International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

Decolourization of Procion Red mx5b Dye by Electrochemical Oxidation

Rashid Mohamed Abdulsalam Jabir[1], Dr. Attar Salim Jamaruddin[2], Prof. K. S. Kulkarni[3]

Abstract: ***In the present study, the electrochemical oxidation experiment was conducted for the decolourization of procion red mx5b dye. A number of batch experiments were run in a laboratory-scale that was analyzed at every 15 min regular intervals, for a total period of 60 min. The results are reported in terms of percentage removal Color. Synthetic effluent was treated with electrochemical oxidation having the stainless steel as anode and cathode. The effects of operational parameters such as current density, Effect of dye concentration (2, 5, 7, 9, 11 ppm) and effect of pH (2, 4, 6, 8, 10, and 12) on the decolourization of procion red mx5b dye was studied at optimistic condition i.e. 25V. It was observed that highest decolourization (99%) was achieved for 2 ppm concentration of procion red mx5b dye. It can be concluded from the results that SS as anode found to be effective in treating this electrolyte and could be effectively used for pretreatment.***

Keywords: Decolourization, Electrochemical Oxidation, Procion Red Mx5b Dye, Textile Effluent, Stainless Steel Electrodes, UV Spectrophotometer.

1. Introduction

The textile industry consumes large amount of water for different processing thereby producing large amount of wastewater. In general, the wastewater produced from textile industries is found to contain high amount of pollutants with high total dissolved solids and suspended solids. The wastewater is highly viscous and colored due to pigments and suspended solids respectively. [1-15]

Dye released to the environment impart colour will directly affects the aquatic life by decreasing the reoxygention of water. The observed by many researchers that the conventional treatments like biological treatments, coagulation/ flocculation treatment do not give satisfactory results. Some techniques of treatment of textile such as Membrane separation and adsorption have the limitation for the effective treatment of textile effluent. Advance oxidation process is considered as effective and attractive treatment for the treatment of textile effluent. [2-6]

Electrochemical oxidation is promising method for the textile effluent. Electrochemical treatment display high efficiency and also prevents the unwanted products.

Recently electrochemical techniques have been growing with interest for the treatment of wastewater containing organic pollutants [19]. The electrochemical process contains two important features which are converting non-biocompatible organics into biocompatible compounds and oxidation of organics into carbon dioxide and water. Many researchers engaged on different electrodes like platinum, copper, zinc, nickel, stainless steel, lead acid battery, graphite, titanium, to get higher degradation efficiency. [6-17]

The objective of this study was to investigate the effect of current density, pH and initial dye concentration on electrochemical degradation (removal) of (Procion Red Mx5b) from its aqueous solution through electrochemical potential.

Procion MX: Procion MX is a cold water reactive dye which could be used at normal room temperature. Fiber reactive dyes produce colour inside the fiber rather than on its surface, hence have light fastness and wash fastness. They are excellent for direct applications such as printing, spatter-painting and immersions dyeing methods. [10]

Properties of (Procion Red Mx5b):

composition	*Mp*	*absorption*	*ChEBI ID*
Dye content, 40%	>300 °C (lit.)	**λmax 538 nm**	CHEBI:53726

The typical structure of Procion Red Mx5b dye as shown in figure No.1

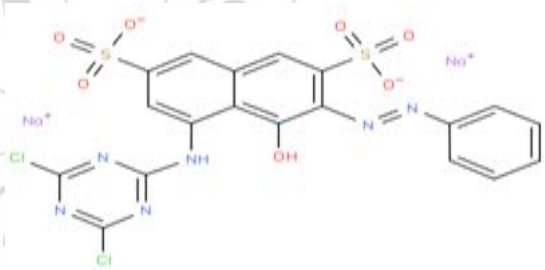


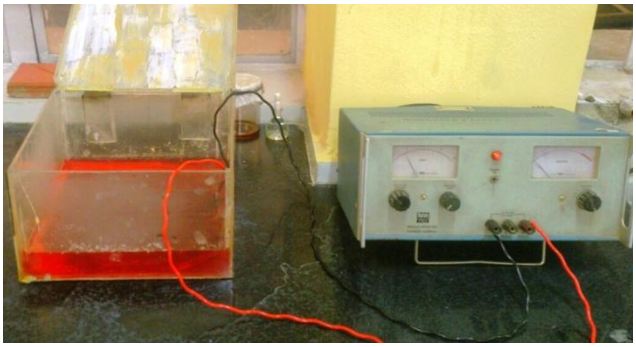
Figure 1: Typical Structure of Procion Red Mx5b Dye

2. Material and Method

2.1 Material

Procion Red Mx5b dye (CHEBI ID: 53726), NaOH, H_2SO_4, salt were used for the experimentation.

