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Utilization of Langsat Peel *(Lansium domesticum)* as Methylene Blue Biosorbent

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Abstract:

Biosorption is a good alternative for removing Methylene blue dyes because it is a fast and reversible method by utilizing natural biosorbents, such as Langsat peel. Using Langsat peel as a biosorbent can add value to Langsat peel and reduce environmental pollution by Methylene blue waste. This research was conducted with a Batch Method to determine the optimum conditions and maximum adsorption capacity of Langsat peel in adsorbing Methylene blue on variations stirring speed and biosorbent mass. The principle of this analysis is based on measuring the absorbance of the dye Methylene blue before biosorption and after biosorption using Spectronic $20D^+$ at a maximum wavelength of 665 nm. The results showed that the optimum conditions for langsat peel biosorbent to adsorb Methylene blue were at a stirring speed of 200 rpm and a biosorbent mass of 0,05 g and the maximum adsorption capacity obtained was 146,683 mg/g.

Keywords **— Biosorption, methylene blue, langsat peel.**

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I. INTRODUCTION

Currently the textile industry in Indonesia has experienced very rapid development. This industry uses a lot of synthetic dyes in the coloring process for reasons of cheap, long-lasting color, easily obtained and used. However, the use of synthetic dyes causes liquid waste that can pollute the environment. About 15-20% of the dyes used will be left in wastewater which will eventually enter the surrounding environment [1].

One of the most commonly used synthetic dyes is Methylene blue. These dyes are often used because the price is economical and easy to obtain [2]. Methylene blue is a major concern in the waste treatment process because the color is difficult to degrade. This compound is toxic, causes genetic mutations, and affects reproduction [3].

According to the Decree of the Minister of Environment and Forestry of the Republic of Indonesia, namely number P.68//MENLHK/Setjen/Kum.1/8/2016 concerning the quality standards of domestic wastewater, the maximum concentration of Methylene Blue allowed in the waters is 5,0-10,0 mg/L [4]. Adverse effects of exposure to the dye Methylene blue on the body will cause cancer, increased heart rate, vomiting, shock, and cyanosis [5].

One method that can be done to reduce pollution from this dye waste is biosorption. The biosorption method is a process of absorption using biological material (biomaterial). Biomaterials that are used as absorbents are also called biosorbents. The material used as biosorbent is expected to be cheap and easily obtained. As an alternative, materials derived from agricultural waste are used because besides having good absorption ability it is also economical. One of the agricultural waste that can be used as biosorbent is langsat peel. In Indonesia, waste langsat peel has not been widely used. Therefore it is necessary to explore another potential in langsat peel waste so that the added value of langsat peel increases. Langsat peel has the potential to be biosorbent because it contains several classes of compounds such as terpenoids, flavonoids, and saponins. The advantages of this biosorption method are low cost, high efficiency, minimal use of chemicals, and easy application [6].

II. MATERIALS AND METHOD

A. Materials

Glassware, shakers (model: VRN-480), pH meter (HI2211), analytical balance (ABS 220-4), filter paper, magnetic stirers (MR Hei Standard), mortar and pestle, spray

bottle, sifter (BS410). The instrument used was FTIR (Fourier Transform Infra Red) type perkin elmer universal ATL Sampling Accessor 735 B and Spectronic 20D$^+$. The materials used in this study were langsat peel, 1000 mg/L Methylene Blue dye solution, aquades, HNO^3 (0,01; 0,1; 0.5) M, and NaOH 0,1 M

B. Procedure

1) Sample Preparation

The langsat peel cleaned of dirt and separated from the flesh of the fruit, then cut into small pieces, and dried at room temperature. Dry langsat peel is mashed with a blender and sieved with a 150 µm sieve. Furthermore, as much as 20 grams of langsat peel is activated with 0,1 M HNO^3 for 2 hours, then washed with distilled water until neutral, then dried again.

2) Standard Curves of Methylene blue Solution

The process of making a standard curve of Methylene blue solution can be done by making a standard solution of Methylene blue with a concentration of 2, 4, 6, 8, 10 and 12 mg/L. Each standard solution of Methylene blue was then measured for its absorbance using spectronic 20D$^+$ at a maximum wavelength of 665 nm. The next step is to make a standard curve of Methylene blue by plotting concentration vs absorbance.

3) Effect of stirring speed

6 samples of 25 mL Methylene blue dye solution were prepared with a concentration of 300 ppm at pH 6. Then each solution was contacted with 0,2 grams of langsat peel using a batch system. Solution was shaken at speeds of 100, 150, 200, 250, 300, and 350 rpm for 30 minutes, then filtered and measured its absorbance by spectronic 20D$^+$.

4) Effect of biosorbent mass

A total of 0,05 g; 0,10 g; 0,15 g; 0,20 g; and 0,25 g of langsat peel is contacted with 25 ml of 300 ppm Methylene blue solution at pH 6. Then each solution was shaken with optimum stirring speed for 150 minutes. Then filtered and measured its absorbance by spectronic 20D$^+$.

