Water and Environmental Sustainability (WES)
ISSN: 2710-3404
DOI: 10.52293/WES.3.2.4347
H o m e p a g e: https://www.journalwes.com/

ORIGINAL RESEARCH PAPER

Methylene blue reduction utilizing waste of low-cost tea

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ARTICIEINFO

Keywords:
Methylene blue
Tea wastage
Absorption
Reduction performance

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Article History:
Received: 27 Oct, 2022
Revised: 23 Nov, 2022
Accepted: 4 Dec, 2022

ABSTRACT

Stains are extremely utilized in various industrial dying aims like materials, food, cosmetics, paper print, Leather, etc. Among those stains, Methylene blue is the most typical one that is utilized in different industries. Furthermore, Tea is one of the most popular beverages and about 3.5 million tons tea has been used yearly in the world (Kumar and al., 2005). In this investigation, Tea Wastage has been employed as an adsorbent for the deduction of Methylene blue. Differing empirical situations have experimented in various rang like absorbent dose, PH, and contact time. Absorbent tea waste balance aimed in two hours for methylene blue concentrations of thirty ppm and pH amount of four. The performance of stain exploitation improved by raising time and the diminishing PH amount of absorption. The highest reduction performance has been found in the expansion of 0.7gm dose. It dismissed the highest stain at PH 4 the removal performance has been 97.87percent. Furthermore, the percent of reduction performance is highest while the test time is 120 minutes. The outcomes demonstrated that tea wastage appears as a so low-cost absorbent for the methylene blue reduction.

Introduction

The first familiar utilization of an organic dye has been so much later, c. 4000 years ago while the blue stain indigo has been discovered in the covering of mummies in Egyptian tombs (Berton and Gordon, 1983). There have been more than 100,000 commercially existing stains by over 7107 tons of dye matter constructed yearly worldwide (Silveira and al., 2009). Stains are broadly utilized in various industrial dying aims like materials, food, cosmetics, and printing of paper, Leather, etc. This industriousness removes a more quantity of wastage to water along with various stains. The release of stain-comprising waste by not considering the appropriate filtration of water bodies generates environmental and public health hazards (Hwang and Chen, 1993). Some stains are poisonous and carcinogenic. Azo stains are famous and could penetrate the body by ingestion, which is mobilized by intestinal microorganism's generation DNA injury. There are so kinds of stains that aren't bio-degradable and travel a long distance in the surface water impacting the environment. Colorings water might have numerous toxic stains, which endanger the plant, aquatic life, and the whole ecosystem. Methylene blue is the most typically utilized material in different industriousness.

According to Methylene blue, a steady cationic dye is hard to bleach considering its

complicated design and steady chemical features (Liu and al., 2012). It contains several toxic impacts on animals and the human body. It could generate eye burns that might be enduring damage to the human eyes and animals eyes (Pirbazari and al., 2015).

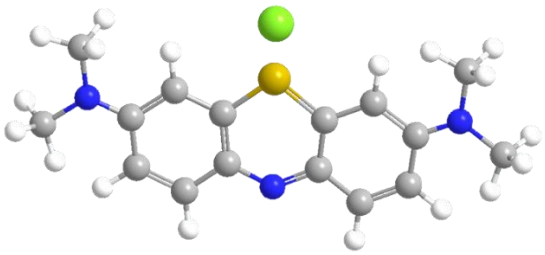

Figure 1. Chemical structure of Methylene Blue

Critical exposure to Methylene blue could generate an increased rate of heart, disgorging, surprise, cyanosis, jaundice Heinz body formation, quadriplegia, and tissue necrosis in humans (Kumar and al., 2005). It is essential for reducing this stain range from wastewater that makes suitable conditions for our ecosystem. Formerly, severe study endeavors on how to proficiently removing stains from industrial effluents have resulted in the investigations of techniques like absorption, developed oxidation, and velum partitions (Ahmad and al., 2015; Kyzas and al., 2015).

