A COMPARATIVE STUDY ON REMOVAL OF METHYLENE BLUE AND MALACHITE GREEN DYE EFFLUENT BY USING KOILINCLAY

G. Jesline Mary*, K. Priyadharshini*, P.Jency*, K.Kartheeswari

Department of Chemistry and Physics, Nadar Saraswathi College of Arts and Science, Theni, Taminadu,

E -Mail: jeslinemary30@gmail.com

Abstract: The present study deals with the removal of Methylene Blue and Malachite Green dye by using a low cost adsorbent Kaolin, and to characterize by UV-visible, FTIR spectroscopic techniques. The adsorbent was tested for the removal of Methylene Blue (MB) and Malachite Green dye in aqueous solution with various experiment parameters like initial concentration, contact time and Dose..To apply various adsorption isotherms models and kinetics equation in order to model adsorption data with an aim to know about the mechanism of adsorption of the dye.

Key Words: Adsorption, Dye, Adsorbent, Kaolin

1. Introduction:

Water is the most important in human life and this utility is use in many industries such as food processing, metal producing industry, paper and wood process, chemicals, oil and gases, textile industries, laundry services and other industries. Most of the industries just release the wastewater to the drain or river and the wastewater can induces water pollution.

The Textile industries consume large volumes of water and dye chemicals for wet processing of textiles. The chemical reagents used are very diverse in chemical composition, ranging from inorganic compounds to polymers and organic products.[1,2,3].

Normally colour is visible at a dye concentration higher than 1 mg L^{-1} and an average concentration of 300 mg L^{-1} has been reported in effluents from textile manufacturing processes[4,5] Over 7×10^5 ton and approximately 10,000 different dyes and pigments are produced annually world-wide, about 10% of which may be found in wastewater[6].

In present day, the most important problems affecting on people live are inorganic and organic pollutants. The increase of pollution in recent years is due to growing industry[7], several

people die from the penalties of unsafe water[8]. So, it is necessary to diminish dye concentration in the wastewater.

2. Method and Materials

2.1 Characterization of the Dye

UV–visible spectrum and FTIR of dye (MB & MG) were recorded using Double Beam Spectrophotometer—2202 (Systronics) and FTIR 8400S (Shimadzu), is an analytical technique used for the elemental analysis or chemical characterization of a sample.

2.2Applications of the adsorbent

The adsorbent (Kaolin) was analysed for the removal of Methylene Blue and Malachite Green Dye.

2.3 Removal of dye

The various experiments in this adsorption study were carried out by employing the batch adsorption technique. Adsorption of the methylene Blue and Malachite Green dye on Kaolin adsorbent was studied under three different experimental conditions in order to understand the effect of the following process parameters.

1. Initial concentration of the dye
2. Contact time
3. Dose

In order to find out optimum experimental conditions for the removal of the dye Methylene Blue and Malachite Green dye by adsorption studies were carried out by varying the following experimental parameters.

3. RESULTS AND DISCUSSION

3.1 Effect of initial concentration

Studies on removal of dye MB dye and MG dye by using kaolin. The different concentration of MB dye and MG dye (300ppm – 600ppm) is taken at constant time 30 min. The percentage removal of dye was found to increase with decrease of MB dye and MG dye decrease to increase of initial concentration.

