Neem Leaves as Adsorbent for Dye Waste water Treatment

Jyoti Rana, Gyanendra Goindi, Navneet Kaur

Abstract: : ***In the present investigation , neem leaves are obtained from the agricultural fields and its potential for the removal of dye is tested with the model system of methylene blue in water . The MB has health hazards, its been reported that exposures to the dyes cause allergic reactions, and hence its reflected as toxic. The results obtained from batch experiments are quite useful in giving information about the efficacy of dye-adsorbent system. The influence of factors such as the initial pH value, adsorbent dose, and time of contact was investigated. The results indicate that the percentage removal also increased with the rise in the adsorption capacity (qe). 82% of colour elimination can be obtained at the dose of 100g/l NLP for methylene blue of 10mg/l concentration. The optimal parameters for this experiment were 10mg/l for initial dye concentration, 5gm/50ml adsorbent dosage and pH 8. In the batch system, the adsorption capacity was increased when the parameters were increased until it achieved the equilibrium. Langmuir adsorption isotherm graphics plotted with l/qevis 1/Ce. Trend lines for the adsorption data of different concentration of methylene blue with neem leave as adsorbent is plotted. The linear regression was piloted using plot l/qevis 1/Ce; it was found that R^2 value are quite closer to 1 signifying Langmuir isotherm as a good fit for this experimental data. Results indicated that neem leaves has potential to remove Methylene Blue Dye from aqueous streams and can be successfully used as a low cost adsorbent.***

Keywords: Methylene Blue, adsorbent, Neem leave, Langmuir adsorption isotherm.

I. INTRODUCTION

The discharge of large volume of textile effluents causes severe environmental effects. These dyes effluents are major contributors of pollution load. Presence of dye concentration does not allow penetration of sunlight and hence destroy aquatic life which directly affects food chain. Certain synthetic dyes are so harmful and have severe adverse effects on human health as they are mutagenic and carcinogenic in nature [1]. Serious environmental effects results because of production of toxic amines, which rare generated by anaerobic decomposition or partial bacterial degradation [2][5]. The elimination of these textile dyes from aqueous stream is one of the main challenge and concern [3]. Many technologies have been presented to treat this textile effluents. Most of the conventional methods used are expensive[4].Various researchers have carried out different studies which shows as adsorption is fairly successful because of its simplicity and competence [5][10][11][12]. Activated carbon is one of the most commonly used adsorbent in adsorption method. Which shows very high percentage removal efficiency for various dyes from aqueous streams. However, activated carbon is highly costly which its drawback for its usage is. [6].As a result, its application for large volume of effluent treatment is rare. .Numerous bio-absorbent have been used as an effective adsorbent to treat these dye effluents as a low cost effective technique [12][13][14]. It's prospective advantages over the conventional adsorbents are less cost, high efficiency, less chemicals usage, regeneration ability and minimum waste [6][7][8][9]. The present investigation is an attempt to identify the potential of Neem leaves (Azadirecta indica) for the removal of Methylenr Blue from aqueous streams.

Neem leaves were collected from the different trees from Panchkula. Repeatedly washing was done by using distilled water for the removal of impurities and then dried sun for three days later hot air oven drying was done at 105^{o}C for 24 hours. Grounding of these dried leaves was done followed by screening by 10- 15 um mesh size. Prepared leaves were stored in air tight glass bottle and kept in refrigerator. Methylene blue stock solution was prepared by dissolving 1 g of methylene blue powder in 1000 ml of distilled water. Further serial dilutions were done from this stock solution. The calibration curve of Methylene blue was prepared using these dilutions by measuring absorbance using spectrophotometer. Three parameter were varied pH, Contact Time and adsorbent dose were varied.

"Figure 1" Dried Neem leave Powder

II. BATCH ADSORPTION EXPERIMENT

From the stock solution 10 ppm dye solution was made by serial dilution. Three parameters pH, contact time and neem leave adsorbent dose were varied. The batch adsorption investigations were carried out by taking 100ml of 10ppm dye solution in conical flasks. These conical flasks were placed on mechanical shaker machine for one hour at 150 rpm The adsorption capacity during the experiment was studied by taking out the flask after desired contact time, filtering the solution using syringe filters, analyzing the supernatant solution spectrophotometric ally at 650nm. Percentage removal was calculated (Q%).

