471.4	2.79E-04	1.29E-02	-0.7857	0.7827	2.769	2.673
0.336	6.941	584.2	454.1	5.75E-04	1.53E-02	-0.4738	0.8414	2.767	2.657
0.300	5.369	584.9	485.1	5.13E-04	1.11E-02	-0.5224	0.7299	2.767	2.686
0.431	5.505	582.4	482.4	7.40E-04	1.14E-02	-0.3657	0.7408	2.765	2.683

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At different liquid waste concentration, the equilibrium adsorption is shown in Table 2. Both Freundich and Langmuir isotherm equation (1 & 2) can be mathematically converted into equation (3 & 4) as following:

Langmuir isotherm:

$$\frac{Ce}{Q} = \frac{1}{K\,.\,b} + \frac{1}{b}Ce \qquad (3)$$

Freundlich isotherm:

$$Log\ Q = Log\ K + \frac{1}{n} Log\ Ce \qquad (4)$$

Plotting equation (3) and equation (4) will determine the fit between Freundlich and Langmuir isotherm and hence its maximum adsorption capacity can be calculated.

- *Analysis of adsorption capacity of adsorbent (active carbon)*

Applying equation (3) will result a linear line (Fig. 2) and this indicates that Langmuir equation fit to the adsorption isotherm for active carbon from cassava skin. From this equation, the calculated adsorption capacity of active carbon in methyl violet solution is 579.91 mg/g.

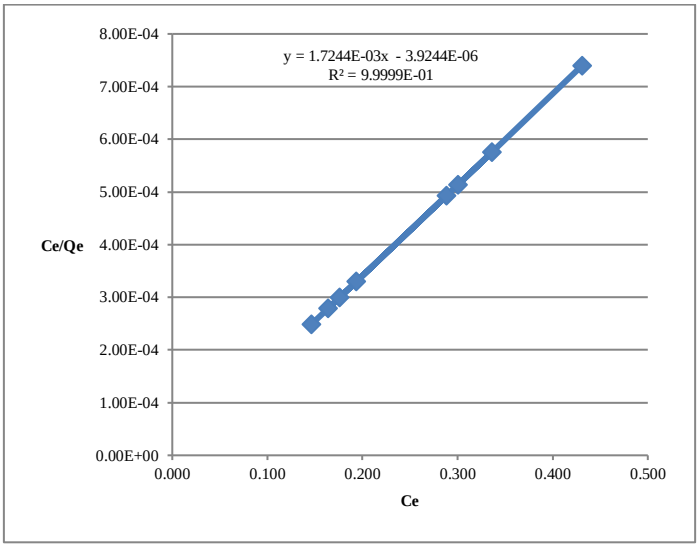

Figure 2. Adsorption capacity of active carbon with Langmuir isotherm

- *Analysis of adsorption capacity of adsorbent (non-activated carbon).*

Similarly, Applying equation (3) will result a linear line (Fig. 3) and this indicates that Langmuir equation fit to the adsorption isotherm for no-activated carbon from cassava skin. From this equation, the calculated adsorption capacity of non-activated carbon in methyl violet solution is 338.94 mg/g.