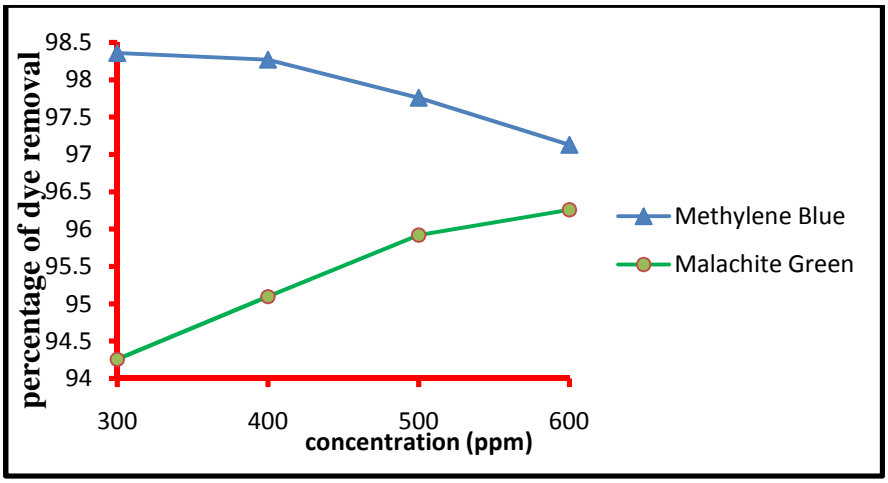

Figure:1 Initial concentration plot

In Freundlich adsorption isotherm the 1/n value is lower than unity. Indicating the favorable adsorption process as it is equal to 0.9479 for MB equal to 0.9858 for MG.

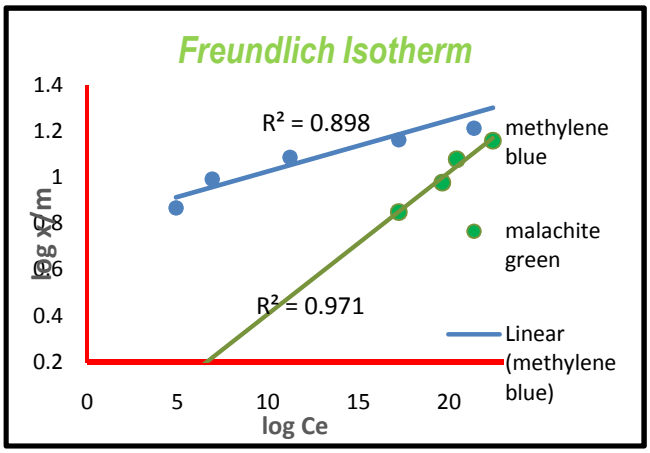

Figure :2 Freundlich Isotherm

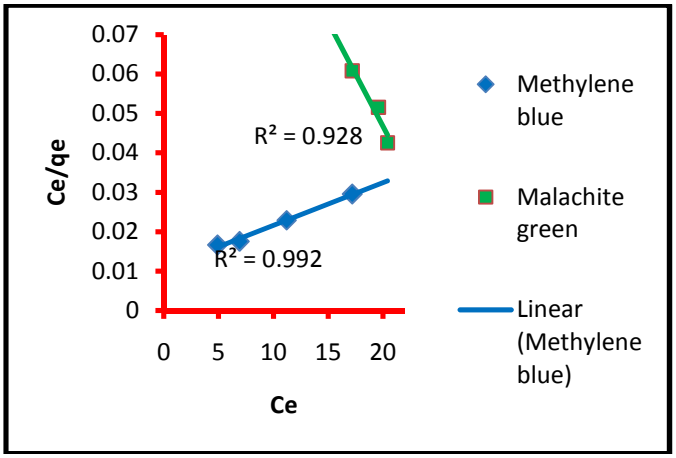

Figure: 3 Langmuir plot

3.2 Effect of time

The contact time has a significant effect in dye adsorption studies. in order to study the kinetics adsorption of MB and MG dye into kaolin, adsorption experiments were carried out at different contact time (10-60min) at constant optimum initial concentration fixed with $1gL^{-1}$ of kaolin. The percentage removal of MB and MG dye reading for increase to increase.

