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Removal of Basic Organic Dyes of Textile Dyeing and Printing Industrial Waste Water by a Natural and Cost Effective Adsorbent

J.K. Jain[1], Neha Shrivastava[2]
[1]*Govt College, Neem ka Thana, Sikar, Rajasthan*
[2]*P.G. Department of Chemistry, Agrawal Post Graduate College, Jaipur*
Email: jkjain8962@yahoo.co.in

***Abstract*- Dyes are one of prevalent types of chemicals used by human being today. Dyes are organic compounds which have complex aromatic molecular structure that make them toxic and harmful. When these dyes introduced with water due to textile dyeing and printing industrial waste water may cause problems to all living organism. In these dyes highly toxic metals are used as mordents so the removal of these dyes is very essential.In the present study NBP is used as adsorbent for the colour removal of TDP industrial waste water. The maximum adsorption i.e. 90.48% is found at pH 6 and adsorption data fitted well on Freundlich & Langmuir adsorption isotherm.**

***Keywords* - NBP- Neem Bark Powder, TDP- Textile Dyeing and Printing**

I. INTRODUCTION

The textile printing and dyeing industry is a water-intensive industry requiring a large volume of freshwater at various steps of printing and therefore, the volume of wastewater produced is equally large. These effluents, with their high BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand) and suspended solids, are very toxic in nature as they contain large quantities of dyes (azoic, indigo and aniline), bleaching agents, salts, acids/alkalies and heavy metals in high concentration. Dyes are widely used in various industries, such as textile, cosmetic, lather, plastic for colouring their product. The effluent of coloured waste water of these industries is very toxic for all living organisms.

The textile industry is one of the oldest and largest organized sectors in India. There are over 7000 large-scale textile industries concentrated mainly in Gujarat, Maharashtra, Rajasthan and Tamil Nadu states. Besides, small-scale industries flourishing in the rural India, more particularly in the state of Gujarat, Rajasthan and parts of Uttarpradesh, are important centres of ethnic textile prints having greater demand in the international market.

The discharge of textile wastewaters into aquatic habitats is of great concern since the discharges are mostly made untreated or partially treated due to poor enforcement of existing laws in the developing world including India. For example, in Sanganer town (26º49'-26º51' N latitudes and 75º46'-75º50' E longitudes; about 16 km south of Jaipur city), which houses almost 400 small-scale textile printing units, a large volume of textile wastewater (>10 000 KL/day) is discharged. This is mostly untreated, and flows into the pools and wastewater drains which lead to reservoirs used for irrigating crop fields. These disposal practices have contaminated the environment and caused adverse effects on the flora, crops and fauna in Sanganer town [1-2].

Many techniques such as coagulation-flocculation [3], electro chemical oxidation, biodrgradation [4], ion exchange [5], ozonation [6], adsorption by activated carbon [7] have been used to remove hazardous dyes from effluent waste water of these industries. But from all of these techniques adsorption method appear to be one of the best techniques because it is quite simple, inexpensive, eco-friendly and does not produce any sludge [8] as compared to other. Activated carbon is most popular adsorbent because it is very capable to adsorb most of the dyes with high adsorption capacity [9]. Some other adsorbents like neem leave [10], used tea leave

[11], rice husk [12] etc.were tested for treatment of dyes-bearing waste water with different success. However, some of these adsorbents do not have good adsorption capacities for basic dyes. Hence, there is need to search for more effective adsorbent.

II. MATERIAL AND METHOD

A. Preparation of Adsorbent Neem Bark Powder

Adsorbent used in present research work is easily and abundantly available material. Collected bark was washed many times with distilled water for removing their own coloure, water soluble material and dirt particle and the washed material completely dried into the Sun light and air till the bark could be grinded to be very fine powder by local mixture grinder. And finally this powder was stored in an air tight container.

B. Select Site

For this study Sanganer town nearly 14 km south of Jaipur city (Pink city) has been selected. Jaipur is most important tourist centre of northen India and Sanganer is one of the famous areas in which textile dyeing and printing small scale indrustrial units are being run by local chippa community and also by others for nearly past one hundred years. Near about four hundred industries are running in this area .These units are famous all over the India for Sanganeri printing textiles. The effluents of these units are being pounded to open places in small ditches at backyard of these printing units. Some of these units throw their effluents in small canals and finally are collected in small river(Amani Shah Nallah).

C. Concentration of Dye

An accurately weighed quantity (10 mg) of dye was dissolved in 1 liter distilled water to prepare the solution for experimental analysis.

