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The Use of Langsat Skin (*Lansium domesticum*) in the Biosorption of Methyl Orange

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Abstract:

Methyl Orange is one of the dyes found in the Batik Industry. There are various ways to deal with the waste, namely Biosorption. This method uses biosorbents and biosorbates. Biosoerben used is langsat skin because it is easy and inexpensive to obtain. This study used a batch method with variations in stirring speed, which used the optimum pH 4, Concentration of 150 mg / L, particle size of 150 µm and contact time of 30 minutes. The results obtained absorption capacity at stirring speed of 3.2443 mg / g at 200 rpm and characterization using FTIR (Fourier Transform Infrared).

Keywords **—Biosorptions, Langsat skin, Batch Method, Methyl Orange**

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I. INTRODUCTION

Food coloring is a dye that is safe for the body so that no further processing is needed if the processing waste is discharged into the environment, while textile dyes need further processing. [1]. In general, dyes from textile industry liquid waste is an organic compound that has an aromatic structure making it difficult to degrade naturally and certainly not environmentally friendly[2].

Wastewater is a major problem in the textile industry environment that provides the most extensive influence, because the physical characteristics and chemical characteristics of the waters can have a negative impact on the waters. Batik production liquid waste mostly originates from the dyeing process and causes environmental pollution if it is discharged into the aquatic environment directly without prior processing, whilethe environment has a limited ability to degrade these dyes. The aquatic environment becomes colored and changes the water quality so that it is not suitable for consumption of living things. This process liquid waste is one of the sources of water pollution which is quite high if no waste treatment is done[3].

One of the azo dyes that are widely used in the dyeing process is Methyl Orange. Methyl Orange (MO) or Methyl Orange is an organic compound with the formula C14H14N3NaO3S. Methyl Orange is made from sulfanylic acid and N, N-dimethylaniline. Methyl Orange is a coloring agent used to give color to substances, especially fabrics. Methyl Orange is dangerous to health because it is toxic and mutagenic[4].

Waste from the dyeing of the textile industry must be treated before being discharged into the environment. Wastewater treatment aims to eliminate or reduce the content of dissolved pollutantsand those that are dispersed in a waste water solution. Liquid waste treatment is intended to eliminate the levels of pollutants contained in liquid waste in order to meet the requirements to be discharged into the environment (meeting specified

quality standards). Waste discharged without processing can be harmful to health, such as skin irritation. Processing of pollutants in the environment by using microorganisms (biological material) is called biosorption [5].

One alternative method for removing dyes in water polluted by methyl orange is biosorption by using biosorbents that are cheap and easy to obtain, such as olive skin. Some groups of compounds that are known to have insecticide activity, namely terpenoids, alkaloids, flavonoids and saponins are found contained in langsat plants. Based on this explanation, the writer will examine the biosorbent of langsat skin which is activated to absorb Methyl Orange using a batch method in the hope that it can produce better absorption with the parameters carried out, namely stirring speed variation, which is used to the optimum pH 4. Concentration of 150 mg / L, the particle size is 150 µm and the contact time is 30 minutes and characterization using FTIR (Fourier Transform Infrared).

II. MATERIAL AND METHODS

A. Materials

glassware, shaker (model: VRN-480), pH meter (HI2211), analytical balance (ABS 220-4), filter paper, magnetic stirer (MR Hei Standard), mortar and pestle, oven, spray bottle, sifter (BS410). The instrument used was FTIR (Fourier Transform Infra Red) perkinelmer universal type ATL Sampling Accessor 735 B and Spectronic 21. The ingredients used in this study were skins langsat, aquades, 1000 mg / L Methyl Orange Solution, 0.1 M NaOH, 0.01 M HNO_3, 0.1 M $HNO_3$1 M, HNO_3, 0.5 M HNO_3 and HNO_3 5 M.

B. Preparation of Biosorbent

The skin is cleaned of dirt, cut, washed with water, and dried for ± 2 months using indirect sunlight. Samples were mashed using a mortar and sieved with sieve sizes 150 µm. A total of 20 grams of olive skin is activated with 0.1 M HNO_3, then washed with distilled water until it is neutral, air dried [6].

