Adsorption of Methylene Blue by Pectin From Durian (*Durio Zibethinus*) Seeds

Siti Nurkhalimah, Devita Wijiyanti, Kuntari[1]

***Abstract*—**Methylene blue is a popular water-soluble dye that is used for dyeing a variety of substrate such as bacteria, wool, and silk. Methylene blue discharged into the aquatic enviromental will cause health problems for living things. Treatment method for industrial wastewater may be divided into three main categories: physical, chemical, and biological. Among them, adsorption technology is generally considered to be an effective method for quickly lowering the concentration of dissolved dyes in a wastewater. This has attracted considerable research into low-cost alternative adsorbents for adsorbing or removing coloring matter. In this research, pectin from durian seeds were utilized here to assess their ability for the removal of methylene blue. Adsorption parameters are contact time and dye concentration were examined in the batch adsorption processes. Pectin characterization was performed by FTIR spectrometry. Methylene blue concentration was determined by using UV-Vis spectrophotometer. FTIR results show that the samples showed the typical fingerprint in IR spectrogram. The adsorption result on 10 mL of 5 mg/L methylene blue solution achieved 95.12% when contact time 10 minutes and pectin 0.2 g.

***Keywords*—**adsorption, durian see, methylene blue, pectin.

I. Introduction

THE growing use of synthetic dyes in various industrial fields results in large quantities of dye liquids.The dyestuff waste discharged into the water potentially reduces the entry of sunlight thus preventing photosynthesis.This results in decreasing quality of waters and disrupting the lives of living things living in the waters due to the lack of dissolved O2 and the presence of contaminated by toxic materials [1].

One of the most widely used dyes in the coloring industry is methylene blue. Methylene blue has a benzene group that makes it difficult to degrade [2]. Methylene blue dyes are of great interest in the waste treatment process because of their difficult coloration.

According to [3] the processing of dyestuff waste such as adsorption process has a high effectiveness in dye removal in liquid waste. Pectin and carbohydrates, both of these compounds can be found in plant waste, for example in banana peel can also be used as an adsorbent. [4] reported in his research that pectin utilization from banana peel can be used as a methylene blue coloring adsorbent. In addition to banana peel, durian peel, orange peel, durian seeds, and so many contain pectin and carbohydrates so it can also be used as an adsorbent.

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Durian seeds are part of durian fruit that is not consumed by most people because of slimy and cause itching on the tongue. In line with the development of harvested area, production also tends to increase. [5] stated durian production very much from 888.127 tons in 2012, then in 2013 759.055 tons and at the end of 2014 to 859.118 tons, with increasing consumer demand for durian made a lot of waste durian seeds that have not been widely utilized. Durian seeds contain high starch, protein, and carbohydrate content that can play a role in dye removal.

The aim of this research is to do pectin by extraction, characterization of pectin produced by FT-IR, using influence of time in methylene blue adsorption using pectin, and understanding influence in adsorption of methylene blue using pectin.

II. Procedure

The raw materials used in this research are durian seeds originating from Sleman Yogyakarta area. The tools used are oven (Memmert), desiccator, electric heater, magnetic stirrer (Thermolyne Cimarec 2), analytical balance (Ohaus), blender, reflux set, propipet, UV-Visible spectrophotometer (Thermo Scientific Genesys 20), cuvette, FT-IR, shaker (Rotator Shaker VRN-200 Gemmy), spatula, dropper pipette, porcelain, spray bottles.

Isolate pectin is made by first of the clean durian seeds of impurities, (durian seed species used by local species), thinly sliced durian , after which it was blended granules, pectin were extracted from durian seeds under reflux for 2 hours at 90ºC using a set of reflux. HCl 37% it is intended to provide an acidic atmosphere, d the solution was refracted for 2 hours at 100 °C using an electric heater, the resulting filtrate was filtered and its volume measurements, ethanol added 96% of the amount (1:1) formed colloidal white, silenced for 20 hours, after which the filtrate and precipitate are separated using filter paper, precipitate or pectin available in the oven to dry, staining to evaporate the water content in the pores of the adsorbent. The result of pectin obtained was characterized by using FT-IR spectrometry with scan of wave number 400-400 cm^{-1}.

