Characterization of Peanuts Shell as Adsorben Color Methyl Violet

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Abstract. The waste product from the textile industry is liquid waste containing dye. Metil violet is one type of dye that can damage the water ecosystem. The decrease levels of methyl violet can be done through the adsorption method. The peanut shell contains cellulose that allows the peanut shell to be adsorbent to adsorb the dye. This study aimed to determine the adsorbent and adsorption capacity using the freundlich and langmuir adsorption isotherm by the time parameter of carbonization and activator influence. The adsorbents are prepared by carbonization process, uniform sizing and followed by chemical activation using H3PO4 1M and NaOH 1M solvents. The next step was to contact the adsorbent with 100 ppm methyl violet solvent for 60 min with stirring process. The results showed that the suitable activator type was activator NaOH 1M with surface area 117,149 m^2/g and fulfill the isotherm of adsorption langmuir equation with ability to adsorb methyl violet dye equal to 8,961 mg/g adsorbent.

Keywords: Peanuts shell · adsorbent · methyl violet · langmuir · freundlich

1 Introduction

One of the dyes that are harmful to the environment is methyl violet, to minimize methyl violet content in liquid waste can be used absorbent media. Inside the adsorbent there is a pore system and active sides affecting the adsorption process. Activation of activated carbon can expand the surface and the active site, so it is expected that the amount of methyl violet absorbed also increased. Peanut shells have not been utilized maximally. Peanut shells contain cellulose that allows the peanut shells were used as an adsorbent to adsorb dyes.

The problem in the research of adsorption of methyl violet dye with the peanut shell adsorbent is how do the characteristics of the adsorbent such as pore area and how big the capability of peanut shell can adsorb the methyl violet dye.

The aim of this research was to determine the characteristic of adsorbent and adsorption capacity by using freundlich and langmuir adsorption isotherm with parameters of carbonization time and activator effect.

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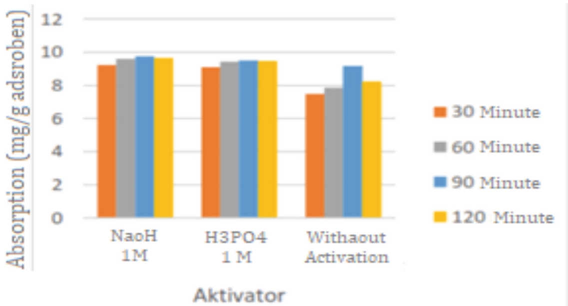

Fig. 1. The Effect of Type Activators to Adsorption

2 Methode

The peanut shell was washed with water to remove the dirt, soil, or dust that was still attached to the surface of peanut shells, and dried under the sun and then carbonized using a furnace with a temperature of 450 °C with time of 30, 60, 90, and 120 min, and in a blender up to 80 mesh size and then stored in sealed containers that are water-resistant and airtight.

The activation process was carried out chemically by immersing the carbon in H3PO4 1M solvent and 100 ml of NaOH at 100 ml for 2 h in room temperature then filtered and rinsed with distilled water for neutralization. The neutral carbon is dried by oven at 120 °C for an hour to obtain a constant mass and stored in a sealed, airtight sealed container.

The adsorption study was carried out by inserting 1 gram of peanut shell adsorbent into 100 ml of methyl violet waste sample with 100 ppm concentration, then turning the stirring motor at a scale of 5 for 60 min and filtering the solvent then measuring the methyl violet concentration after adsorption with the uv- vis (Susanti 2009).

3 Result and Discussion

Activation can increase the adsorption capacity and the type of activator affect the adsorption capacity, as shown in Fig. 1.

Activated adsorbent adsorption with NaOH 1M tends to be greater than the activated adsorbent with H3PO4 1M and the adsorbent without activation on nearly every variation of carbonization time, with the largest adsorption capacity of 9.752 mg/g adsorbent (ie as much as 9.752 mg of adsorbate adsorbed in 1.0 g of adsorbent). Better activators used for lignocellulosic materials such as peanut shells, rice husk and palm sugar before carbonization process, are acidic activators, such as H_3PO_4 compared to basic activators, such as NaOH. This is because the lignocellulosic material has a high oxygen content and the acidic activator reacts with the oxygen- containing functional group, whereas for the activator NaOH is more able to react with carbon so that the raw material with high carbon content is better to use the activator NaOH (Esterlita, Marina Olivia and Herlina, Netti, 2015). In this experiment the activation is charcoal from a peanut shell

Table 1. Brunauer-Emmet-Teller (BET) Analysis

No	Sample	Surface Area (m^2/g)
1	Activator NaOH 1M (90')	117,149
2	Activator H_3PO_4 1M (90')	83,945
3	Without activation (90')	35,966

that contains much carbon then the more suitable activator is NaOH 1M, if you want to use activator H_3PO_4 should be activated before carbonization process.

Brunauer-Emmet-Teller (BET) characterization was performed to determine the specific surface area, total pore volume and average of pore radius. For BET test result on three samples can be seen in Table 1.