Where %Q is expressed as

$$\%Q = (Ci-Cf)/Ci \times 100$$

Where, % Q = percentage of dye adsorbed

Ci = initial concentration of dye (mg/lit)

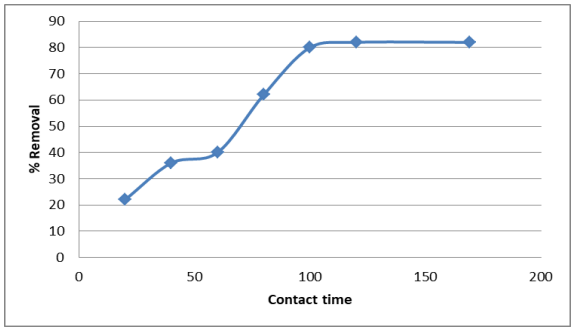
Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

Cf = final concentration of dye (mg/lit)

III. RESULTS AND DISCUSSIONS

Effect of Contact Time

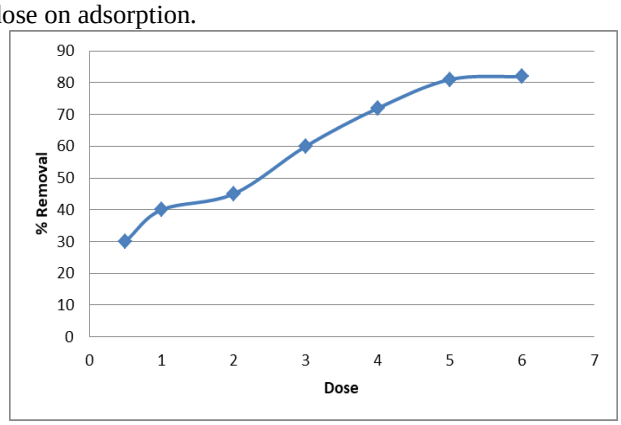
100 ml of the 10ppm dye solution was taken in different conical flask. Adsorbent dose of 5grams was introduced in all the flasks. These flasks were put in the mechanical shaker at 100 rpm and 25°C.After 10 minutes first flask was withdrawn from the mechanical shaker,solution was filtered using syringe filters and absorbance of the solution was measured. Same process was followed for other flasks by removing them from shaker after predetermined time period stretching from 10 minutes to 180 minutes. On the basis of absorbance, percentage removal was calculated and graph was plotted between % Q and contact time. The graph clearly indicate that optimum time for dye removal is 100 minutes above this value we get a straight curve this indicates no absorbance further.



"Figure.3"Effect of Time of contact on adsorption on MB using NLP.

Effect of adsorbent dosage on adsorption process

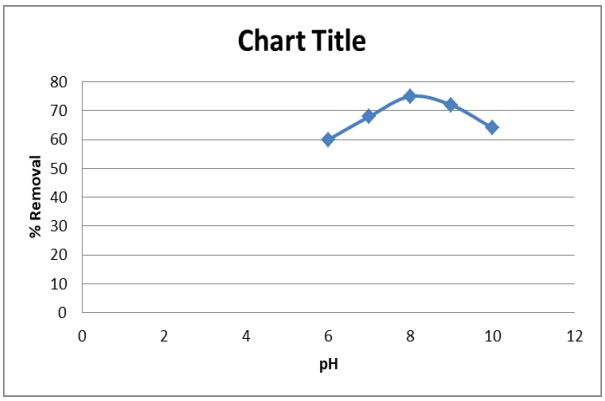
Initial Methylene Blue solution concentration of 10 ppm was used in conjunction with NLP sample of 0.5,1,2,3,4,5,6 mg/100ml .Contact times and pH were 80 min and pH 8, respectively. The removal efficiency was 30% to 80%. The optimum dose is 5g/100ml. At which 80 % of removal efficiency is achieved. Fig below shows the effect of different dose on adsorption.



"Figure.4"Effect of adsorbent dosage on adsorption process using NLP

Effect of pH

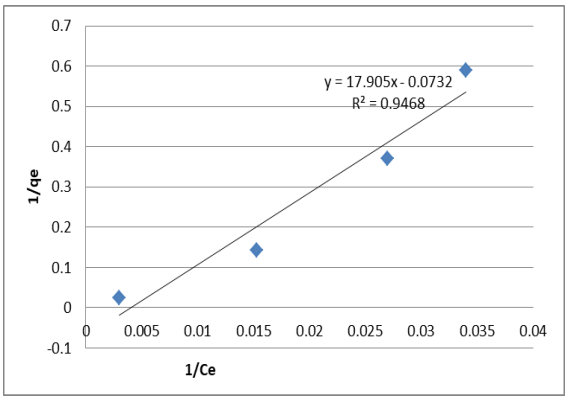
100ml of the10ppm dye solution was taken in different conical flask. The optimum adsorbent dose of 5gram obtained from the above experimentation results was put in each flask. The pH of the dye solution in diffent flasks were adjusted in between the range of 6-10, this modification were done by using dilute HCl (1 M) and NaOH (1 M) solution using pH meter for measurement. further, all the flasks were kept inside the mechanical shaker at 150 rpm and 25 ^{0}C for 60 minutes. After 60 minutes flasks were taken out, solution from each flask was filtered using syringe filters and adsorbance was measured using spectrophotometer. On the basis of absorbance, percentage removal was calculated and graph was plotted between % Q and initial pH. The result shows that optimum pH is 8. Above and below this value there is decrease in the absorbance valve.