The stock solution preparation of methylene blue 100 mg / L by dissolving 0.01 g methylene blue in 100 mL of distilled water. The subsequent preparation of methylene blue solution by diluting the prepared master methylene blue solution. The optimum contact time determination was carried out by interacting the adsorbent 0.2 g in 50 mL beaker glass with 50 mL methylene 50 mg/L solution of 10 mL at a time variation contacts 5, 10, 15, 30, 60, and 90 minutes. The filtrate was filtered using whatman 42 paper, after which dilution was done 50 times in a 10 mL measuring flask, measured its absorbance using a single UV-Vis light spectrophotometer at optimum methylene blue wavelength (664 nm). The determination of

concentration effect on methylene blue dye adsorption was done by interacting adsorbent of 0.2 g in 50 mL beaker with variation of methylene blue 10 dye concentration; 30; 50; 70; and 90 mg/L of 10 mL. Filtrate filtered using whatman 42 paper, then dilution was done 10 times in 10 mL measuring flask, measured uptake with UV-Vis single beam spectrophotometer at the optimum wavelength of methylene blue. The percentage determination of methylene blue dye adsorption can be determined by the following formula:

$$\text{Persentase adsorpsi} = 100\,\frac{(C_i - C_f)}{C_i}$$

Description: Ci = Concentration of methylene blue solution before adsorbed Cf = Concentration of methylene blue solution after adsorbed Where Cf value can be calculated from calibration curve equation y = 1,8508x - 0,03082 plotting absorbance data on concentration variation.

III. MATH

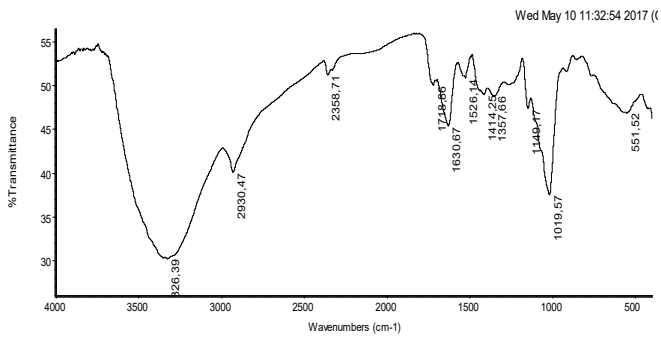

Fig. 1 Pectin characterization

TABLE I
DETERMINATION OF OPTIMUM CONTACT TIME

Number	Concentration (mg/L)	% Adsorption
1	5	89.45
2	10	92.69
3	15	90.40
4	30	91.20
5	60	91.15
6	90	91.18

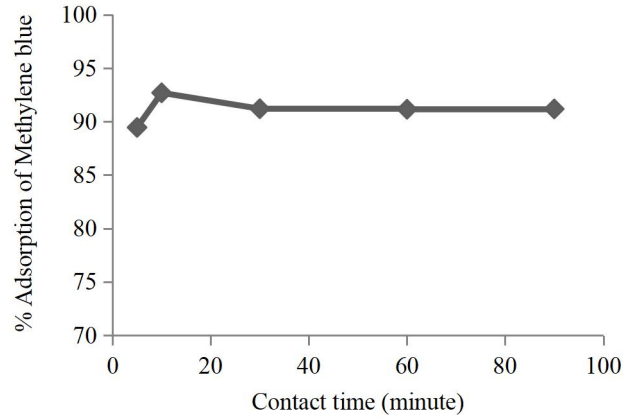

Fig. 2 Graph of the relationship between % adsorption and contact time

The resulting data shows that the optimum contact time is at 10 minutes.