2.2 Apparatus



Setup of Electrochemical Oxidation

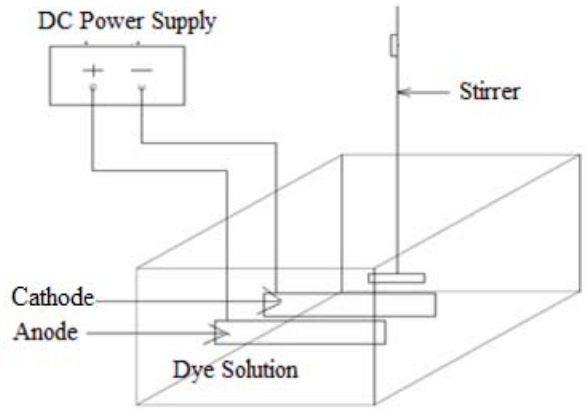


Figure 2: Schematic Diagram of Electrochemical Oxidation

The reactor was fabricated by using acrylic sheet. The dimensions of the reactor were 25 cm× 25 cm × 15 cm. The stainless steel electrodes were (18 cm × 2.5 cm × 0.1 cm) as an anode and (18 cm × 2.5 cm × 0.2 cm) as a cathode were placed 6 cm apart which were attached to DC supply.

2.3 Method

With the help of this experimental setup the scheme of experiment was conducted. For each experiment 2 liter of aqueous dye solution was prepared. The pH of the synthetic effluent was adjusted to desired level using 1N NaOH and 1N H_2SO_4. The pH values were measured by using pH meter (Labline Auto digital pH meter).

- **Electrochemical Oxidation**

Prior each experiment electrodes were dipped into dilute HCl for few minutes and then washed with distilled water. 1 gm of common salt was added as a supporting electrolyte. In this system first we have optimized the voltage for the decolourization of dye. In this work the effect of initial dye concentration and effect of pH on the decolourization was evaluated.

2.4 Analysis

The efficiency of dye decolourization was evaluated by monitoring at maximum absorption wavelength (530 nm) with UV Spectrophotometer (LABINDIA UV 3000+ UV/ VIS spectrophotometer).

3. Result and Discussion

3.1 Voltage variation

The experiments were carried out by varying the voltage from 5 V to 25 V at 5 ppm dye concentration. It was observed that with increase in the voltage dye decolourization was also increased. It was found that at 25 V the highest decolourization of procion red mx5b was achieved.

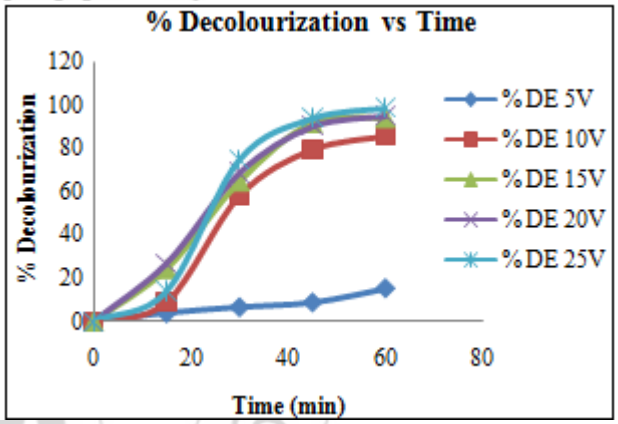


Figure 3: Variation of voltage

3.2 Effect of initial Dye Concentration

Effect of initial dye concentration was evaluated by using the optimized voltage 25V. Fig. 4 shows the decolourization of procion red mx5b at different dye concentration. It was observed that with the increase in the initial dye concentration the decolourization was decreased. It was observed that at 2 ppm the highest decolourization in 60 minute.