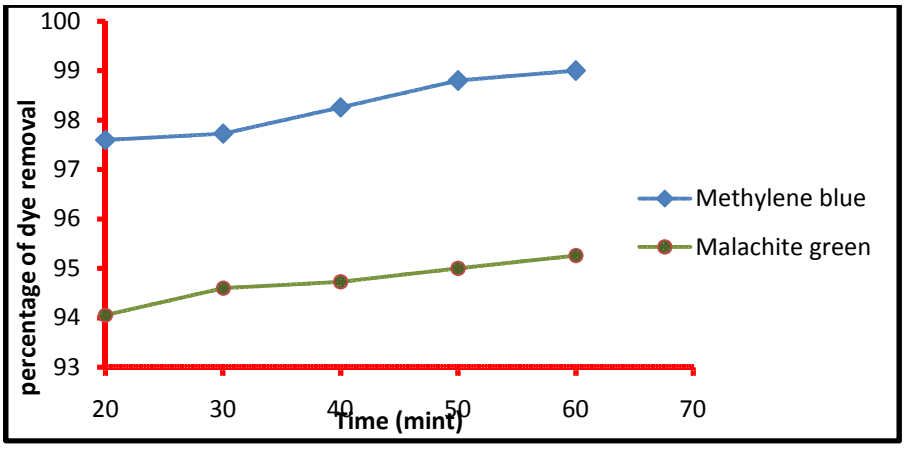

Figure :4 contact time

3.3 Effect of dose

To study the effect of adsorbent dose, the experiments are performed at various doses of adsorbent lying between MB and MG solution..The results of this study % removal of dye is almost same lying between (95.2 – 97.2% for MB and 92.53% - 93.2 for MG).

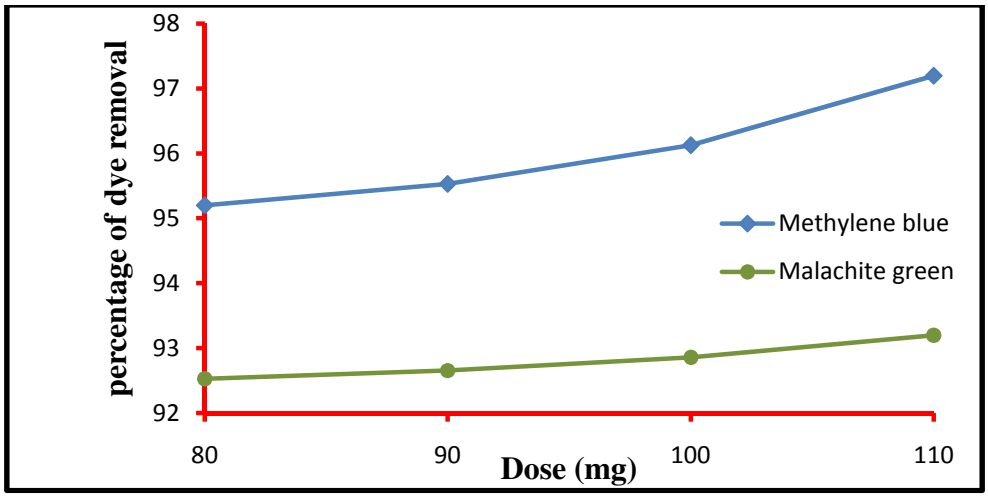

Figure: 5 Effect of Dose

4. Characterization of MB and MG

4.1 UV-Visible spectroscopy of kaolin

The UV-visible spectrum shows the dyes are degradation of MB and MG dyes on 260nm to 663nm.It is clearly explain the methylene blue and malachite green dye are degradation in after adsorption.