The best results for surface area were obtained on adsorbent activated with NaOH 1M of 117.149 m^2/g, while for adsorbent activated with H_3PO_4 1M was 83,945 m^2/g and adsorbent without activation 35,966 m^2/g. From the data it can be said that the activation can expand the pore, the activated surface area of activated carbon is much lower than the result of activated activated carbon using NaOH 1M and H_3PO_4 1M. This is because NaOH and H_3PO_4 have elemental minerals from the added chemical compounds will seep into the charcoal and open the surface which is first closed by the chemical components so that the active surface area grows larger (Mohd din, Azam T and H. Hameed, Bassim 2010). The larger the surface of the adsorbent, the greater the adsorption power and the greater the efficiency of the adsorption.

The adsorption process has a specific specific adsorption isotherm pattern, therefore any adsorbent absorbing one substance with another will not have the same adsorption isotherm pattern. Testing of suitable adsorption isotherm pattern for the absorption process of methyl violet dye by adsorbent from peanut shell is done by calculation using langmuir and freundlich equations. The Langmuir equation test is performed using the equation: $Ce/(x/m) = 1/ab + 1/a\ Ce$. As for freundlich equation test done by using equation test:

$$\text{Log}\,(x/m) = \log k + 1/n \log Ce$$

where:
Ce = methyl violet concentration in solution after adsorption (ppm)
x/m = methyl violet mass absorbed per gram of adsorbent (mg/g)
b = affiness parameter or Langmuir constant a,
k = maximum adsorption capacity (mg/gram)

The values of a and k show the capacity of the adsorption of methyl violet by the adsorbent, the greater the value of a in the equation of the langmuir isotherm and k in the freundlich isotherm equation show the greater adsorption capacity as well. The values

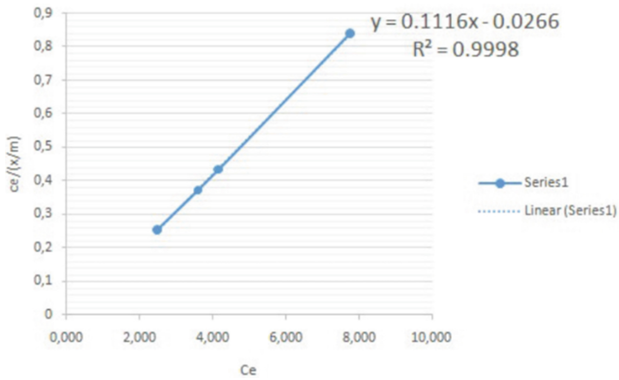

Fig. 2. The isotherm isotherm of Ce/(x/m) vs. Ce with adsorption of 1M NaOH activation

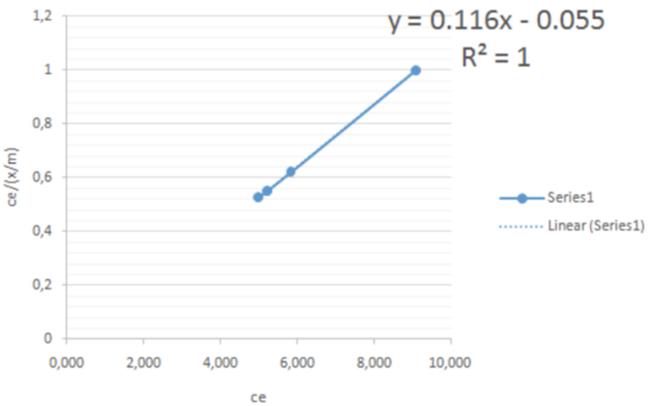

Fig. 3. The isotherm gradient isotherm of Ce/(x/m) versus Ce with H_3PO_4 1M activation adsorbent

of 1/ab and log k are of course greatly influenced by the temperature thus affecting the adsorption rate. To determine the equation of Langmuir and Fruendlich isotherms then calculated x/m, Ce/(x/m), Ce/(x/m) and log Ce. A graph mapping can be done using Excel by plotting the price of Ce/(x/m) versus Ce to obtain the langmuir equation and plotting the log (x/m) versus the Ce log to obtain the freundlich equation. Mapping results with graphs as shown in Fig. 2.

Testing of langmuir adsorption equation and freundlich adsorption equation is evidenced by good linearization graph and having coefficient determination value $R2 \geq 0.90$ (close to 1). From Figs. 2, 3, 4, 5, 6 and 7 it can be seen that the methyl violet dye adsorption equation by the peanut shell adsorbent satisfies the langmuir adsorption equation with $R2 = 0{,}9998$; 1 and 0.9964 and also the freundlich adsorption equation with $R2 = 96980$; 0.9967 and 0.9726. This shows that the langmuir and freundlich equations can be applied to the methyl violet adsorption process by the peanut shell adsorbent. From the freundlich and langmuir isotherms the langmuir can be seen in Table 2.