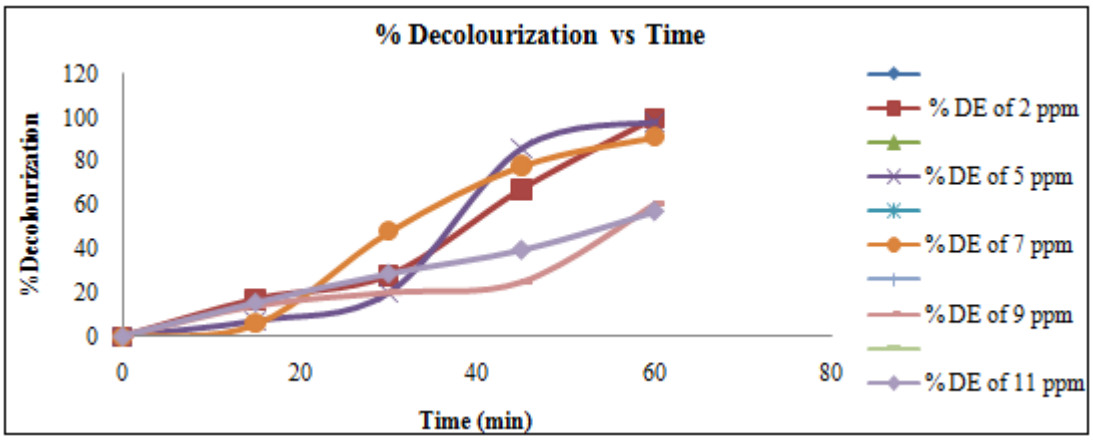


Figure 4: Effect of initial dye concentration

3.3 Effect of pH

Solution pH varied from 2 to 12 in order to determine the effect on the electrochemical decolourization of procion red mx5b. Fig. 5 shows the percent decolourization at different pH values.

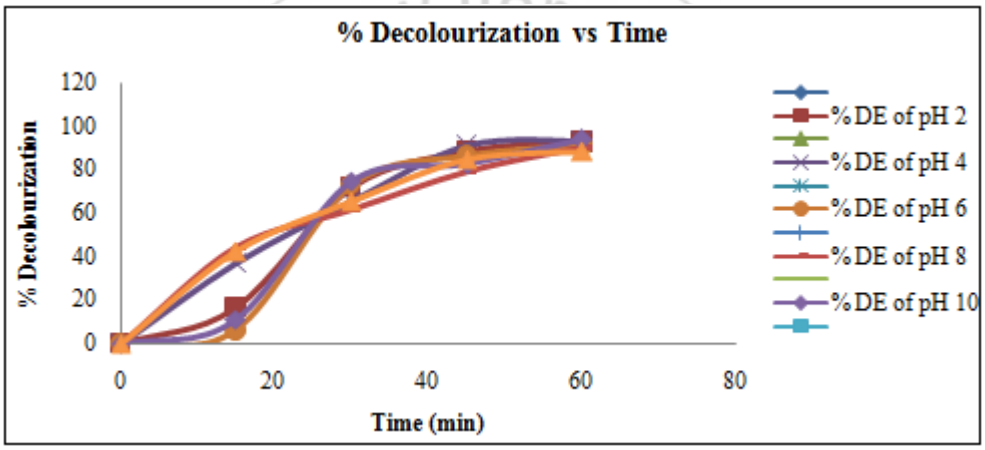


Figure 5: Effect of pH

4. Conclusion

The results of the present studied showed the electrochemical oxidation could be the effective treatment for the decolourization of procion red mx5b.The initial dye concentration shows the significant effect on the procion red mx5b dye decolourization while it was observed that there was no significant effect of pH variation on decolourization. From the study we proposed that the electrochemical oxidation could be the best solution for the effective treatment of textile wastewater.

References

[1] K. T. Fletcher, Design the Environment and Textile: Developing Strategies for Environmental Impact Reduction, Journal of the Textile Institute, 89, 1998, 72-80.

[2] H. A. Mekkawy, M.O. Ali, A.M El- Zawahry, Toxic effect of synthetic and natural food dyes on renal and hepatic functions in rat, Toxicology Letters, 1998, 95-155.

