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Impact of Particle Size and Contact Time Biosorptionof Rhodamine B by Lengkeng Seeds (*Euphoria longan lour*) Biosorbent

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Abstract:

Rhodamine B is a dye commonly used in the textile industry. Research on the impact of particle size and contact time on Rhodamine B adsorption using lengkeng seeds has been carried out. Particle size determination was carried out at variations of 106, 150, 250, and 425 µm. Determination of the optimum contact time was undertake by varying the contact time of 30, 60, 90, 120, 180, 210 and 240 minutes. This study used a pH of 4, a concentration of 350 mg / L, and a stirring speed of 200 rpm. Optimal conditions for the absorption of Rhodamine B occurred at a particle size of 106 µm with 80.33% of Rhodamine B adsorption and an optimum contact time of 180 minutes with 75.92% of Rhodamine B absorption. Overall, lengkeng seed biomass is a promising bisorbent for absorption of Rhodamine B dye waste.

Keywords **—Biosorption, Rhodamine B, Lengkeng Seeds, Biosorbent**

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I. INTRODUCTION

Increasing the amount of production of the textile industry will also involve increasing the supply of liquid waste to the water. One of the dyes that are relatively widely used in the textile industry in the dyeing process is Rhodamine B which is applied to the wool, paper, silk and paint industries. Rhodamine B can cause carcinogenic effects and is toxic to humans when accumulated in the body, such as skin irritation to liver cancer.

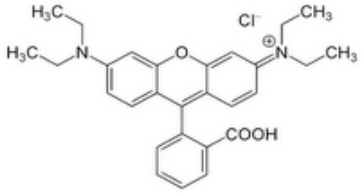

Figure 1. Structure Rhodamine B

Methods for reducing the levels of Rhodamine B in water have been widely used, such as methods of precipitation and oxidation, but they have the disadvantage of being relatively expensive in application. For that we need other methods, such as biosorption methods that are easy, relatively inexpensive, biosorbents that are commonly found in nature and can be generated. Lengkeng seeds are a biomass that can be applied as a biosorbent because there are *gallic acid*, *elagic acid* and *corilagin*compounds which have C-O, C = O, and COOH functional groups that can absorb Rhodamine B [1].

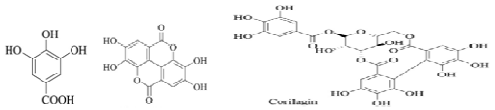

Figure 2. (a) *gallic acid*, (b) *elagic acid*. and (c) *corilagin*

Previous studies related to the use of lengkeng seeds as biosorbents in the absorption process of Cu^{2+} [2] and Pb^{2+} [3]. Meanwhile, research on the use of biosorbents to absorb Rhodamine B has been carried out

with banana peels [4], almond shells [5] and *Aspergillus oryzae*cells [6].

II. MATERIAL AND METHODS

B. Materials

The materials used in this study were lengkeng seeds, aquades, Rhodamine B dye, 65% HNO3, NaOH. The tools used in this study were pH meter, glassware, mortar and pestle, analytical balance (ABS 220-4), filter paper, magnetic stirrer (MR Hei Standard), shaker (model: VRN-480), sieve (BS410). spray bottle, the instrument used is the FTIR Spectrometer (Model : SHIMADZU) and Spectronic,

C. Procedur

1) Sample Preparation

Lengkeng seeds are cleaned of dirt, washed with water, and dried for ± 2 months using indirect sunlight. Splitting the sample then smoothing it using a grinder and sieving it for sizes 106, 150, 250 and 425 µm. A total of 20 grams of lengkeng seeds had beenactivated with 0.01 M HNO3, then wash up to the neutral with distilled water and dry [7].

2) Impact of Particle Size

A total of 0.2 grams of lengkeng seeds with varying particle sizes of 106, 150, 250, and 425 µm were mixed in 25 ml of rhodamine B solution at pH 4 and concentration 350 mg/L, then use the batch system to contact each solution, the solution was stirred at a rotational speed of 200 rpm for 180 min. The solution is then strained, the filtrate is stored and the absorption is measured by spectronic.

3) Impact of Contact Time

0.2 grams of lengkeng seeds with a particle size of 106 µm were contacted with 25 ml of Rhodamine B at pH 4 and a concentration of 350 mg / L. Then use the batch system to contact each solution, the solution was stirred at 200 rpm for 30, 60, 90, 120, 180, 210 and 240 minutes. The solution is then filtered, the filtrate is stored and the absorption is measured by spectronic.

III. RESULT AND DISCUSSION

A. Impact of Particle Size

The particle size of a biosorbent can show many properties, qualities and performance of a biosorbent. The effect of particle size is also related to the interaction of the biosorbent with solution [8].

