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Biosorption of Malachite Green Dye Using Langsat Peel *(Lansium domesticum)* Biosorbent

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Abstract:

Malachite green dye is one of the hazardous dyes produced from various textile industry wastes and needs to be treated. Biosorption using langsat peel can absorb malachite green dye. In this research, using the batch method the optimum results were obtained for pH 3, concentration 300 mg/L, particle size of langsat peel 106 µm, and contact time 60 minutes and the maximum adsorption capacity obtained was 26.0 mg/g at stiring speed 200 rpm. To determine the biosorption mechanism from functional group analysis is carried out using FTIR from the sample before and after being activated using HNO_3. This research show that there are differences in the spectrum langsat peel before and after activation and after contact with MG.

Keywords **—biosorption, langsat peel, malachite green , batch method**

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I. INTRODUCTION

The textile industry is an industry that uses dyes in its production. Dyestuff waste is generated from the remiander of the fabric dyeing process, because not all of the dye can be absorbed by the fabric [12]. Waste liquid from the dye malachite green to give effect the environment, because the nature of the physical and properties of chemical waste can have negative impact on the environment waters.

Malachite green dye waste is dangerous to the environment, if it is disposed of in the waters above the permissible threshold concentration of 0.01 ppm [10]. An alternative method that can be used to tackle pollution from textile dyes is through the biosorption method because it does not require expensive costs, is easy to apply, and safe for the environment biosorbent, because from natural materials [7] .

Research on biosorption has been widely applied in the use of biomaterials such as longan peel [5], coffee peels [1] zalacca peels [13], orange peels, lemon peels, peels [9], which are used as biosorbents. The reason for using fruit peels as biosorbents is that the skin from the fruit contains functional groups that can form ligands with dyes [6].

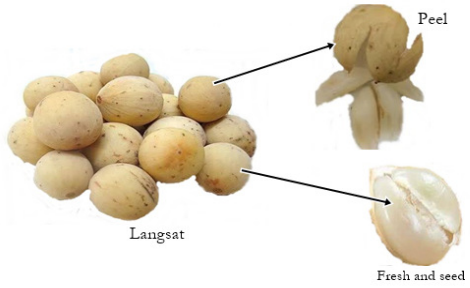

Figure 1. Langsat *(Lansium domesticum)*

Langsat peel contains a lot of triterpenoid compounds, flavonoids, and saponins. The functional groups are: O-H, C=O, N-H, COOH [3]. Triterpenoid

compounds were lancic acid and lansiolic acid. These compounds can interact with the dye in aqueous solution. Therefore, langsat peel is very effective as a biosorbent [14] to absorb dye in an aqueous solution.

II. MATERIAL AND METHODS

A. Materials

The materials used in this study were langsat peel, aquades, malachite green oxalate dye, 65% HNO_3 , NaOH. Equipment that is used on research is composed of equipment for the analysis and characterization, equipment for analysis consisted of glassware, filter paper, mortar pestle, spray bottles, shaker (model: VRN-480), a pH meter, analytical balance (AB S220-4), magnetic stirrer (MR Hei Standart), sieve (BS410). Measurement of solution concentration using Spektronic, and analysis of biosorbent functional groups using FTIR [11].

B. Procedur

1) Sample Preparation

The langsat peel cleaned of dirt, cut, washed with deionized water, and dried for ± 2 month using indirect sunlight. Samples were mashed using a mortar and sieved with particle size 106, 150, 250, and 425 µm. A total of 20 grams of langsat peel were activated with 80 ml of H NO_3 0.01 M for 2 hours. Subsequently washed with distilled water until neutral, dried and dried. The resulting biosorbent is dried until the weight is stable and free from distilled water [5].

2) Standard Curves of Malachite Green

The process of making a standard curve of malachite green solution can be determined by making a standard solution of malachite green with concentrations of 2, 4, 6, 8, 10, and 12 mg / L. Each solution was measured for absorbance at a wavelength of 618 nm. The next step is to make a standard curve by plot concentration vs absorbance [9].

3) Effect of Particle Size

Biosorption of malachite green dyes using activated langsat peel is contacted in erlemeyer containing 25 ml of malachite green 300 ppm solution at pH 3 with a stirring speed of 200 rpm with a contact time of 30 minutes and a biosorbent weight of 0.2 grams with a variety of particle sizes 106, 150 , 250, 425 µm . The filtrate was measured with a spectronic [4].

4) Effect of Contact Time

Langsat peel have been activated contacted the erlemeyer contains 25 ml of solution malachite green with a concentration of 300 ppm with tan stirring speed 200 rpm[8] with a variation of contact time 30, 60, 90, 120, 150, 180 minute and heavy bio- sorbent 0.2 gram with a particle size of 106 µm. The filtrate was measured by spectronic.

III. RESULT AND DISCUSSION

A. Standard Curves of Malachite Green

The concentration of Malachite green solution after and before adsoption is determined by a standard curve, which by making several standard solutions of known concentration.

A standard solution of malachite green with concentrations of 2, 4, 6, 8, 10, and 12 mg / L. Each solution was measured for absorbance at a wavelength of 618 nm. Standard curves were created by correlating absorbance vs concentration graphs. According to Lambert-Beer Law, the intensity transmitted by the adsorbent substance solution is directly proportional to the solution concentration. The standard curves of M alachite green solution and its absorbance can be seen in figure 2.

