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Submission date: 23-Jun-2022 01:07PM (UTC+0700)

Submission ID: 1861685310

File name: ngan_2019_IOP_Conf._Ser._Earth_Environ._Sci._343_012194.pdf (904.9K)

Word count: 2180

Character count: 10616

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To cite this article: J Y Parlindungan *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **343** 012194

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1 Encapsulation powder skin duck eggshells on alginate as adsorbent methylene blue

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Abstract. The textile industry has a major role in water pollution problems. River water is contaminated with sewage can cause damage to the aquatic ecosystem and if entry into the food chain cycle can be carcinogenic and mutagenic compounds. Methylene blue (MB) is one of the dyes are widely used in the textile industry and is of great concern in the process of wastewater treatment because it is difficult outlined in nature and harmful to the environment. Methylene blue adsorption from solution via adsorption using adsorbents calcium alginate (CA) and eggshell powder encapsulated in calcium alginate (CA-SCT) and eggshell shell powder (SCT) has been studied. The results showed that the optimum contact time SCT, CA, and CA-SCT occur at the contact time of 2 hours. The optimum adsorbent mass of 0.05 grams, and pH optimum at pH 6-7. SCT percent adsorption, CA, and CA-SCT are respectively 25.07%; 60.07%; and 69.66%. Consider it encapsulation can improve the performance of the adsorbent.

15 1. Introduction

The rapid development of the industry due to technological advancements is very advantageous in terms of the economy because it opens up new jobs and contributes foreign exchange to the country. But in addition to the positive side, it also causes the negative side in the form of considerable waste and has an imbalance with the ability of nature to purify [1].

The textile industry has a big portion of the problem of water pollution. Because liquid waste that is disposed of can cause unpleasant odors and very thick colors. In the textile industry, the main source of pollution is the coloring process and finishing stage [2]. River water that has been contaminated with waste can cause damage to aquatic ecosystems and if it enters the food chain cycle it can become a cancer-causing compound and mutagen [3].

Methylene blue is a dye that is most often used in the textile industry. The dye is an organic compound containing a color carrier group (chromophore) and autochrome, a chromophore is generally an electron-withdrawing group while autochrome generally constitutes the driving force of electrons and both are connected to each other through a conjugated system [4].



This removal of toxic pollutants is becoming a global concern. The presence of excess chemicals in the environment has a bad influence on living things because the chemicals that accumulate in tissues can cause dangerous diseases. To minimize this threat several physical and chemical methods such as reverse osmosis and ultrafiltration, oxidation/reduction, precipitation, electro dialysis adsorption, and others have been carried out [5,6]

From some of the above methods, adsorption is the most widely developed and used. In recent years they have learned inexpensive material that can be used to remove the dye include sawdust plant [7], clay [8], plant[9], coco [10], bagasse[11] and phyrophyllite[12].

Eggshells have good adsorption properties to absorb dyes. Zulfikar and Setiyanto in the previous study stated that eggshells can be used to remove congo red dye in solution [2]. The research carried out will study the effectiveness of duck eggshells as a dyestuff remover when encapsulated in alginate.

2. Methods

2.1. Preparation of Powdered Egg Shells (SCT) into calcium alginate

A total of 0.2 g of Na-Alginate is mixed with 2 g of eggshell powder and then 100 mL of water is added at a temperature of $\pm 80^\circ\text{C}$ little by a little while stirring with the stirrer. The mixture is then stirred until homogeneous. Next, the mixture is dropped into a 2% $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ solution using a burette. CA-SCT granules which are formed later, are allowed to stand for 24 hours in solution. Then removed, washed using aqua dm, drained and dried at room temperature for ± 24 hours.

2.2. Adsorption of Methylene Blue Using Eggshell Egg Skin Encapsulated (Ca-SCT)

2.2.1. *The determination of the optimum pH.* In this study, adsorption was studied using a batch method. To find out the optimum pH of MB adsorption was carried out by contacting 0.1 gram of CA, CA-SCT, and SCT adsorbents in 20 ml of MB solution at the room temperature of Erlenmeyer 100 ml. the contact process uses a shaker at 200 rpm for 2 hours. Variations in pH used were 1, 2, 3, 4, 6, 8, and 10 made by adding NaOH and HCl.

2.2.2. *Determination of Optimum Time.* To study the effect of contact time, carried in the same way in point 2.2.1, optimum pH was used. The variation of contact time used was 15 minutes, 30 minutes, 45 minutes, 1, 2, 4, 8, and 12 hours.

2.2.3. *Determination of Optimum Massa Adsorbent.* To find out the optimum mass of MB adsorption in the same way in point 2.2.1, the optimum pH and time are used. The mass variation of the adsorbent used is 0.01; 0.025; 0.05; 0.075; 0.1; 0.125 grams.

3. Results and discussion

3.1. Effect of pH on

From the results of the research shown in figure 1 it can be seen that at the pH of the solution from pH 2-6 there is an increase in percent adsorption whereas at $\text{pH} > 6$ it tends to show a relatively higher percentage of adsorption but with a small amount.