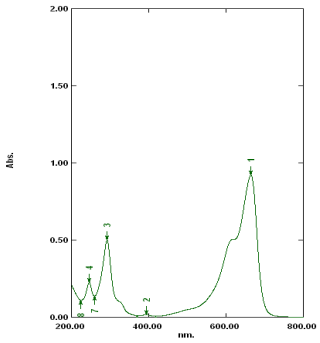

Figure : 6UV-visible spectra of MB dye before (a) and after (b) adsorption

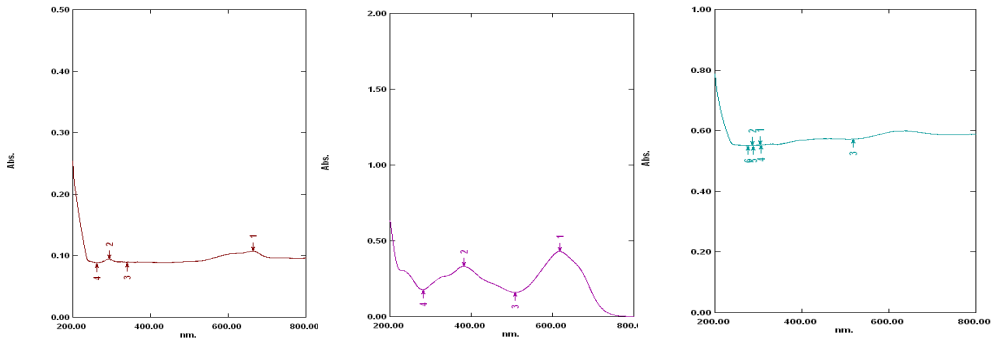

Figure : 7UV-visible spectra of MG dye before (a) and after (b)adsorption

4.2 FTIR spectroscopy for kaolin

FTIR spectra (Fig.8 and Fig.9) shows that the bands at 3616 and 3396 cm^{-1} were correspond to the O–H vibration for kaolin. The bands at 1001 and 1109 cm^{-1} attributed to Si–O stretching vibration. In addition, the band at 1635 cm^{-1} for kaolin maybe related to the C=C ring stretching in polyphenols, indicating the formation of the iron–polyphenols complex.

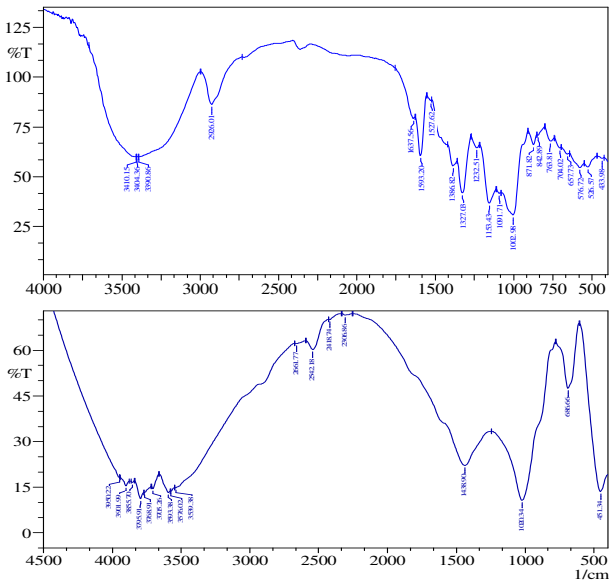

Figure :8FTIR – Spectra for MB dye before after (b) on kaolin

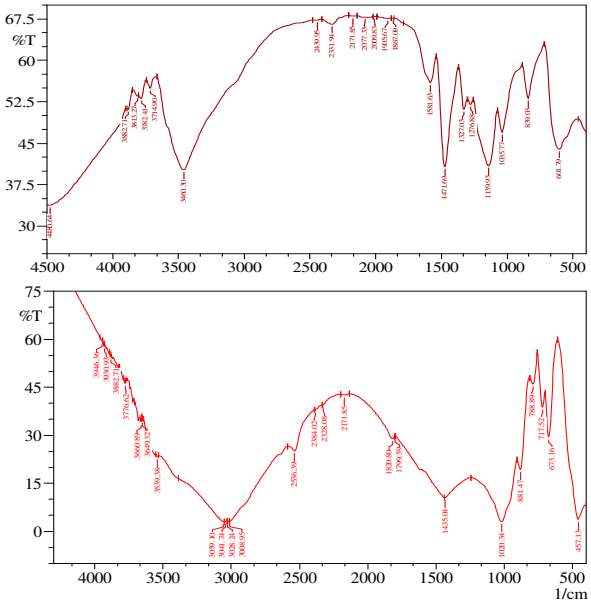

Figure: 9FTIR – Spectra for MGdye before (a) after (b) on

5. Conclusion

- The batch experiment conducted with the adsorption demonstrated that kaolin the potential removal of methylene blue and malachite green dye from aqueous solution.
- The percentage removal of MB and MG dye by kaolin were found to increase with the decrease in initial concentration of dye. It is due to the lackof availableactive sites required for higher initial concentration.
- The optimuminitial concentration ofdye at which the maximum percentage removal takes place was found to be 300 ppm for kaolin adsorbents.
- Langmuir and Freundlich adsorption isotherms were tested and found to be applicable. Kaolin layer coverage of dye molecules exist on the surface of this system.
- The percentage of removal of dye MB and MG was found to increase with the increasein contact time. The optimum contact time was found to be 30 min
- The percentage of removal of dye MB and MG by adsorption on kaolin was found to increase with decrease in dose.
- The prepared dyes were characterized by UV-visible;FTIR spectroscopic techniques confirm the formation and also the adsorption of MB and MG dye on their surface.