III. EXPERIMENTAL METHODS AND MEASUREMENTS

Batch adsorption studies were carried out by using in 2 gm/lit. The measurements as optical density, pH, conductivity & TDS were taken by the Systronics

B. Contact Time Variation

113, Systronics MV VI and Toshiniwal TCM-15 respectively. The FTIR, XRD, SEM and EDX elemental analysis was also carried out.

IV. RESULT AND DISCUSSION

A. Effect of pH

The effect of pH on adsorption of dye solution is very important factor for controlling the adsorption of dye on to adsorbent. The pH was adjusting by using 0.1 N NaOH and 0.1 N HCl solutions. As the pH range is 3.0 to 9.0 and the results are summarized in Table I and Fig.1.

Table I

S. No.	pH	% removal
1	3	68.09
2	4	71.43
3	5	80.95
4	6	90.48
5	7	76.19
6	8	57.15

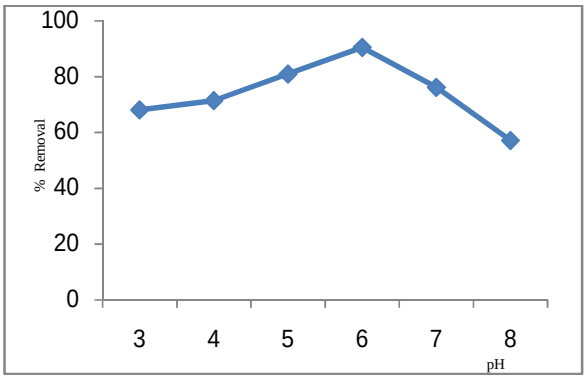

Fig. 1

Graph showing effect of pH on % adsorption of basic dye using Neem (Azadirachta indica) bark as adsorbent Initial dye Concentration (C_o)- 10 mg/Lit., Temperature- At Room Temperature, Dose of adsorbent- 2gm/Lit, Volume of dye Solution taken- 50 ml.

Contact time was changed from 10 to 90 min. For different contact times, the percent removal of the dye was recorded.

Effect of contact time on adsorption was studied and results are shown in Table II and Fig. 2. Increase in removal efficiency with increase in time of contact can be attributed to the fact that more time becomes available for the dye to make an attraction complex with neem bark powder.

C. Effect of Contact time

Table II

S. No.	Contact Time	% Removal
1	0	0
2	10	42.85
3	20	57.15
4	30	61.91
5	40	66.67
6	50	71.43
7	60	76.19
8	70	80.95
9	80	90.48
10	90	85.72

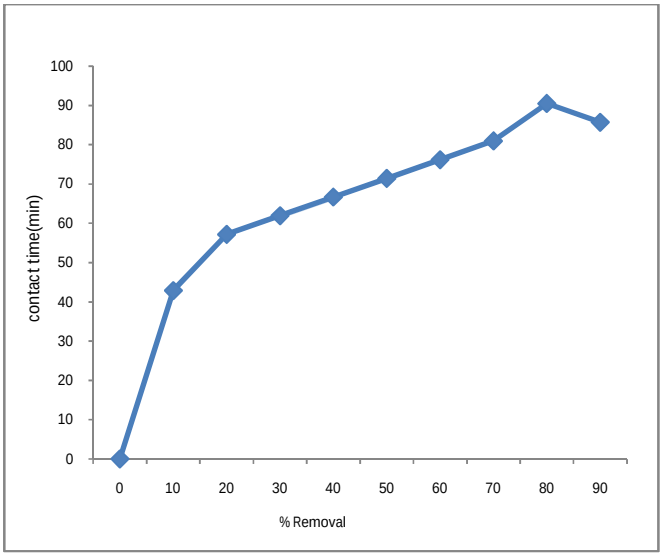

Fig. 2

D. Adsorption Isotherms

Adsorption isotherms are essential for the description of how dye particles will interact with different adsorbent surfaces and are useful to optimize the use of adsorbents for the colour removal. The equilibrium adsorption isotherms are one of the most important data to understand sorption mechanism. Several isotherm equations are available and two important isotherms are selected in the study, which are namely the Langmuir & Freundlich adsorption isotherms. Both Freundlich and Langmuir models were used for the evaluation of experimental results.