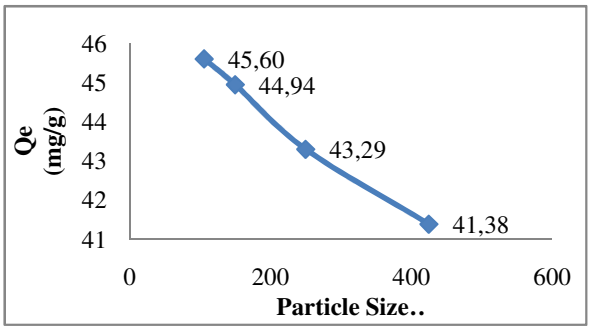

Figure 3.The impact of particle size on the absorption of Rhodamine B pH 4, a concentration of 350 mg/g, and a stirring speed of 200 rpm

The absorption capacity reached the optimum capacity at a particle size is 106 µm, the absorption capacity is 45,6045 mg/g, and the absorption percentage is 80.33%. Along with the increase in particle size, the absorption capacity of Rhodamine B dye by lengkeng seeds also decreased with the lowest absorption capacity at the size of 425 µm of 41.7289 mg/g with absorption percentage of 72.89%.

The absorption will increase with the decrease in the particle size of lengkeng seeds in the Rhodamine B dye solution. The smaller particles will has a larger surface area, and there are more active sites on the surface of the biosorbent, thus increasing the chance of collisions between dyes. Rhodamine B with lengkeng seeds. The collision that occurs will cause the biosorption rate of small lengkeng seed particles to be faster than that of larger lengkeng seed particles [9].

In addition, the small lengkeng seed particles will move faster in solution and reach equilibrium faster than particles with larger size and there will be more interaction by the surface with the

Rhodamine B dye solution [10]. Then the large particle size apart from absorption on the biosorbent surface there is also the possibility of intraparticle diffusion from the outer surface and a mass transfer due to the contact time factor, and the part of the particles that is blocked so that absorption cannot occurthereby inhibiting equilibriumand the absorption capacity decreases [11]. The optimum particle size condition at 106 µm also showed the same results for lead (II) biosorption with longan seed and shell biosorbent [12].

B. Impact of Contact Time

The contact time of the biosorption is useful as an indicator of the rate at which the biosorption process reaches an equilibrium and it plays a role in the diffusion of adsorbed substances in solution [13].

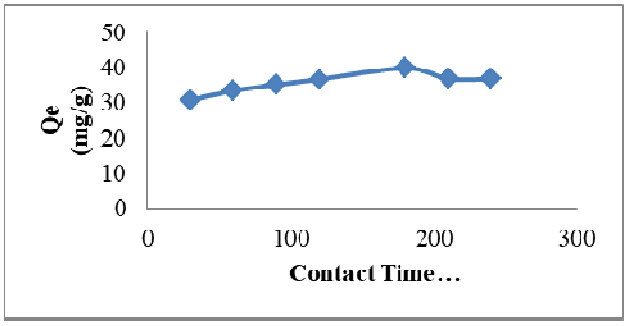

Figure 3.The impact of contact time onabsorption of Rhodamine B pH 4, a concentration of 350 mg / g, and a stirring speed of 200 rpm

The biosorption process that occurs shows that equilibrium is reached at a contact time of 180 minutes, indicated by starting to taper the curve after 180 minutes. The absorption capacity obtained at the optimum time was 39.7967 mg/g with an absorption efficiency that occurred at 75.92%. When equilibrium has been reached, the biosorption process will decrease, this is because the Rhodamine B ion has saturated the surface active site of the adsorbent.

Generally, there are three stages in the time for the adsorption to occur. First, the biosorption process takes place quickly where there is a large amount of dye attached to the adsorbent, this is attributed to the enormous surface space of the adsorbent and the accessibility of abundant active sites. In the next second, the biosorption rate was gradually slower relative to increasing contact time. Then, the absorption begins to decline wherein the process starts to enter the saturation phase [14].

In the saturation phase, the empty active site on the adsorbent surface will be difficult to occupy due to the repulsion force between Rhodamine B in the solid phase and Rhodamine B in solution and the slow diffusion of pores that occurs from the dissolved ions to most of the adsorbents. In the biosorption of rhodamine B, the color should initially bear the impact of the limit layer, at that point it should diffuse from the limit layer to the outside of the adsorbent lastly, it should enentuallydiffuse into the porous structure of the adsorbent [15]. The results of the optimum contact time at 180 minutes were also obtained on the absorption of Basic Red 46 dye with biosorbentziziphus lotus stones [16].

CONCLUSIONS

Based on the research conducted, it can show that at pH 4, the concentration of 350 mg / L, stirring speed of 200 rpm, the optimum conditions for particle size are 106 µm and contact time is 180 minutes with the maximum absorption of Rhodamine B is 45.60 mg/g.

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