III. RESULTS AND DISCUSSION

A. Standard Curves of Methylene blue Solution

The concentration of Methylene blue solution after and before adsorption is determined by a standard curve, which is by making several standard solutions of known concentration. Series of standard solutions 2, 4, 6, 8, 10, and 12 mg/L measured absorbance values as much as two readings at a maximum wavelength of 665 nm.

According to Lambert-Beer Law, the intensity transmitted by the absorbent substance solution is directly proportional to the solution concentration. The standard curves of Methylene blue solution and its absorbance can be seen in Figure 1.

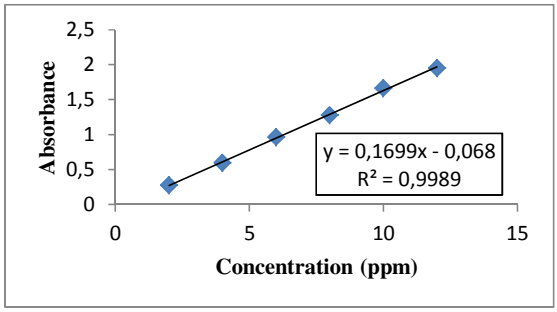

Figure 1. Absorbance relationship curve to the concentration of Methylene blue

The standard calibration curve of Methylene blue shows the absorbance relationship is directly proportional to the concentration. This means that the greater concentration of the standard solution, the greater the absorbance value. The linear regression equation obtained is y = 0,1699x – 0,068 with the coefficient of determination (R^2) = 0,998. This indicates the value of the coefficient of determination obtained is good because it approaches the value of 1. The value of the coefficient of determination indicates the feasibility of using graphs in testing.

B. Effect of stirring speed

Stirring speed is one of the parameters that can affect the biosorption process. This variation is done to determine the optimum stirring speed so that Methylene blue can be optimally absorbed by langsat peel biosorbents. The effect of the stirring speed curve on the absorption capacity can be seen in Figure 2.

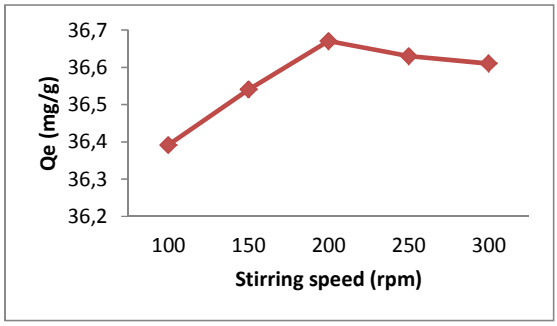

Figure 2. The effect of stirring speed on absorption capacity of Methylene blue using langsat peel

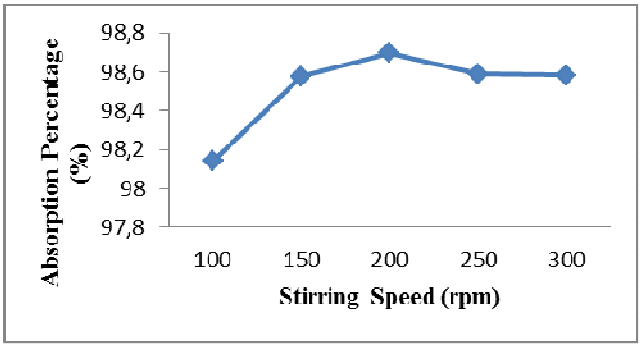

Figure 3. The effect of stirring speed on absorption percentage of Methylene blue using langsat peel

Figure 2 shows that the speed of 200 rpm is the optimum stirring speed with an absorption capacity of 36,670 mg/g. Absorption capacity has increased from 100 rpm to 200 rpm. The faster stirring speed used, the more a compound or ion will be absorbed because of frequent interactions that occur between biosorbents and adsorbates. And if the equilibrium point has been reached, the absorption will experience a constant state [7]. However, when the stirring speed is raised above 200 rpm, the absorption capacity decreases. This is caused by the mixing speed that is too high will damage the structure of biosorbent, so the biosorption process is less than optimal. Besides, Methylene blue which has been bound to biosorbents can be released back into the solution and cause a decrease in absorption capacity.

C. Effect of biosorbent mass

Biosorbent mass is one of the important factors that can influence the biosorption process. To optimize the absorption, it is necessary to determine the optimum mass of the langsat peel used. The more biosorbents used, the more active sites are available. Mass variation used is 0,05; 0,10; 0,15; 0,20; and 0,25. The results obtained can be seen in Figure 4.