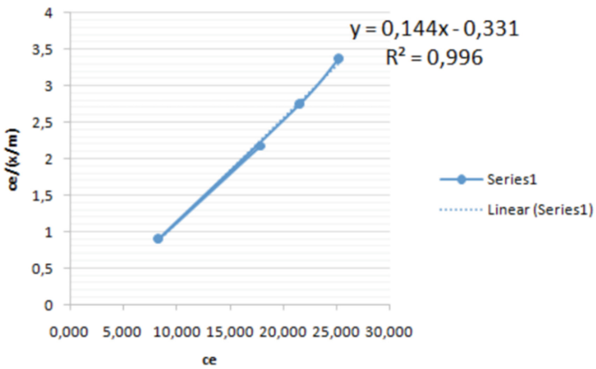

Fig. 4. The isotherm gradient isotherm of Ce/(x/m) versus Ce with adsorbent without activation

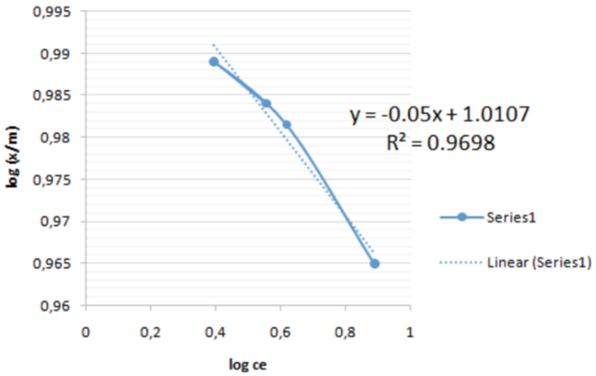

Fig. 5. Freundlich isotherm adsorption equation from log (x/m) versus log Ce with adsorption adsorbant NaOH 1M

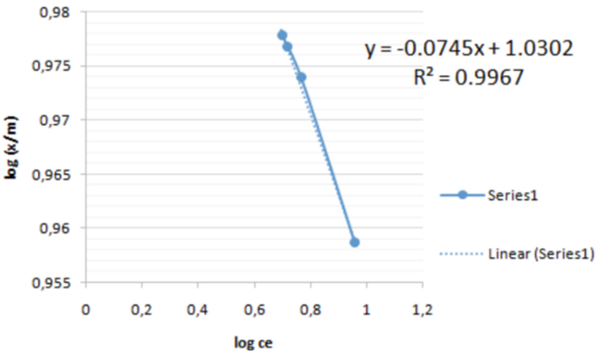

Fig. 6. The freundlich isotherm adsorption equation from log (x/m) versus log Ce with H_3PO_4 1M activation adsorbent

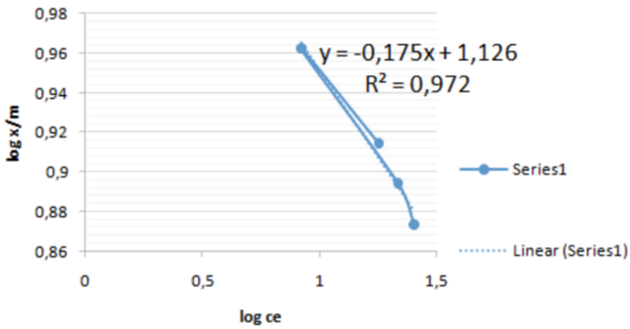

Fig. 7. Freundlich isotherm adsorption equation from log (x/m) versus log Ce with adsorbent without activation

Table 2. Value of Frenlich and Langmuir Constants

Isoterm	Activator	Constant	Value
Langmuir	NaOH	A	8,961
		B	4,195
	H_3PO_4	A	8,621
		b	2,109
	Non aktivasi	a	6,925
		b	0,435
Freundlich	NaOH	k	10,249
		n	20,000
	H_3PO_4	k	10,720
		n	13,423
	Non aktivasi	k	13,366
		n	5,711

From result of calculation by using equation Q = (Vx (Co – Ca))/m obtained maximum adsorption power value equal to 9,752 mg/gram. From Table 7. The maximum adsorption power approaching the calculation result is 8.961 mg/gram on the isotherm of langmuir and the R2 value of the isotherm langmuir is close to 1, so it can be concluded that the Langmuir Isotherm can be used. Adsorption of the methyl violet dye corresponding to the indirect adsorption isotherm pattern indicates that the adsorption is only one layer (monolayer). Parameter a denotes the maximum capacity of the adsorbent monolayer, and the parameter b called the affinity constant shows the adsorbate molecular bonding strength on the surface of the adsorbent.

4 Conclusions and Suggestions

Conclusion

1. Adsorbent peanut shell with carbonization time 90 min with activator of NaOH 1M has ability to adsorb methyl violet dye equal to 9,752 mg/g adsorbent.
2. Adsorbent with best result that is at time of carbonization 90 min with activator NaOH 1M with surface area 117,149 m^2/g.
3. Adsorption process of methyl violet dyestuff by peanut shell adsorbent satisfies isotherm adsorption langmuir equation with ability to adsorb methyl violet dye by 8,961 mg/g adsorbent.

Suggestion

1. Varying the activation method (physical and chemical activation).
2. Adding bacteria or catalyst to optimize the adsorption process.

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