

# Cek Plagiarisme 5

*by* Maryudi Maryudi

---

**Submission date:** 30-Mar-2023 06:06PM (UTC+1000)

**Submission ID:** 2050809949

**File name:** -Salamah-Removal\_of\_Methylene\_Blue\_of\_Textile\_Industry\_Waste.pdf (311.16K)

**Word count:** 1922

**Character count:** 10310

## Removal of Methylene Blue of Textile Industry Waste with Activated Carbon Using Adsorption Method

Maryudi<sup>1)</sup>, Shinta Amelia<sup>1,\*)</sup>, and Siti Salamah<sup>1)</sup>

14

<sup>1)</sup> Department of Chemical Engineering, Faculty of Industrial Technology, Universitas Ahmad Dahlan Kragilan, Tamanan, Banguntapan, Bantul

\*) Corresponding author: [shinta.amelia@che.uad.ac.id](mailto:shinta.amelia@che.uad.ac.id)

(Received: October 25, 2019 Accepted: November 25, 2019)

### Abstract

The colorant that is often used in the textile industry is methylene blue which is a cationic heterocyclic aromatic compound. This compound is very stable and is difficult to decompose naturally leading to environment in large concentrations. Therefore, a waste treatment technology to reduce the concentration of dye waste in water becomes important. So far, adsorption method with activated carbon remains the most efficient and effective technique in removing dyes from liquid waste due to its relatively large adsorption capacity. Activated carbon is one of the non-metallic mineral commodities or multipurpose industrial minerals, one of which is as an adsorbent or adsorbent media. This study aims to determine the potential of activated carbon in adsorbing methylene blue with variations in the concentration of methylene blue and particle size of activated carbon. The procedures in this experiment include, the preparation of activated carbon with size variations (20-60, 60-100 and > 100 mesh) and variations in the concentration of methylene blue (15 ppm, 30 ppm and 45 ppm) with contact time (0 to 180 minutes). From the results of the study, it was found that the smaller the size of activated carbon used, the greater the adsorption capacity, ie at mesh size > 100 mesh, the adsorption capacity was 9.8%. Whereas, the smaller the concentration of methylene blue, the activated carbon could work optimally at a concentration of 15 ppm at 30 minutes with adsorption capacity as high as 100%.

**Keywords:** adsorption; Methylene Blue; activated carbon; concentration; time; particle size

**How to Cite This Article:** Maryudi, Amelia, S., and Salamah, S. (2019), Removal Of Methylene Blue of Textile Industry Waste With Activated Carbon Using Adsorption Method, *Reaktor*, 19(4), 168-171, <http://dx.doi.org/10.14710/reaktor.19.4.168-171>.

### INTRODUCTION

Dyes are one of the main components of the textile industry process. So far, the textile is the major user of dyes. More than 100,000 commercially available dyes with an estimate annual production of more than 70,000 tons of textile commodities, of which 12% of textile dyes are lost during the coloring process. Textile dyes are lost into waste and found accumulated

in industrial waste streams (Tunc *et al.*, 2009). Textile industry wastes contain dyes that are difficult to decompose naturally and cause disruption of water ecosystems (Anshar *et al.*, 2016). Dyestuffs produced from the textile industry are generally non-biodegradable compounds which cause environmental pollution, especially to aquatic environments (Gupta *et al.*, 2012).

The textile industry is a prominent foreign exchange contributor, but handling environmental sustainability should be an important concern. Therefore, it is needed a waste treatment technology that can reduce the pollution of the aquatic environment generated by the textile industry. The dyestuff waste treatment method that is often applied is the adsorption method. The adsorption method has been proven to have a high effectiveness in removing dyes in liquid waste.

In recent years, a lot of research has been done to develop an effective adsorption method for processing of dye waste. One of the commonly used adsorbents is activated carbon. So far, the adsorption method with activated carbon remains the most efficient and effective technique in removing dyes because of its high adsorption capacity (Hameed *et al.*, 2007). Activated carbon (powdered or granulated) is the most efficient adsorbent used for dye removal (Anshar *et al.*, 2016; Nandiyanto *et al.*, 2017; Nandiyanto *et al.*, 2018). In this research, activated carbon with micropore character as adsorbent was used. In addition, characterization and activity testing of activated carbon adsorbents was carried out.

#### 4 MATERIALS AND METHOD

##### Materials

The materials used in this study were activated carbon as an adsorbent and methylene blue (95% analytical grade, Sigma Aldrich) used as the synthetic waste. The pore structure of activated carbon was characterized by using an N<sub>2</sub>-sorption analyzer (Nova 2000, Quantachrome). While the ultraviolet / visible (UV / Vis) spectrophotometer (Shimadzu Mini 1240) was used to analyze the concentration of methylene blue per unit time.