According to reports, which these methods were demonstrated to be practical and showed a variable degree of stain reduction from industrial wastewater (Yagub and al., 2014; Kyzas and al., 2015). Nowadays, the absorption method is widely utilized for reducing the stain. Absorption possesses some benefits while corresponding to previous traditional approaches in terms of clarity of use, efficacy, low-cost, etc. There are different kinds of absorbents existing under natural and chemical absorbents to perform the process many absorbents are more affordable and so easy to exist (EL Alouani and al., 2018). The performance and authority of the absorption method are mostly depending on the potential innocuous of the filtered water (Moussavi and Mahmoudi, 2009).

As the execution of an absorptive split is instantly related to the material and price-absorbent effectiveness. the last decade has seen continuous improvement in the evolution of efficacious absorbents in the form of activated carbon (Christie, 2007). Lignocelluloses (Mahmoud and Al-Bishri, 2011), clay minerals (Kumar and al., 2005), zeolites (Nabil et al., 2014), chitosan (Al-Degs and al., 2001) natural minerals (Shafeeyan and al., 2010), functionalized polymers (Panuccio and al., 2009), coal fly ash, effluent mud, biomass, and farming wastage.

Thus, there is a demand for appearing to choices for researching a low-cost absorbent, which is practical and economical, for a possible method is the utilization of tea wastage. Tea is one of the most favored drinks and about 3.5 million tons of tea has been used yearly in the universe (Boonamnuayvitaya and al., 2004). In 2017, Bangladesh made a whole of 78.95 million kg of tea, and its people uses most of that and then tea wastage is so available.

In this investigation, tea wastage was utilized as an adsorbent for the reduction of Methylene blue. Tea wastage is a cost-efficient and less biodegradable absorbent. Therefore, the effects of various doses, PH, and contact time on the amount of color reduction have been analyzed.

Methodology

Absorbent

Methylene Blue, utilized as an Absorbent in this investigation, has been purchased from India. The chemical formulation and molecular mass of Methylene Blue are $C_{16}H_{18}ClN_3S$ and 319.85g/mol orderly. Methylene Blue has been chosen in this investigation according to its known strong absorption on solids. The highest wavelength of this stain is 670nm.

Absorption preparation

The consumed tea bag has been gathered from nearby tea stalls near the Leather Engineering and Technology Institute, University of Dhaka, Hazaribag, Dhaka. The consumed tea leaves have been then spread up from the bag and cleaned by faucet water and filtered water sometimes for removing whole the impurity particle. It has been then automatically boiled by filtered water for removing caffeine, tannin, and other stains and cleaned by filtered water until the wash water possesses no stains. The washed matters have been then dried at 95 ◦C for 6 h. The parched matter has been then smashed and sifted to get a special size of 0.5 to 1 mm and held in bottles to use.

Chemical

The examination solution has been organized by counting 3g of Methylene blue in 1L filtered water. This has been accomplished for getting the expected concentration. It is critical for adjusting the pH of the solution according to conducting the examination at various PH. Analytical rate dilutes HCl acid and NaOH have been utilized for this arrangement.

Absorbent dose impact

The impact of the utilized tealeaves dose on the values of Methylene blue absorbent has

been investigated with counting various doses such as 0.50, 0.60, 0.80, 1.2, and 1.5 g of the utilized tea leaves to 250 mL conic bottle. The bottle included a substantial mass of about 50 mL in every bottle of selected primary concentration about 30 ppm of the stain solution in the temperature of 25 ◦C and of PH 4. The bottles have been then determined in a shaker for performing stimulation for 2 hours.

Solution PH Impact

In this investigation, 50 mL of stain solution of thirty ppm primary concentration at various PH amounts of about 2.0 to 13.0 has been mixed by 0.7 g of STL in a water-bath shaker at 25 ◦C. mix has been created for 120 minutes. A double-beam UV–vis spectroscope has calculated the stain concentrations. 0.1N NaOH has modified the PH and 0.1N HCl solutions and estimated utilizing a PH meter.