"Figure 5" Effect of pH on adsorption process

Langmuir adsorption isotherm for NLP

Langmuir adsorption isotherm graph was plotted between l/qe and 1/Ce. The linear regression was conducted using plot l/qe vis 1/Ce, it was found that R^2 values are closer to 1 (0.961), signifying that the Langmuir adsorption isotherm is a good fit for the adsorption data.



"Figure.6"Langmuir adsorption isotherm for NLP

IV. CONCLUSION

Through this investigation an attempt is made to identify the low cost neem leave adsorbent for the decolorizing the textile wastewater. Neem trees are found commonly in India so the availability of neem leaves are abundant. From the Investigation, it was detected that the Neem leaves are effective in removing methylene blue dye from aqueous streams. Numerous doses of Neem leave powder were used to find the removal efficiency. The results indicated that percentage removal efficiency improved with the increment in dose of adsorbent. The investigation

showed maximum removal efficiency of 80 % using 5 g m of dose for 10ppm dye solution at 100 minutes of contact time, which clearly shows that NLP has potential to remove Methylene Blue so can be used as an effective adsorbent and being a low cost material it is an economical way for the removal of colour from the aqueous streams

REFERENCES

1. Allen, S. J., Mckay, G., & Porter, J. F. (2004). Adsorption isotherm models for basic dye adsorption by peat in single and binary component systems. *Journal of colloid and interface science*, *280*(2), 322-333.:
2. Weber, E. J., & Lee Wolfe, N. (1987). Kinetic studies of the reduction of aromatic azo compounds in anaerobic sediment/water systems. *Environmental Toxicology and Chemistry: An International Journal*, *6*(12), 911-919.
3. McKay G., Otterburn M.S. and Sweeney A.G. 1985. Fullers earth and fired clay as adsorbents for dye stuffs– Equilibrium and rate studies, Water Air Soil Pollutu, 24, 147-161
4. Robinson T., McMullan G., Marchant R. and Nigam P. (2001). Remediation of dyes in textile effluent; a critical review on current treatment technologies with a proposed alternative. BioresourTechnol, 77, 247-255.
5. N. Mathur and A. Kumar, "Physico-chemical characterization of industrial effluents contaminated soil of sanganer," vol. 4, no. 2, pp. 226–228, 2013
6. Pandhare, G. G., Trivedi, N., & Dawande, S. D. (2013). Adsorption of color from a stock solution using neem leaves powder as a low-cost adsorbent. *International Journal of Engineering Sciences & Emerging Technologies*, *5*(2), 97-103.
7. Arafath, M. A., Hossain, M., Alam, S. S., & Sourav, R. (2013). Studies on Adsorption Efficiency and Kinetics of Dye Removal from Textile Effluent using some Natural Bio-adsorbent. *Int. J. Sci. Eng. Technol*, *2*, 853-856.
8. D. Pimentel, B. Berger, and D. Filiberto, "Water resources: agricultural and environmental issues," vol. 54, no. 10, pp. 909–918, 2004.
9. K. V. Wong and B. Bachelier, "Carbon nanotubes used for renewable energy applications and environmental protection/remediation: A Review," Journal of energy resources technology, vol. 136, no. 2, p. 21601, 2013.
10. G. Sudarjanto, B. Keller-Lehmann, and J. Keller, "Optimization of integrated chemicalbiological degradation of a reactive azo dye using response surface methodology," Journal of Hazardous Materials, vol. 138, no. 1, pp. 160–168, 2006.
11. K. M. Reza, A. S. W. Kurny, and F. Gulshan, "Parameters affecting the photocatalytic degradation of dyes using TiO2: a review," Applied Water Science, pp. 1–10, 2015.
12. S. Zhezhova, S. Risteski, and G. Saska, "Methods for waste waters treatment in textile industry," International Scientific Conference, vol. 17, no. 2, pp. 248–252, 2014.
13. Bhatnagar, A., Sillanpa€€ a, M., Witek-Krowiak, A., 2015. Agricultural waste peels as versatile biomass for water purification e a review. Chem. Eng. J. 270, 244e271.
14. Kurniawan, T.A., Chan, G.Y.S., Lo, W.-H., Babel, S., 2006. Physicoechemical treatment techniques for wastewater laden with heavy metals. Chem. Eng. J. 118 (1e2), 83e98

AUTHORS PROFILE

Jyoti Rana B.tech, M..E Chemical Engg, working as assistant Professor in Chandigarh University, Have published many papers in reputed journals.

Dr. Gyanendra Goindi, Phd ,Having 20 years of industrial and academic experience, Currently working ad HOD Mechanical ,Chandigarh University. Have published many papers nation and international in reputed journals ,and attended national and international conferences.

Dr. Navneet Kaur, Phd Chemical Engineering, Having 10 years of teaching experience. Currently working as a assistant professor at chandigarh University. Have published many papers nation and international in reputed journals, such as T&F, Elsevier etc.