##### Adsorption Process

Prior to adsorption process, a total of 200 ml of methylene blue solution with the appropriate concentration of variables respectively 15, 30 and 45 ppm were prepared in a glass beaker. The solution was stirred with a magnetic stirrer at a constant speed of 450 rpm and a room temperature of 30°C. Furthermore, 0.025 grams of activated carbon adsorbent with various particle size were put into a glass beaker each containing a methylene blue solution. Sample containing of 2 ml of the solution were taken at intervals for 3 hours. Furthermore, the concentration of methylene blue in solution (C) at any given time interval was analyzed with a UV-Vis spectrophotometer at a wavelength of 663 nm.

##### Analysis Method

The adsorption data were analyzed using a UV / Vis spectrophotometer with wavelength  $\lambda = 663$  nm. The results of the analysis are used to calculate the concentration of methylene blue in liquids per unit time.

## RESULTS AND DISCUSSION

### Characterization of Activated Carbon Adsorbents

Table 1 shows data on the characteristics of activated carbon adsorbents including specific surface area, average pore diameter and pore volume. Based on Table 1, it can be concluded that the adsorbent used is micropore carbon (IUPAC classification) with a mean diameter of 1.82 nm.

In addition, related to the pore size distribution calculated by the Quenched Solid State Functional Theory (QSSFT) model. Based on the results of calculations with the Quenched Solid State Functional Theory (QSDFT) model, it can be seen a large pore size distribution of particles below 2 nm, so that it further strengthens that the activated carbon adsorbent used is micropore carbon (IUPAC classification). The results of pore size distribution with QSDFT-N<sub>2</sub> model can be seen in Figure 1.

The morphological analysis performed using Scanning Electron Microscopy (SEM) shows the morphology and that the pores of the adsorbent surface are uniformly distributed. These pores will later provide the surface area during the process of adsorbing synthetic methylene blue waste. The larger surface area of the adsorbent exhibits a more evenly distributed pore size leading to a greater the adsorption capacity. Morphological analysis results can be seen in Figure 2.

Table 1. Characterization of Activated Carbon Adsorbents (Amelia *et al.*, 2019)

Characteristic	Value
Specific surface area (S <sub>BET</sub> ), m <sup>2</sup> /gram	1320
Micropore area (S <sub>mic</sub> ), m <sup>2</sup> /gram	1220
% S <sub>mic</sub>	92
Total pore volume, cm <sup>3</sup> /gram	0.60
Micropore volume (V <sub>mic</sub> ), cm <sup>3</sup> /gram	0.45
% V <sub>mic</sub>	75
Average pore diameter, nm	1.82

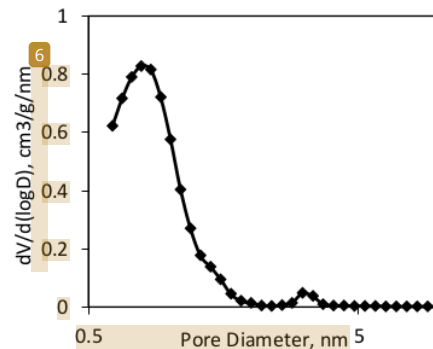


Figure 1. Pore Distribution with QSDFT-N<sub>2</sub> Model (Amelia *et al.*, 2019)

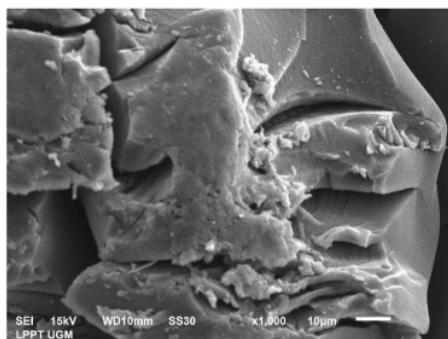


Figure 2. The SEM Image of Activated Carbon Adsorbent

#### Adsorption Activity Test

In this study the variation in the concentration of methylene blue solution as synthetic waste of 15, 30 and 45 ppm was used to measure the adsorption capacity of activated carbon in the adsorption process. From Figure 3 it can be seen that the maximum adsorption is achieved at a methylene blue concentration of 15 ppm. Adsorption capacity of methylene blue at a concentration of 15 ppm reached 100% at 30 minutes contact time. Whereas, at the concentration of 30 ppm and 45 ppm the highest adsorption capacity was reached with a contact time of 180 minutes that was equal to 68.1% and 30.6%. This shows that the greater the concentration of synthetic methylene blue waste, a longer contact time required for activated carbon adsorbents to adsorb the waste.