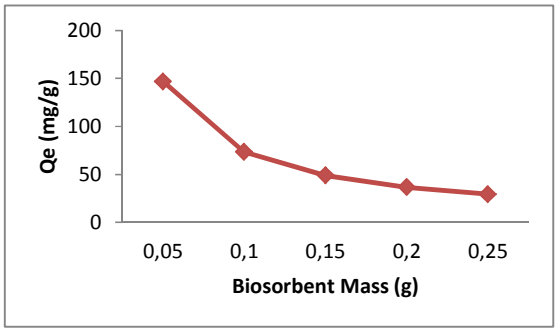

Figure 4. The effect of biosorbent mass on absorption capacity of Methylene blue using langsat peel

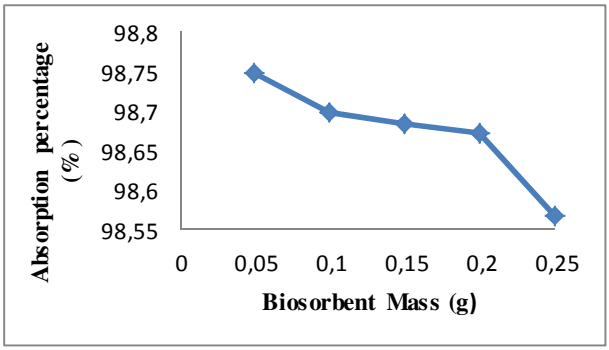

Figure 5. The effect of biosorbent mass on absorption percentage of Methylene blue using langsat peel

In theory, the number of active sites available increases with an increase in biosorbent mass. Increased uptake capacity with an increase in biosorbent mass caused by unsaturation of active sites (active sites not saturated) in the biosorption process. However, if observed from the data obtained there is a difference wherein the increase in biosorbent mass from 0,05 g to 0,25 g decreases the absorption capacity. This is because biosorbent mass that are too high can cause particle fusion or clumping. Such interactions between particles can cause a decrease in the total surface area of the biosorbent and an increase in the length of the diffusion pathway [8].

Absorption capacity is inversely proportional to biosorbent mass. The more biosorbents used, the smaller the absorption capacity if C_o and V are constant, according to the equation:

$$Qe = \frac{(Co - Cf)}{M} x\ V$$

Where Qe is the maximum absorption capacity (mg/g), C_o is the initial concentration of the dye (mg/L), C_f the final concentration of the dye (mg/L), V is the volume of the solution (L) and M is the biosorbent mass (g) [9].

In this study, the optimum biosorbent mass to absorb 300 mg/L Methylene blue solution was 0,05 g with an absorption capacity of 146, 683 mg/g.

IV. CONCLUSIONS

Based on the research that has been done, the following conclusions are obtained:

1) Activated langsat peel can be used as biosorbent to absorb Methylene blue dyes with optimum conditions obtained at a stirring speed of 200 rpm, and biosorbent mass of 0.05 g.
2) The maximum absorption capacity of Methylene blue using langsat peel obtained is 146, 683 mg/g.

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REFERENCES

[1] Chatterjee, D. *Et al*. 2007. *Kinetics of The Decoloration of Reactive Dyes Over Visible Light Irradiated TiO2 Semiconductor Photocatalyst*. Journal of Hazardous Materials. 156 : 435-441.

[2] Hamdaoui, O and Chiha, M. 2006. *Removal of Methylene Blue from Aqueous Solutions by Wheat Bran*. Acta Chim. 54 : 407–418.

[3] Riapanitra, A., Setyaningtyas, T., Riyani, K. 2012. *Penentuan Waktu Kontak dan pH Optimum Penyerap Metilen Biru Menggunakan Abu Sekam Padi*. Purwokerto : MIPA Unsoed.

[4] Menklh RI. 2016. *Keputusan Menteri Lingkungan Hidup dan Kehutanan RI yaitu nomor P.68//MENLHK/Setjen/Kum.1/8/2016 tentang Baku Mutu Air Limbah Domestik.*

[5] Ashtoukhy, El, E.S.Z., Fouad, Y.O. 2015. *Liquid–Liquid Extraction of Methylene Blue Dye from Aqueous Solutions Using Sodium Dodecylbenzenesulfonate as an Extractant.* Alexandria Engineering Journal: 1-5.

[6] Yang, J., Yu, M., and Qiu, T. 2013. *Adsorption Thermodynamics and Kinetics of Cr (VI) on KIP210 Resin*. J. Ind. Eng. Chem. 1-7.

[7] Lestari, S. 2017. *Observasi dan Karakterisasi Morfologi Tanaman Pisang (Musa spp .) Di Kecamatan Ngancar Kabupaten Kediri (Observation And Morphological Characterization Of Banana (Musa spp). 5*(5): 821–827.

[8] Smilja, M., Ana, S., Zorica, L., Slavica, L., Mirjana, S., Dragan, U. 2015. *Application of raw peach shell particles for removal of methylene blue*. J. Environ.Chem. Eng. 615 : 1-9.

[9] Kurniawati, D., Lestari, I., Harmiwati, Sy, S., Chaidir, Z., Zein, R., Aziz, H., and Zainul, R. 2015. *Biosorption of Pb (II) from Aqueous Solutions using Column Method by Lengkeng (Euphoria logan lou) Seed and Shell*. J. Chem. Pharm. 7(12): 872–877.