Contact Time Impact

The Methylene blue amount absorbed by the absorbent has been examined in various contact. a whole of 0.7 g of absorbent has been counted to 50 ml Methylene blue by a concentration of thirty ppm in certain PH 6.2 and temperature. The examination has been conducted in various time categories 20, 40, 60, 80, 100, and 120 minutes.

Reduction Performance

As the examination has been accomplished in various amounts of absorbent dose, various PH, and various time ranges, so it needs to be estimated for reduction performance. The stain reduction percent is performed by this formulation:

$$reduction\ performance = \frac{(C_i - C_f) * 100}{C_i}$$

where, C_i and C_f is the Methylene blue concentration primary and ultimate orderly.

Analytical Approach

The whole examination has been performed with a UV-Vis spectrophotometer. Before accomplishing the test, the Methylene blue solution model has been experimented with for obtaining the molar absorptivity consistent and calibration curve. This is performed by the equation of Beer-Lambert Law.

$$A = \mathrm{\mathfrak{E}IC}$$

where, A is adsorption, Molar Absorptivity Constant is demonstrated by $\mathfrak{E}$, I is Path length, and example concentration is sown by C.

The whole of the adsorbent doses have been chosen at the highest wavelength and a calibration curve has been shown utilizing Matlab. For doing this, a concentration of 30, 40, 50, 60, and 70-ppm model solution has been considered UV spectrometer. Then the resulting data has been chosen for analysis.

Discussion and results

According to Figure 2, the Methylene Blue calibration curve at 30-ppm concentration provides the maximum adsorbent amount of 2.82 at the highest wavelength of 670nm. After plot the various concentration and adsorbent values at a 670nm wavelength in the diagram, we have obtained linear tread line shown as follows. The estimated molar adsorptive steady, $\mathfrak{E}$ was $3*10^4$ $Lmol^{-1}cm^{-1}$.

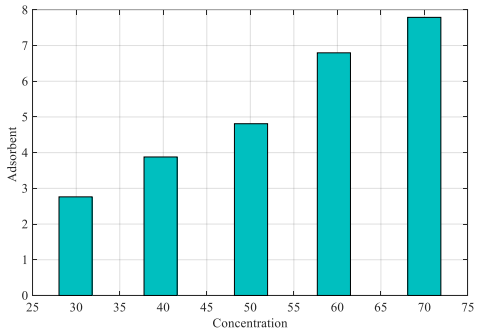

Figure 2. Calibration Curve of the Methylene Blue

Impact of absorbent dose on stain absorption

The impact of various absorbent doses on the adsorption of Methylene blue has been performed in various absorbent doses varying from 0.3 gm-1 gm demonstrated in table 1. The doses have been counted to 50 ml Methylene blue solution by a concentration of 30 ppm at PH 4 and room temperature of 25 ℃ for two hours.

Table 1. Concentration of dye solutions at different adsorbent doses.

	Concentration after filtration	Absorbent dose
1	1.52 ppm	0.30 gm
2	1.19 ppm	0.40 gm
3	0.95 ppm	0.50 gm
4	0.83 ppm	0.60 gm
5	0.64 ppm	0.70 gm
6	0.66 ppm	0.80 gm
7	0.76 ppm	0.90 gm
8	0.79 ppm	1.00 gm

According to Figure 3, the reduction performance grows at a specific dose of 0.7 gm. After that, it hasn't been growing performance. At 0.3 gm dose of absorbent, it provided a reduction

performance of 94.93 percent. The highest reduction performance has been discovered on the accumulation of 0.7 gm dose as demonstrated below.

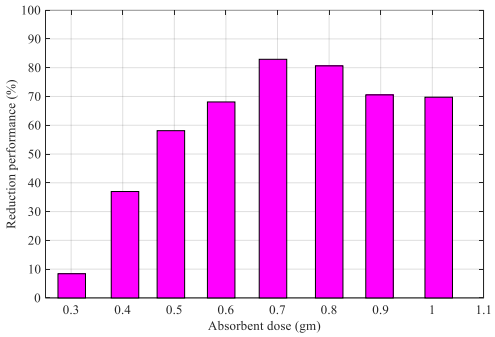

Figure 3. Absorbent vs reduction performance of Methylene blue in various absorbent dose.