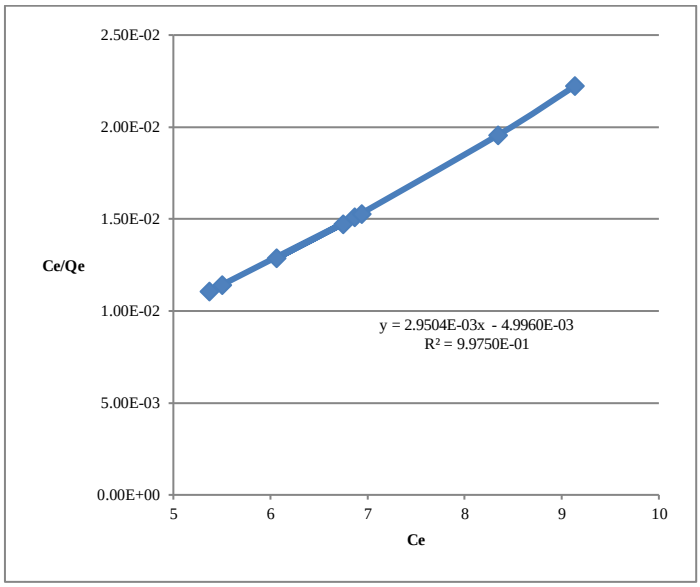

Figure 3. Adsorption capacity of non-activated carbon with Langmuir isotherm

On the other hand, plotting equation (4) for both active and non-activated carbon does not show linear line (Fig. 4 & 5). This indicates adsorption freundlich equation does not fit with this equation.

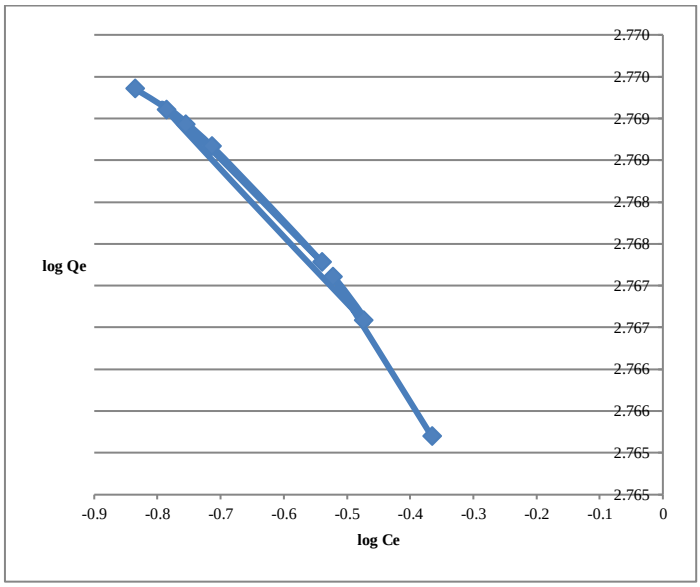

Figure 4. Adsorption capacity of active carbon with freundlich isotherm

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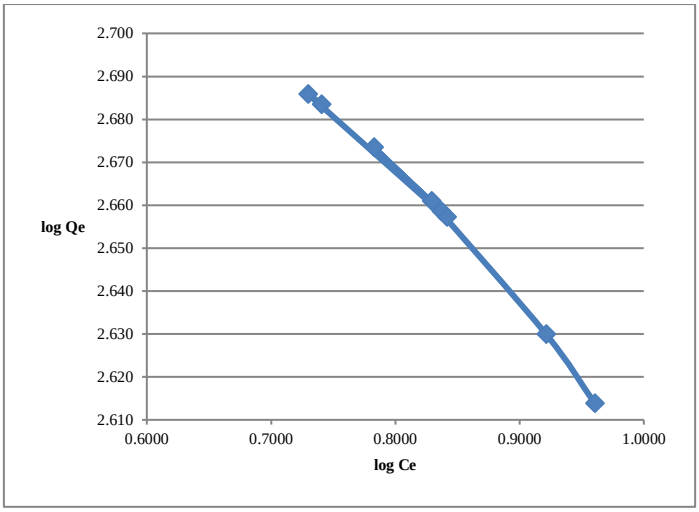

Figure 5. Adsorption capacity of non-activated carbon with freundlich isotherm

IV. Conclusion

Both adsorbent (active and non-activated carbon from chocoa skin) can be used to decrease the amount of methyl violet contained in liquid waste with time reaction of only 5 minutes and they follow to Langmuir equation. The adsorption capacity of active carbon and non-activated carbon from chocoa skin is 579.91 mg/g and 338.94 mg/g respectively.

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