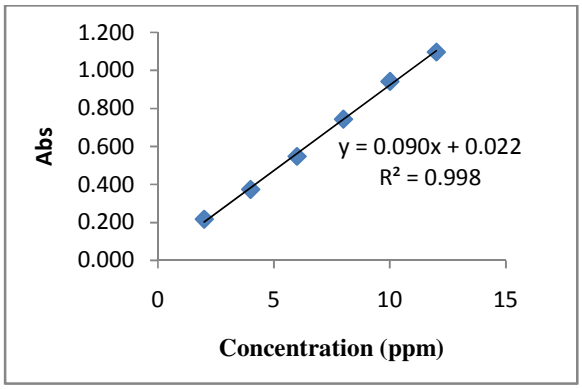

Fig. 2 Absorbance relationship curve to the concentration of Malachite Green

The linear equation obtained is y = 0.090x + 0.022 and the value of R^2 = 0.998 . The standard curve meets the requirements, namely ≥ 0.98.

B. Effect of Particle Size

Particle size is one of the factors that affect the absorption capacity of the biosorption process. The

absorption capacity will increase with the smaller the size of the biosorbent particles [9].

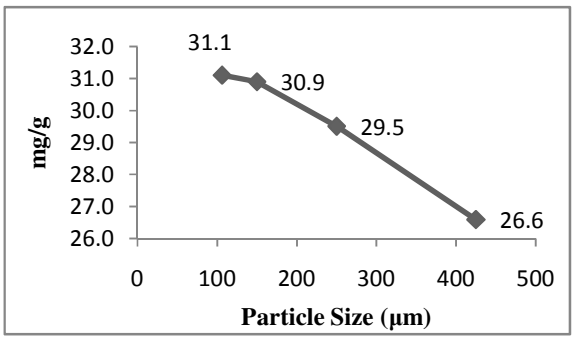

Fig. 3 The effect of Particle size on adsorption capacity of Malachite Green using langsat peel

The smaller the particle size, the greater the surface area of the biosorbent, so that the amount of biosorbate that is absorbed will also be greater. If the size of the biosorbent used is larger it can cause a decrease in the surface area of the biosorbent [16].

From Figure 3 it can be seen that there was a decrease in the size of the biosorbent particles 106 to 425 µm. The optimum absorption was at a particle size of 106 µ m with an absorption capacity of 31.1 mg/g. The small particle size causes a high absorption capacity [17]. The small particle size has a large surface area so that the active side of the biosorbent that interacts with the dye ion increases.

The research work concludes that higher the surface area, the higher the rate of adsorption capacity. The particle size can indicate the quality of the materials and its performance, and a material is very important component in understanding how the performance of biosorbent [15].

C. Effect of Contact Time

Contact time is one of the most effective biosorption parameters to determine the diffusion process that occurs. To determine the optimum contact time in this research, contact time is varied on 30, 60, 90, 120, and 150 minutes with MG solution as adsorbate at pH 3, MG concentration 300 mg/L, volume MG solution 25 mL, and mass of biosorbent 0.2 grams.

The optimum contact time occurs at 60 minutes, under these conditions there is an optimum increase adsorption of MG reaches a point maximum so that increasing contact time has no effect significant decreased against the dye in the sample [18].

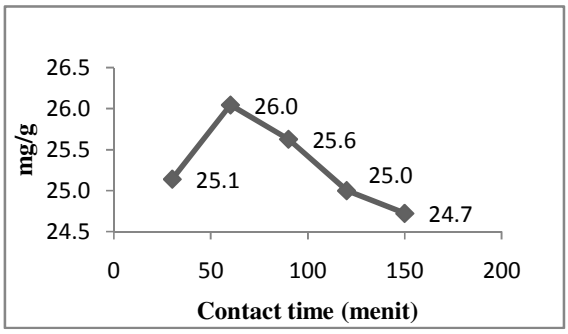

Fig. 4 The effect of Contact Time on adsorption capacity of Malachite Green using langsat peel

Based on Figure 4, it can be seen that the optimum absorption process at a contact time of 60 minutes with an absorption capacity of 26.0 mg/g. After 60 minutes the absorption decreases because the biosorbent has been saturated by the dye ions, so that gradually the active sites that interact with the dye ions begin to release the dye ions back into the solution (desorption process) [17]. The addition of contact time after 60 minutes no longer increases the absorption of dye ions [2].

The result shows that the maximum uptake increase from 30 to 60 minutes, and the contact time of the biosorbent with MG increases. Adsorption of the MG increases until saturation point occured [15].

IV. CONCLUSIONS

The Based on the research conducted, it can be concluded that the langsat peel *(Lansium domesticum)* can be used as a biosorbent to absorb malachite green dye. The optimum conditions for adsorption of Malachite green were at pH 3, a concentration of 300 mg/L, a particle size of 106 µm, and a contact time of 60 minutes. The optimum adsorption capacity of Malachite green was 26.0 mg/g on stiring speed 200 rpm.

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