TABLE II
DETERMINATION OF CONCENTRATION EFFECT ON METHYLENE BLUE COLOR SUBSTANCE ADSORPTION

Number	Concentration (mg/L)	% Adsorption
1	1	92.59
2	3	94.41
3	5	95.12
4	7	94.91
5	9	94.93

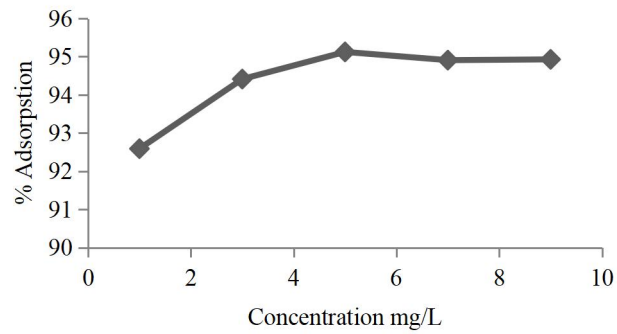

Fig. 3 Graph of the relationship between % adsorption with concentration

The resulting data show that the optimum adsorption is 5 mg/L.

IV. DISCUSSION

In this chapter presented the results of research and discussion on the isolation of pectin adsorbent results of isolation from waste seed durian. The characterization of durian seed pectin using FT-IR and adsorption with the parameters studied was the effect of optimum contact time and the concentration of adsorbate. Pectin characteristics of durian seed using FT-IR spectrometry aims to determine the functional groups contained in pectin research results. The main functional group in pectin usually lies in the area of 1000-2000 cm^{-1} wave numbers. The carboxyl bond is located at 1630-1650 cm^{-1} for the free carboxyl group and 1740-1760 cm^{-1} for the

esterified carboxyl group. The data generated in FIG. 3 shows that, the absorption of each functional group of standard pectin and pectin of the extraction results shows some differences. The spectrum shows a typical wide absorption peak at the wavelength number 3446.17 cm^{-1} for standard pectin and at 3326.39 cm^{-1} for extracted pectin, indicating the absorption of the hydroxyl group. The wave number 2934,16 cm^{-1} indicates a vibration -CH3 vibration, wherein the extracted pectin is read on the spectrum 2930.17 cm^{-1}. In standard pectin there is a -C = O group with wave numbers 1698.02 cm^{-1} and the spectrum reads in pectin 1630.67 cm^{-1} wavelength extraction. Then the clusters of C-H in the standard pectin wave number of 1359 cm^{-1} and pectin extraction of 1357.66 cm^{-1}. The -O- group on the standard pectin is at the wave number 1152 cm^{-1} while the pectin extraction at the wave number is 1148.17 cm^{-1}. Determination of effect of optimum contact time aims to find out how long optimum time required by adsorbent to adsorb methylene blue dyes. The longer the contact time can allow for better adsorption. The data generated in FIG. 4 shows that the maximum contact time is at 10 min. At 5-10 minutes contact time the percentage of adsorption increases as longer contact time causes the interaction between the adsorbent with the methylene blue dye becomes larger. The decrease in percentage of methylene blue dye adsorption occurs at 10-90 minutes, this is because the methylene blue dyes absorbed on the surface of the adsorbent are in a fixed solution for a long time causing the adsorbent to have saturation point, so that the methylene blue dye has been absorbed on the adsorbent will loose back in solution. Determination of effect of concentration on methylene blue dye adsorption aims to find out optimum concentration that can be absorbed by adsorbent with mass 0,2 g in contact time maximum 10 minutes. The data generated in FIG. 5 indicates that the percentage of adsorption increases at a concentration of 1-5 ppm. This explains that the greater the concentration of adsorbate, the greater the chance of adsorption, while the percentage of adsorption at 5-9 ppm concentrations decreases because of the surface the adsorbent is fully charged by the methylene blue dye, so that the adsorbent has a saturation point and cannot absorb the methylene blue dye solution again.

V. CONCLUSION

Based on the results of research conducted can be summed up as follows: 1.Intolation of pectin can be done by extraction method 2. The optimum contact time occurs at 10 minutes. 3. The concentration of methylene blue optimum dye adsorption occurs at 5 ppm. Based on the results of research conducted, there are several suggestions proposed to improve the next research as follows: 1.There is a continued assessment of the effect of heating, the influence of time, and other types of solvents used in the process of pectin insulation from durian seed by extraction method. 2. It is necessary to implement pectin absorption on dye waste.

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