Figure 3 presents that there is a correlation between contact time and adsorption capacity. The adsorption process occurs more rapidly at the beginning of the adsorption process (Khuluk *et al.*, 2019). Then after the adsorbate starts to be accumulated on the adsorbents, the adsorption process became slower so that a greater methylene blue concentration required a longer contact time.

In addition to the variation in the concentration of synthetic methylene blue waste, this research also uses variations in the size of the activated carbon mesh. The

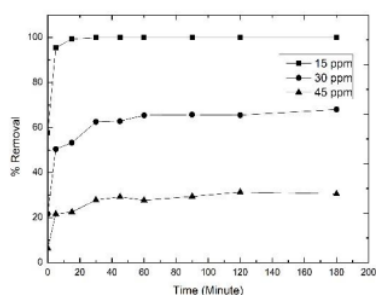


Figure 3. Effect of Methylene Blue Waste Concentration on Activated Carbon Adsorption Activity Test

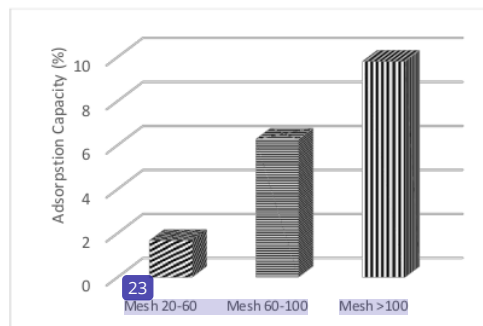


Figure 4. Effect of Adsorbent Size on Activated Carbon Adsorption Activity Test

activated carbon used were 20-60 mesh, 60-100 mesh and > 100 mesh. Based on Figure 4 it can be seen that activated carbon with particle size of > 100 mesh has the largest adsorption capacity. This shows that the smaller the size of the adsorbent, the greater the adsorption capacity produced. This can occur because the smaller the size of the adsorbent, the resulting surface area to adsorb the adsorbate is greater so that the adsorption capacity is even greater.

#### CONCLUSIONS

Based on the results of the research discussed above, it can be concluded that the difference in the concentration of synthetic methylene blue waste affects the adsorption capacity. The highest adsorption capacity was achieved at a concentration of synthetic ppm of 15 ppm which is 100% with a contact time of 30 minutes. In addition, contact time during the adsorption process also affects the adsorption yield. The longer the contact time, the more adsorbate can be adsorbed by the adsorbent.

In addition, the smaller the size of the adsorbent provides a greater surface area of the adsorption field so that the resulting a higher adsorption capacity. The highest adsorption capacity is produced by activated carbon with a size < 100 mesh.

#### ACKNOWLEDGEMENT

The author would like to thank to the Research and Development Institute, Universitas Ahmad Dahlan, Yogyakarta, which has provided an internal research grant to fund this research.

#### REFERENCES

- Amelia, S., Sediawan, W.B., Prasetyo, I., Munoz, M., Ariyanto, T. (2019). Role of the Pore Structure of Fe/C Catalys on Heterogeneous Fenton Oxidation. *Journal of Environmental Chemical Engineering*.
- Anshar, A. M., Taba, P., and Raya, I. (2016). Kinetic and Thermodynamics Studies the Adsorption of Phenol on Activated Carbon from Rice Husk Activated by

ZnCl<sub>2</sub>. *Indonesian Journal of Science and Technology*, 1(1), 47-60.

Gupta, V. K., Patania, D., Agarwal, S., and Singh, P. (2012). Adsorptional photocatalytic degradation of methylene blue onto pectin-CuS nanocomposite under solar ligh. *Journal of Hazardous Materials*, 243, 179-186.

Hameed, B. H., Ahmad, A. A., Aziz, N. (2007). Isotherm, kinetics and thermodynamics of acid dye adsorption on activated palm ash. *Chemical Engineering Science*.133: 193-203.

Khuluk, R.H., Rahmat, A., Buhani, Suharso. (2019). Removal of Methylene Blue by Adsorption onto

Activated Carbon from Coconut Shell (*Cocos Nucifera L.*). *Indonesian Journal of Science & Technology*, 4(2), 229-240.

Nandiyanto, A. B., Putra, Z. A., Andika, R., Bilad, M. R., Kurniawan, T., Zulhijah, R., and Hamidah, I. (2017). Porous activated carbon particles from rice straw waste and their adsorption properties. *Journal of Engineering Science and Technology*, 12, 1-11.

Tunc, O., Tanaci, H., and Aksu, Z. (2009). Potential use of cotton plant wastes from the removal of remazol black B reactive dye. *Journal of Hazardous Materials*, 163(1), 187-198.