C. Effect of Stirring Speed

A total of 0.2 grams of langsat skin was contacted with 25 ml of Methyl Orange solution with a pH of 4, a concentration of 150 ppm, optimum size of 150 µm and contact time 30 minutes. Then each solution is contacted using a batch system, the solution is shakered at speeds of 50, 100, 150, 200, 250 rpm during the optimum time. Then the solution is filtered and the filtrate is collected and measured by spectronics

The Determination Formula of absorption capacity is used not only for heavy metals but also for dyes. The amount of dyes adsorbed over various times, qt (mg / g), is calculated based on Equation 1.

$$qt = \frac{(Co - Ct)\,V}{w}$$

Where, Co and Ct (mg / L) is the liquid phase concentration at the beginning and at time t. V is the volume of the solution (L), and w is the mass of the adsorbent (g) [7].

III. RESULTS AND DISCUSSION

A. Langsat Skin Before it is Activated, After Activated and After contact

Langsat skin is cleaned from dirt, cut, replaced with air, and dried air for ± 2 months without moving sunlight. The dried langsat skin is then mashed and sieved to get a uniform size. The smaller the particle size of the adsorbent, the more adsorbate is absorbed. Due to the small particle size having greater inter-molecular power, the absorption is better [8].

The biosorbent activation process, ± 20 gram Langsat Skin powder is activated with 0.01 M HNO3. Activation of bisorbent is carried out to remove components attached to the adsorbent [9]. The biosorbent texture that must be activated is better which should have a smaller particle size compared to the adsorbent which is not activated. The efficiency of biosorbent absorption of biosorbates is highly dependent on the size of the biosorbent particles. The smaller the biosorbent particle size, the greater the surface of the biosorbent, which will increase its saving capacity.

After the biosorbent is contacted, the skin will be reduced because it is absorbed by the dye Methyl Orange also the color change is also seen in the

biosorbent that has been contacted. Changes in the structure and color of biosorbents can be seen in the image below :

Fig. 1 Langsat skin before activated

Fig. 2 Lagsat Skin after activated

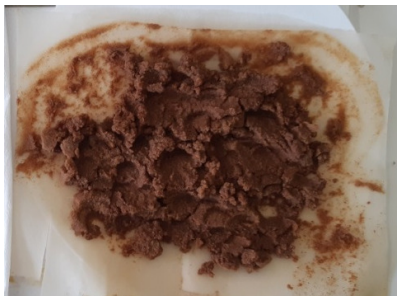

Fig. 3 Langsat Skin after contact

In the skin of langsat found several groups of compounds that are known to have activity as insecticides, namely terpenoids, alkaloids, flavonoids and saponins [10], functional groups found in the components of these compounds such as: N-H, O-H, C = O, and COOH [11].

B.* FTIR *Analysis

Testing of the skin sample before activation to determine the functional groups contained in the skin, then the skin test that has been activated to determine the functional groups and structural changes that occur in the skin, then the skin test that has been contacted with Methyl Orange is done to determine functional groups that can bind to the compound of Methyl Orange. The results of the analysis carried out on the skin langsat before and after activated and after contact with the skin langsat. The results of each biosorbent test can be seen in Figure 1 to before activated

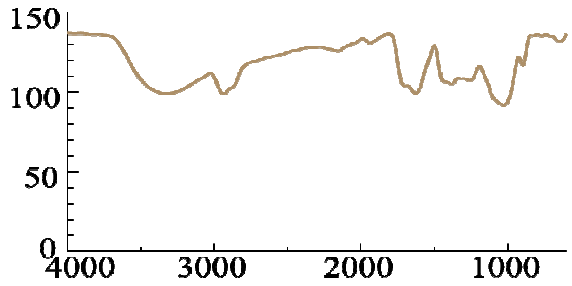

Fig.4 FTIR spectrum before activated

Un-activated langsat skin, the hydroxyl peak (-OH) appears at the wave number 3330 cm^{-1} with a transmittance value of 18.96% T. The wave number indicates that the presence of a free hydroxyl group of a polymeric compound, this corresponds to the frequency range for hydroxyl groups between 3600-2800 cm^{-1} indicating the presence of polymeric compounds [12]. In the wave number 2934 cm^{-1} there is a -CH functional group with a transmittance value of 18.23% T in the frequency range 2800-3000 cm^{-1}, and in the wave number 1625 cm^{-1} there is a C = O (carbonyl) functional group with a value of transmittance of 19.51% T frequency range 1640-1820 cm^{-1}.