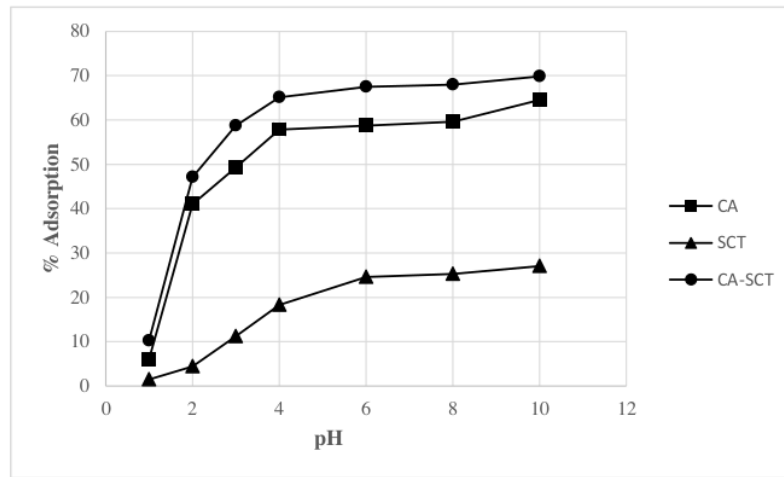


Figure 1. Percentage of CA, CA-SCT, and SCT adsorption at various pHs

The adsorption performance that increases in the pH range is due to the $-\text{COO}$ group being more dominant than $-\text{COOH}$ due to pK_a from D-manuronate (M) and L-gulonate (G) in alginates respectively 3.38 and 3.65 [13]. From the research that has been done, it can also be seen that the encapsulation of eggshell powder gives an increase in MB adsorption. This is because SCT consists of proteins and polysaccharides that have functional groups such as hydroxy, amine, and sulfur which can also react with dyes that depend on pH [14].

3.2. Optimum time Adsorption

Based on the data obtained, the adsorption capacity increases every hour which will reach equilibrium at a certain time

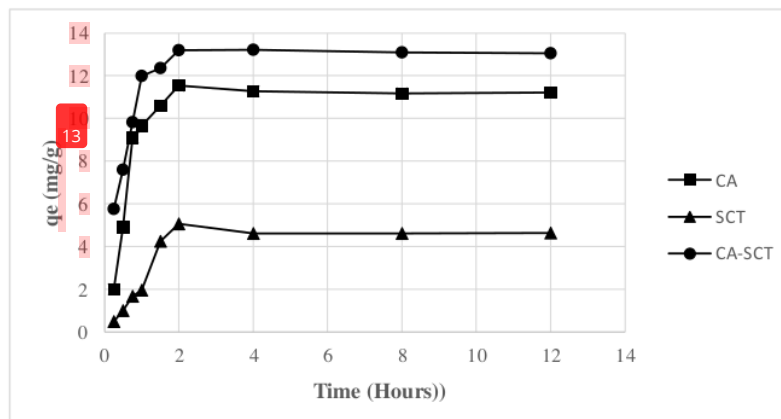


Figure 2. CA, CA-SCT, and SCT adsorption capacity curves in contact time variations

This happens because the longer the contact time, the MB is absorbed more on the surface but at a certain time, the active side of the adsorbent decreases [15]. Significant improvement can be seen at the 2nd hour. While at the 4th to 12th hours the adsorption capacity did not increase significantly. Therefore, the next experiment was carried out at the time of contact for 2 hours.

3.3. Against Mass Effect of Adsorption Capacity

The results of the effect of the mass of the adsorbent on the percent concentration are presented in Figure V.10. The mass range used is from 0.01 gram to 0.125 gram. Based on the research data obtained for the optimum CA and CA-SCT mass was 0.05 grams with percent adsorption 60.07% and 69.66%, respectively. While the mass of the adsorbent is greater than 0.05-gram percent, the adsorption decreases.

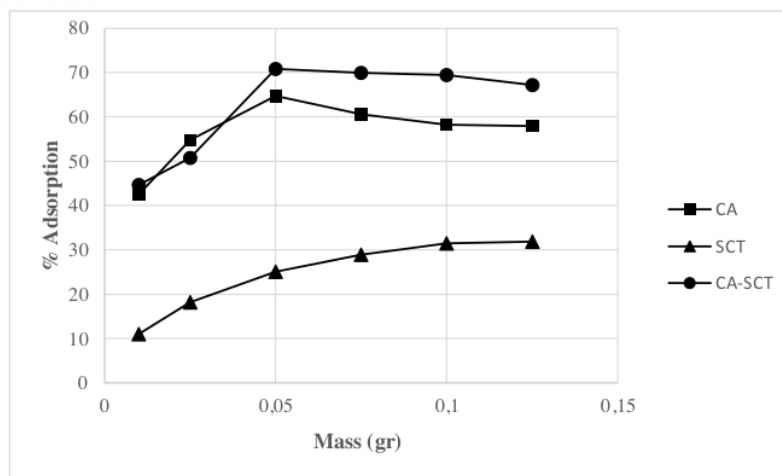


Figure 3. Percentage adsorption of CA, CA-SCT, and SCT on the mass variation of the adsorbent.

This is because the amount of adsorbent that is too much with the amount of adsorbate that still causes the adsorbent to be used an clot so that it can cover the part or surface of the adsorbent used for the adsorption process. In Figure 3 can be seen that the adsorption capacity of CA, CA-SCT, and SCT decreases with the number of adsorbents. This is due to the sharing of the same number of adsorbates in the increasing number of adsorbents [16].

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4. Conclusion

Based on the results of the study, it can be concluded that CA, CA-SCT, and SCT can be used as methylene blue adsorbents. The optimum conditions for methylene blue adsorption in CA, CA-SCT, and SCT are pH 6-7, contact time is 2 hours. The adsorbent mass of 0.05 grams with percent of SCT, CA, and CA-SCT was 25.07%; 60.07%; and 69.66%

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