From this work, it can be concluded that kaolin adsorbent can be mostly used as adsorbents for removal of MBdye compared than MG dye.

6. Reference

1. K.ShahulHameed. K, Aruna Devi . R and M.Meenakshisundaram (2017), Comparative study of various adsorbents on the remova of Nile Bue in aqueous solution, *Int.joural of Modern Trends in Engineering and Research* , ISSN: 2393-8161.
2. Combes RD., Havel and-Smith RB, (1982)- A review of the genotoxicity of food, drug and cosmetic colours and other azo, triphenyl methane and xanthene dyes. *Mut. Res*. 98(2):101-243.
3. Vadivelan.V,Kuma.K.V, (2005)- Equilibrium, kinetics, mechanism, and process design for the sorption of methylene blue onto rice husk, *J. Colloid Interface Sci*., 286,90-100.
4. NazimaBanu S.(2019), Comparative study of photodegradation of methylene bue and methyl orange in presence of soar ight using green synthesized CuOnanocatalyst , *Int.journal of Engineering and appied* sciences technology , Volume 4 issues 8.

5. Gaston Fumba, Jean Serge Essomba, Guy MerlainTagne, Julius NdiNsami,PlacideDésiréBélibiBélibi and Joseph KetchaMbadcam,(2014)-Equilibrium and Kinetic Adsorption Studies of Methyl Orange from Aqueous Solutions Using Kaolinite, Metakaolinite and Activated Geopolymer as Low Cost Adsorbents-*Journal of Academia and Industrial Research (JAIR)*Volume 3, Issue 4 .
6. BaghaA.R,H.Nikkar,N.Mahmoodi, M.Markazi, F. MMenger, (2011)-The adsorption of cationic dyes onto kaolin: Kinetics,isothermandthermodynamicstudies**,***Desalination,* 266, 274- 280.
7. Abd El-Latif MM, El-Kady MF, Ibrahim AM, Ossman ME. (2010) Alginate/polyvinyl alcohol-kaolin composite for removal of methylene blue from aqueous solution in a batch stirred tank reactor. *J Am Sci*.,6: 280.
8. Krishnan, B. Radha, M. Ramesh, M. Selvakumar, S. Karthick, A. Sasikumar, D. VarunGeerthi, and N. Senthilkumar. "A Facile Green Approach of Cone-like ZnO NSs Synthesized ViaJatrophagossypifolia Leaves Extract for Photocatalytic and Biological Activity." JOURNAL OF INORGANIC AND ORGANOMETALLIC POLYMERS AND MATERIALS (2020).
9. Beemaraj, Radha Krishnan, MathalaiSundaram Chandra Sekar, and VenkatramanVijayan. "Computer vision measurement and optimization of surface roughness using soft computing approaches." Transactions of the Institute of Measurement and Control (2020): 0142331220916056.
10. Krishnan, B. Radha, and M. Ramesh. "Optimization of machining process parameters in CNC turning process of IS2062 E250 Steel using coated carbide cutting tool." Materials Today: Proceedings 21 (2020): 346-350.
11. Parthiban, A., A. Mohana Krishnan, B. Radha Krishnan, and V. Vijayan. "Experimental Investigation of Mechanical and Wear Properties of AL7075/Al 2 O 3/MICA Hybrid Composite." Journal of Inorganic and Organometallic Polymers and Materials (2020): 1-9.
12. Dr. Radha Krishnan B, Ph.D, Dr. Harikishore S, and Dr. V. Vijayan, Wear Behavior of B4C reinforced Al6063 matrix composites electrode fabricated by stir casting method (2020).Transactions of the Canadian Society for Mechanical Engineering DOI: 10.1139/tcsme-2019-0294.
13. Karthikeyan, N., B. Radha Krishnan, A. VembathuRajesh, and V. Vijayan. "Experimental analysis of Al-Cu-Si metal matrix composite by powder-metallurgy process." Materials Today: Proceedings (2020).
14. Sanjeevi, R., G. Arun Kumar, and B. Radha Krishnan. "Optimization of machining parameters in plane surface grinding process by response surface methodology." Materials Today: Proceedings (2020).