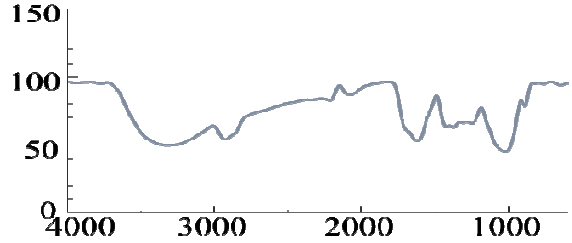

Fig.5 FTIR spectrum after activated

In activated langsat biomass, the hydroxyl peak (-OH) appears at wave number 3329 cm^{-1} and transmittance value of 11.99% T. For the -CH

group there was no change in the absorption band with a shift in the wave number from 2934 cm^{-1} and the transmittance value obtained was 20.19% T. And in the functional group –C = O appeared at the wave number 1627 cm^{-1} and the transmittance value obtained that is equal to 18.07% T.

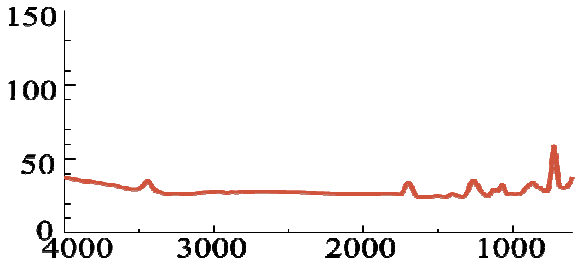

Fig. 6 FTIR spectrum after contact

In the langsat skin biomass that has been contacted with Methyl Orange solution, it can be seen the absorption changes in each functional group where the OH function group appears at wave number 3532 cm^{-1} and the transmittance value is 6.03% T. The -CH function group appears at wave number 2849 cm^{-1} with a transmittance value of 4.66% T. And the functional group C = O appears at wave number 1609 cm^{-1} and the transmittance value obtained is 1.91% T.

C. Effect of Stirring speed

Effect of stirring speed on the absorption capacity of Methyl Orange dye by langsat skin biosorbent is shown in Figure 4.Stirring speed greatly affects the biosorption results of Methyl Orange. The faster the stirring speed will produce the greater the absorption. This is because the faster the stirring, the contact that occurs between the active site on the surface of the biosorbent with Methyl Orange will be faster and better, resulting in a large absorption capacity.Reserving can expand the contact fieldwith increasing stirring speedthereby increasing the homogeneity of anmix [13].

In Figure 4 it can be seen that increasing the stirring speed can increase the absorption capacity. The optimum stirring speed occurs at a speed of 200 rpm with an absorption capacity of 3.2443 mg / g. Then there is a decrease in the absorption capacity to the speed of 250 rpm. This happens because the biosorbent has been saturated and can no longer absorb Methyl Orange.

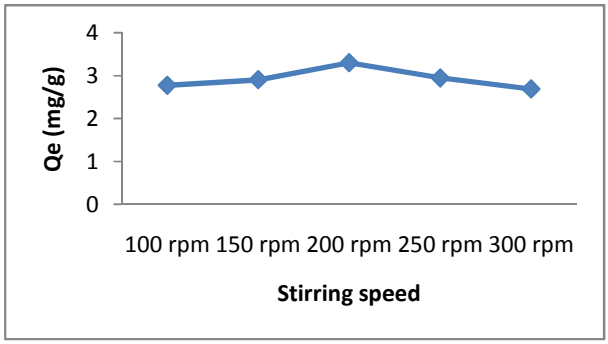

Fig. 7 Effect of stirring speed of the solution on the absorption capacity of Methyl Orange using activated langsat skin (0.2 grams of biosorbent, 25 mL of 150 mg / L solution optimum pH 4, 150 µm for 30 minutes)

IV. CONCLUSIONS

1. Activated olive skin can be used as a biosorbent to absorb Methyl Orange with optimum capacity obtained at a pH of 4, a solution concentration of 150 mg / L, biosorbent particle size of 150 µm and stirring speed 200 rpm.
2. Maximum absorption capacity obtained from Methyl Orange at pH 4, concentration of 150 ppm, particle size of 150 µm, speed of stirring 200 rpm of 3.2443 mg / g

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