The Freundlich model is as follows:

$$q_e = K_f C_e^{1/n}$$

Freundlich adsorption in its usual logarithmic form as follows:

$$\log(q_e) = \frac{1}{n}\log(C_e) + \log k_f$$

Where log k_f is a measure of the adsorption capacity and n is adsorption intensity. The function coefficient 1/n which should have values in the range of 0 to 1 for favorable adsorption. A plot of log q_e v/s log C_e gives a slope of 1/n and intercept of log k shown in Fig.3. The value 1/n and k are calculated from slope and intercept respectively [13] and are given in Table III.

Langmuir Isotherm:

$$qe = abCe/(1+bCe)$$

Where the constant 'a' signifies the adsorption capacity (mg/g) and b is related to the energy of adsorption (1/mg). The linear plot of $1/q_e$ v/s $1/C_e$ shows the adsorption follows Langmuir[14] isotherm (Fig.: 4). Value of 'a' and 'b' were calculated from the slope and interact of the linear plots and are presented in Table III.

Equilibrium parameters R_L is represented as follows:

$$R_L = \frac{1}{(1+bC_0)}$$

Where, C_0 is initial dye concentration (mg/lit).

R_L value obtained using equation (1) for 10 mg/lit dye concentration are 0.0620. R_L values between 0 & 1 confirming that the adsorption isotherm is favorable. R_L indicates isotherms shape and whether it is favorable or not as per the criteria given below:

R_L Values	Adsorption
$R_L > 1$	Unfavorable
$R_L = 1$	Linear
$0 < R_L < 1$	Favorable
$R_L = 0$	Irreversible

TABLE III

Adsorbents	**Frendlich Coefficient**				**Langmuir Coefficient**			
	K_f l/g	**n**	**1/n**	**r^2**	**a mg/g**	**b/mg**	**R_L**	**r^2**
Neem Bark Powder	0.432	1.031	0.969	0.855	0.113	1.979	0.939	0.987

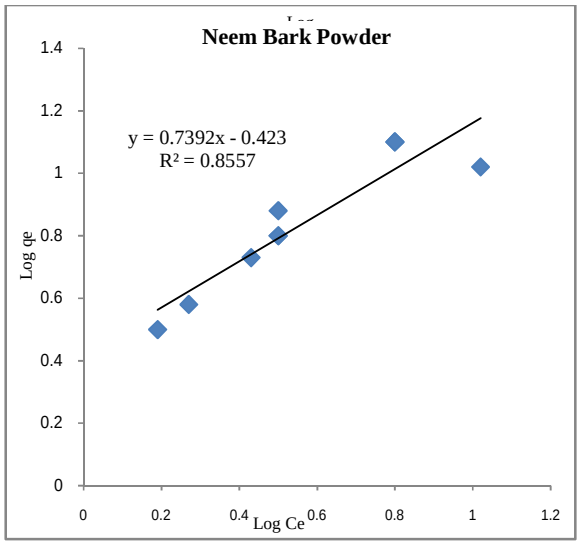

Fig. 3: Freundich Adsorption Isotherm

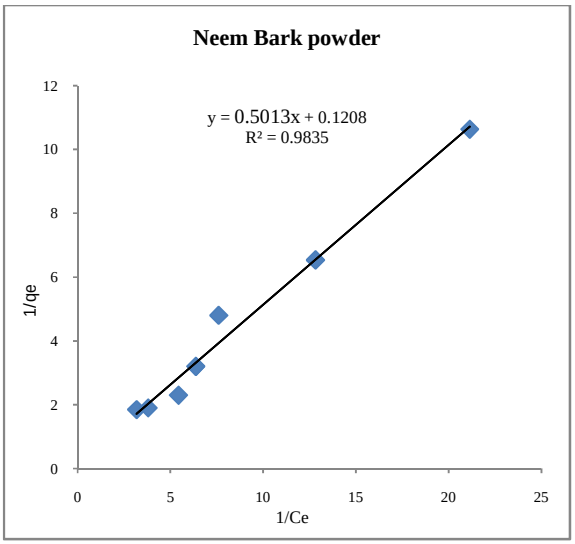

Fig. 4: Langmuir Adsorption Isotherm

V. CONCLUSION

The adsorbent (Neem Bark Powder) used in our present study have proved to be very efficient and economical for removing colouring compounds from textile dyeing and printing industrial waste water. The substrate raw materials employed are widely available and inexpensive. The colour removal capacity of that adsorbent is appreciably good. Thus, it can be concluded that, this alternative adsorbent seems to offer a very cheap and useful products for effective removal of colour from textile dyeing and printing effluents. It is also clear from the above data that, the efficiency this adsorbent gives satisfactory results on Freundlich and Langmuir adsorption isotherms.

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