15. Sanjeevi, R., R. Nagaraja, and B. Radha Krishnan. "Vision-based surface roughness accuracy prediction in the CNC milling process (Al6061) using ANN." Materials Science 2214 (2020): 7853.
16. Veluchamy, B., N. Karthikeyan, B. Radha Krishnan, and C. MathalaiSundaram. "Surface roughness accuracy prediction in turning of Al7075 by adaptive neuro-fuzzy inference system." Materials Today: Proceedings (2020).
17. Giridharan, R., A. VennimalaiRajan, and B. Radha Krishnan. "Performance and emission characteristics of algae oil in diesel engine." Materials Today: Proceedings (2020). (Scopus Indexed)
18. Radha Krishnan, B., Vijayan, V., ParameshwaranPillai, T. and Sathish, T., 2019. Influence of surface roughness in turning process—an analysis using artificial neural network. Transactions of the Canadian Society for Mechanical Engineering, 43(4), pp.509-514.
19. Krishnan, B. Radha, and M. Ramesh. "Experimental evaluation of Al-Zn-Al2O3 composite on piston analysis by CAE tools." Mechanics and Mechanical Engineering 23, no. 1 (2019): 212-217.
20. Krishnan, B. R., V. Vijayan, and G. Senthilkumar. "Performance analysis of surface roughness modelling using soft computing approaches." Applied Mathematics and Information Sci 12, no. 6 (2018): 1209-1217.
21. Kumar, N. Saran, N. Kaleeswaran, and B. Radha Krishnan. "Review on optimization parametrs in Abrasive Jet Machining process." International Journal of Recent Trends in Engineering and Research 4, no. 10 (2018): 2455-1457.
22. BR Krishnan, M Ajith, RA kumar, P Bala, GG Maurice, "Determination of Surface Roughness in AA6063 Using Response Surface Methodology". International Research Journal of Engineering and Technology 5 (3), 2556-2558
23. Radhakrishnan, B., P. Ramakrishnan, S. Sarankumar, S. Tharun Kumar, and P. Sankarlal. "Optimization of CNC machining parameters for surface roughness in turning of aluminium 6063 T6 with response surface methodology." SSSG international journal of mechanical engineering–(ICCRESt 17), Specia issue 23 (2017).
24. Krishnan, B. Radha, R. Aravindh, M. Barathkumar, K. Gowtham, and R. Hariharan. "Prediction of Surface Roughness (AISI 4140 Steel) in Cylindrical Grinding Operation by RSM." International Journal for Research and Development in Technology 9, no. 3 (2018): 702-704.
25. KRISHNAN, B. RADHA, and K. ARUN PRASATH. "Six Sigma concept and DMAIC implementation." International Journal of Business, Management & Research (IJBMR) 3, no. 2, pp: 111-114.
26. 3Krishnan, B. Radha. "Review Of Surface Roughness Prediction In Machining Process By Using Various Parameters." Int. J. Recent Trends Eng. Res.(IJRTER) 6, no. 1 (2020): 7-12.

27. Krishnan, B. Radha, C. MathalaiSundaram, and A. Vembathurajesh. "Review of Surface Roughness Prediction in Cylindrical Grinding process by using RSM and ANN." International Journal of Recent Trends in Engineering and Research 4, no. 12 (2018): 2455-1457.
28. Sundar, S., T. Sudarsanan, and Radha Krishnan. "Review of Design and Fabrication of four wheel Steering system." International Journal of Recent Trends in Engineering & Research (IJRTER) 4, no. 10 (2018): 1034-1049.
29. Radhakrishnan, B., Sathish, T., Siva Subramanian, T.B., Tamizharasan, N. and VarunKarthik, E., 2017. Optimisation of Surface Roughness in CNC Milling Process Using RSM. SSRG International Journal of Mechanical Engineering-(ICRTECITA-2017)
30. Bensalah.N, Alfaro, M. A. Q., and martãnez-Huitle, C. A. (2009), "Electrochemical treatment ofSynthetic wastewaters containing Alphazurine A dye."Chemical Engineering Journal, 149(1), 348-352.