# Cek Plagiarisme 5

---

## ORIGINALITY REPORT

---

19%

SIMILARITY INDEX

9%

INTERNET SOURCES

16%

PUBLICATIONS

2%

STUDENT PAPERS

---

## PRIMARY SOURCES

---

- 1** "Combined Application of Physico-Chemical & Microbiological Processes for Industrial Effluent Treatment Plant", Springer Science and Business Media LLC, 2020  
Publication 1%
- 2** Y. Ammari, K. El Atmani, L. Bay, I. Bakas, S. Qourzal, I. Ait Ichou. "Elimination of a mixture of two dyes by photocatalytic degradation based on TiO<sub>2</sub> P-25 Degussa", Materials Today: Proceedings, 2020  
Publication 1%
- 3** Riyanto, A D Prawidha. "Preparation of Carbon-Chitosan-Polyvinyl Chloride (CC-PVC) Material and its Application to Electrochemical Degradation of Methylene Blue in Sodium Chloride Solution", IOP Conference Series: Materials Science and Engineering, 2018  
Publication 1%
- 4** Aulia Septiani Mutia, Teguh Ariyanto, Imam Prasetyo. "Ciprofloxacin Removal from Simulated Wastewater Through a Combined

# Process of Adsorption and Oxidation Processes Using Fe/C Adsorbent", Water, Air, & Soil Pollution, 2022

Publication

---

5	<a href="https://ifory.id">ifory.id</a> Internet Source	1 %
6	<a href="https://scholarsmine.mst.edu">scholarsmine.mst.edu</a> Internet Source	1 %
7	Tsai, W.T.. "Adsorption kinetics of herbicide paraquat from aqueous solution onto activated bleaching earth", Chemosphere, 200405 Publication	1 %
8	V P J Lairah, A D Wuntu, H F Aritonang. " Synthesis of Ag PO /HAp from Red Snapper Bone (Lutjanus spp.) For Photodegradation of Methylene Blue ", IOP Conference Series: Materials Science and Engineering, 2021 Publication	1 %
9	<a href="https://jurnal.radenfatah.ac.id">jurnal.radenfatah.ac.id</a> Internet Source	1 %
10	Goktug Tenekeci, Simon Wainaina, Ian Askew, Adil Mohammad. "Sustainable operational lane capacity for highways", Proceedings of the Institution of Civil Engineers - Transport, 2014 Publication	1 %

---



11	<a href="https://apps.dtic.mil">apps.dtic.mil</a> Internet Source	1 %
12	E. Padmini., Singh K. Prakash, Lima Rose Miranda. " Photocatalytic Degradation of Quinol and Blue FFS Acid Using TiO and Doped TiO ", Carbon letters, 2010 Publication	1 %
13	<a href="https://innovareacademics.in">innovareacademics.in</a> Internet Source	1 %
14	<a href="https://iopscience.iop.org">iopscience.iop.org</a> Internet Source	1 %
15	Rolf Sören Kraußhar. "Recent and new results on octonionic Bergman and Szegö kernels", Mathematical Methods in the Applied Sciences, 2021 Publication	1 %
16	<a href="https://journal.uad.ac.id">journal.uad.ac.id</a> Internet Source	1 %
17	<a href="https://real.mtak.hu">real.mtak.hu</a> Internet Source	1 %
18	<a href="https://www.mdpi.com">www.mdpi.com</a> Internet Source	1 %
19	A. V. Pimenov, A. I. Lieberman, J. L. Shmidt, H. Y. Cheh. "Accelerated Adsorption with Activated Carbon Fiber", Separation Science and Technology, 1995	<1 %



20

Djody Virgiawan Ramadhan, Theresia Romauli Purba, Feninda Amalia Nabilah, Mariyanto Mariyanto. "Analysis of Isothermal Remanent Magnetization (IRM) data of Brantas river sediments using IRMITS program", Journal of Physics: Conference Series, 2022

Publication

---

21

Fatih Deniz, Elif Tezel Ersanli. "A novel biowaste-based biosorbent material for effective purification of methylene blue from water environment", International Journal of Phytoremediation, 2022

Publication

---

22

Trimardji Atmono, Andre Yoan Setyanjana, Asih Melati. "Optical behaviour of CuO/Ag thin film, prepared by RF-sputtering method at 13.56 Mhz, applicated as photocatalic degradation of methylene blue dye waste", AIP Publishing, 2022

Publication

---

23

[aurora.auburn.edu](http://aurora.auburn.edu)

Internet Source

---

24

[eprints.umm.ac.id](http://eprints.umm.ac.id)

Internet Source

---

25

[repository.lppm.unila.ac.id](http://repository.lppm.unila.ac.id)

Internet Source

---

<1 %

<1 %

<1 %

<1 %

<1 %

<1 %

Exclude quotes      On  
Exclude bibliography      On

Exclude matches      Off