Solution PH impact on stain adsorption

Table 2 demonstrates the concentration after counting 0.7gm absorbent in various PH. The impact of PH has been investigated in both acidic and basic conditions varying from two to twelve.

Table 2. Solution Concentration in various PH after dose adding

	Concentration after filtration	Solution - PH
1	0.92 ppm	02
2	0.79 ppm	03
3	0.64 ppm	04
4	0.77 ppm	05
5	1.03 ppm	06
6	1.04 ppm	08
7	1.07 ppm	10
8	1.13 ppm	12

Figure 4 demonstrates various percent of stain reduction in various PH. At PH 2, it presented a reduction performance of 96.93 percent. It released the highest stain at PH 4 the reduction performance has been 97.87percent. It is notable from the diagram the reduction performance percent reduces by the PH growth.

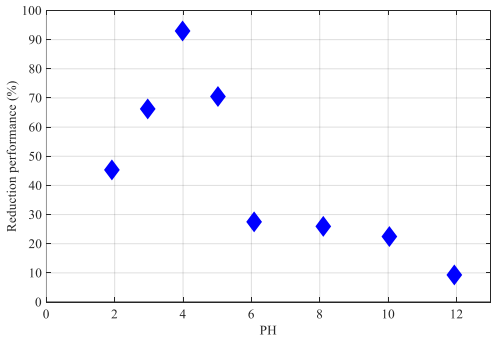

Figure 4. Reduction performance percent in various PH

Contact time impact on stain adsorption

The contact time impact on the reduction of stain has been investigated in various periods. Table 3 demonstrates the concentration of Methylene blue after treatment with the absorbent at the period from 20-160 min.

Table 3. The stain solution concentration at the various period.

	Concentration after filtration	Time
1	1.23 ppm	20 min
2	0.95 ppm	40 min
3	0.91 ppm	60 min
4	0.89 ppm	90 min
5	0.80 ppm	100 min
6	0.64 ppm	120 min
7	0.68 ppm	140 min
08	0.69 ppm	160 min

Figure 5 demonstrates the percent of reduction performance highest while the test time is 120 minutes. At a period of 20 minutes, its reduction performance was 95.9 percent. After 120 minutes, the percent of reduction performance diminishes over time.

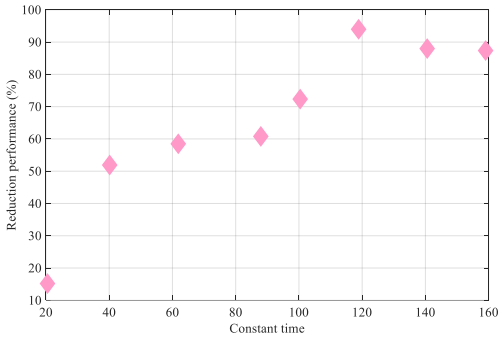

Figure 5. Reduction performance percent in various period

Conclusion

Consumed tealeaves are so low-cost and efficiently accessible matter that could be utilized as a perfect absorbent for Methylene Blue reduction. Although it doesn't reduce 100percent stain from the solution, it reaches 100 percent which could be regarded as a fine absorbent as compared to other adsorbents. The stain reduction dose has been discovered to differ by absorbent dose, PH, and contact period. Thus, the absorbent is anticipated to be economically possible for the reduction of Methylene blue stain from aqueous solutions.

Acknowledgement

The research is supported by the Public Welfare Technology Application Research Project

of Zhejiang Province, China (No. LGF22B070001), the New-Shoot Talents Program of Zhejiang Province, China (No. 2021R426059),
The National College Student Innovation and Entrepreneurship Training Program (202210346069 & 202210346070), the Science Foundation of Qianjiang College (No. 2022QJJL06), and the Science Foundation of Qianjiang College and Meiya Company's Project.

Conflict of interest

The author declares there is no conflict of interest.

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