[3] S. Sathian, M. Rajasimman, G. Radha, V. Shanmugapriya, C. Karthikeyan, Performance of SBR for the treatment of textile dye wastewater: optimization and kinetic studies, Alexandria Engineering Journal, 53, 2014, 417- 426.

[4] Muhammad Saqib Nawaz, Muhammad Ahsan, Comparison of physico- chemical advance oxidation and biological techniques for textile wastewater treatment, Alexandria Engineering Journal, 53, 2014, 717- 722.

[5] Hala Yassin El- Kassas, Laila Abdelfattah Mohamed, Bioremediation of the textile waste effluent by Chlorella vulgaris, Egyptian Journal of Aquatic Research, 40, 2014, 301- 308.

[6] Karuppan Muthukumar and P Shunmuga Sundaram, Treatment of textile dye wastewater by using an electrochemical bipolar disc stack reactor. J of chemical technology and Biotechnology, 2004, 79:1135-1141.

[7] Debabrata mazumder, Process evaluation and treatability study of wastewater in a textile dyeing industry, International Journal of Energy and Environment, 2(6), 2011, 1053- 1066.

[8] Jhilly Dasgupta, Jaya Sikder, Sudip Chakraborty, Stefano Curcio, Enrico Drioli, Remediation of textile effluent by membrane based treatment techniques: A state of the art review, Journal of Environmental Management, 147, 2015, 55- 72.

[9] Mohammadine El Haddad, Rachid Slimani, Rachid Mamouni, Said ElAntri, Said Lazar, Removal of two textile dyes from aqueous solutions onto calcined bones, Journal of the Association of Arab Universities for Basic and Applied Sciences, 14, 2013, 51- 59.
[10] Ghaly AE, Ananthashankar R, Alhattab M, Ramakrishnan VV (2014) Production, Characterization and Treatment of Textile Effluents: A Critical Review. J Chem Eng Process Technol 5: 182. doi: 10.4172/2157-7048.1000182.
[11] C. Hachem, F. Bocquillon, O. Zahrra, M. Bouchy, Decolourization of textile industry wastewater by the photocatalytic degradation process, Dyes and Pigments, 49, 2001, 117- 125.
[12] Masood Hamadanian, Ali Sadeghi, Ali Mohammadi Mehra, Vahid Jabbari, Photocatalyst Cr doped TiO2 nanoparticles: Fabrication characterization and investigation of the effect of doping on methyl orange dye degradation, Material Science in Semiconductor Processing, 21, 2014, 161-166.
[13] R. Lakshmi Narayana, Manickam Matheswaran, Azrina Abd Aziz, Pichaih Saravanan, Photocatalytic decolourization of basic green dye by pure and Fe, Co doped TiO_2 under daylight illumination, Desalination, 269, 2011, 249- 253.
[14] C. Sahoo, A.K. Gupta, Anjali Pal, Photocatalytic degradation of crystal violet (C.I. Basic Violet 3) on silver ion doped TiO_2, Dyes and pigments, 66, 2005, 189- 196.
[15] J Hussain, I Hussain, and M Arif. "Characterization of textile wastewater", Journal of Industrial Pollution Control, 2004, Vol. 20(1), pp.137-144.
[16] Chung- Hsuang, Photocatalytic reaction characteristics of a metal doped photocatalyst: Dying wastewater treatment, Journal of chinese institute of environmental engineering, 11(2), 2001, 143- 150.
[17] M. M. Ahmed, Electrochemical Oxidation of Acid Yellow and Acid Violet Dyes Assisted by Transition Metal Modified Kaolin, Portugaliae Electrochimica Acta 26(6), (2008) 547-557.
[18] P. Sarala, T. V. Venkatesha, Effect of Cathode Materials on Electrochemical Degradation of Luganil Blue N and Acid Red I, Portugaliae Electrochimica Acta, 31(3), 2013, 175-183.
[19] Bhavna D Soni, Jayesh P Ruparelia, Decolourization and mineralization of Reactive black-5 with transition metal oxide coated electrodes by electrochemical oxidation, Procedia Engineering, 51, 2013, 335 – 341.
[20] Indu M. S., A. K. Gupta, C. Sahoo, Electrochemical Oxidation of Methylene Blue using Lead Acid Battery Anode, APCBEE Procedia, 9, 2014, 70 – 74.