Adsorption Based Dye Removal with Sustainanility Concern in Textile Industrial Sector Using Parthenium as Low Cost Adsorbent

RAKESH M
Research Scholar SSAHE
Sri Siddhartha Academy of Higher Education, Tumakuru,
Karnataka, India
rakeshm@ssit.edu.in

Dr. B H MANJUNATH
Professor
Sri Siddhartha Institute of Technology, Tumakuru
Karnataka, India
bhmanjunath@gmail.com

Dr. KISHOR KUMAR S
Assistant Professor
Malnad College of Engineering, Hassan
Karnataka, India
skk@mcehassan.ac.in

***Abstract*— Water is the most essential unit for all living beings on the earth. It's not only required for human consumption, but it is essential for the many productive activities like agriculture, industrial activities, cattle raising, tourism etc. Increasing urbanization require a more advanced technology to preserve water quality. In industrialized countries, widespread shortage of water is caused due to contamination of ground and surface water by industrial effluents, and agricultural chemicals which are called non point source of pollution. Wastewater with high levels of organic and inorganic matter cause several problems when discharged to the environment. Therefore it's very necessary to remove dye substances from wastewater for reducing their harm to ecology and environment. The present study was done to clarify the potential of activated carbon made from parthenium weed in the adsorption of dyes. In our experimental-laboratory study, the changes in removal efficiency were assessed by considering the changes in values of pH, concentration, adsorbent dose, contact time.**

Keywords—Textile effluent, dyes, Adsorption, Novel Adsorbent Parthenium

I. INTRODUCTION

Dyes which are using in the industries are divided in to two main groups natural dyes and synthetic dyes, natural dyes which extracted from plants ex: Madder root and the dyes also extracted from animals ex: sea snails.Synthetic dyes classified in to two groups mainly Azo dyes and non azo dyes, the Azo dyes are classified in to acidic, basic, reactive, disperse, sulphur, vat dyes. due to increase in population and also growth in fashion sector natural dyes are in less usage, only synthetic dyes are using in printing, cosmetics and food processing industries which react with water and cause the health problems so treatment of effluent which include dyes is very much essential.Dyes release into waste water from various industrial outlets, such as paper, food colouring, cosmetics, leather, pharmaceutical, dyeing, printing, carpet industries etc. The textile manufacturing and dyeing industries utilize more quantities of dyes and release these dye pollutants into environment as waste water effluents. These dyes are highly toxic and even carcinogenic to microbial populations and mammalian animals hence these are needed to remove from the water effluents before they are released into water bodies. Dyes are stable to light and not biologically degradable; they are resistant to aerobic digestion and signify one of the difficult groups to be removed from the industrial wastewater Dyes are normally used in textile industry to colour the raw material and then has product, dyes are naturally or synthetically in nature, and the dyes which are natural, were obtained by plants and minerals with combination of starch. Dyes which are synthetic were made of coal tar and also by petroleum. Once the waste water is released to water body its effect on aquatic and asthetic nature of water and also reduces the penetration of light cause adverse effect on photosynthesis process..Biosorbents is most favorable uses in recent researches. Because of its high efficiency, produce minimum chemical and biological sludge. Adsorption considered as one of the most promising technique for waste water treatment. To use adsorbent for removal of dyes, cost of adsorbent plays very important role, so the parthenium hysteroporous an unwanted weed and its huge biomass round the year and good adsorption capacity is using for adsorbent.

A) Textile Sector

India's textiles sector is one of the oldest industries in the Indian economy, dating back to several centuries. The industry is extremely varied, with hand-spun and hand-woven textiles sectors at one end of the spectrum, with the capital-intensive sophisticated mills sector at the other end. The fundamental strength of the textile industry in India is its strong production base of a wide range of fibre/yarns from natural fibres like cotton, jute, silk and wool, to synthetic/man-made fibres like polyester, viscose, nylon and acrylic.The decentralised power looms/ hosiery and knitting sector form the largest component of the textiles sector. The close linkage of textiles industry to agriculture (for raw materials such as cotton) and the ancient culture and traditions of the country in terms of textiles makes it unique in comparison to other industries in the country.

India's textiles industry has a capacity to produce a wide variety of products suitable for different market segments, both within India and across the world.

B) Textile Sector In Karnataka Overview

The founder of Karnataka's industrial sector is Sir M. Vishveshwaraiah. The Department of Handlooms and Textiles was set up during 1991-92 in the state of Karnataka. The main objective to set up an exclusive Department for Handlooms and Textiles was to promote investment in MSME and Large industries sector and to facilitate traditional handloom and power loom weavers.Karnataka is known for silk and traditional weaving. Karnataka is the largest producer of mulbary silk in the country with a share of about 65%. Similarly the state also grows abundant cotton and produces 20 lakh bales of cotton annually. The traditional weaving in Karnataka dates back to 8th century. Ilkal sarees from north Karnataka are being woven since then and retained it's glory even today. Many varieties of sarees have obtained Geographical Indication (GI) namely Ilkal Sarees, Mysore Silk Sarees, Udupi Cotton Sarees and Karnataka Kasuti Sarees. At present there are about 40000 handloom weavers and 120000 powerlooms.Karnataka is also a pioneer in Modern textiles. First such plants were MSK Mill in Kalburgi set up in 1885, Gokak Forbs set up in 1886 among others. Today Karnataka is home to the world's biggest spinning unit under one roof i.e M/S Himatsingkasiede with 2.11 lakh spindles. Similarly Karnataka is the Garment capital of the country which accounts for 20% of garments production of the country. The largest employer in RMG sector M/S Shahi Exports has provided employment to the tune of 1 lakh people, mainly women in Karnataka. The State is also an ideal destination for investments in Technical Textile sector.

C) Types Of Dyes

Dyes which are using in the industries are divided in to two main groups: natural dyes and synthetic dyes, natural dyes which extracted from plants ex: Madder root and the dyes also extracted from animals, ex: sea snails Synthetic dyes classified in to two groups mainly Azo dyes and non Azo dyes, the Azo dyes are classified in to acidic, basic, reactive, disperse, sulphur, vat dyes, due to increase in population and also growth in fashion sector natural dyes are in less usage. only synthetic dyes are using in printing, cosmetics and food processing industries which react with water and cause the health problems so treatment of effluent which include dyes is very much needed.

D) Characteristics Of Textile Wastewater

It is important to characterize textile wastewater to develop effective treatment methods and process flow. Various raw materials, such as cotton, synthetic fibers, and wool, are used in the textile industry. Wastewater is primarily produced during the execution of four steps: pretreatment, dyeing, printing, and functional finishing and the nature of effluent discharged at each step of the industrial process). The definite parameter for characterization of textile wastewater included chemical oxygen demand (COD), pH, color, suspended solids, biochemical oxygen demand (BOD5), N-NHx, total phosphate (TP), total Kjeldahl nitrogen (TKN), conductivity, metals, total oxygen demand (TOC), Cl, total dissolved solid (TDS), grease, alkalinity, surfactants, hardness, volatile suspended solid (VSS), sulfide, N-NOx, total solids, turbidity, dissolved organic carbon (DOC), absorbable organic halogen (AOX), total carbon (TC), Composite textile wastewater is primarily characterized by analyzing BOD, COD, suspended solids (SS), and dissolved solids (DS).

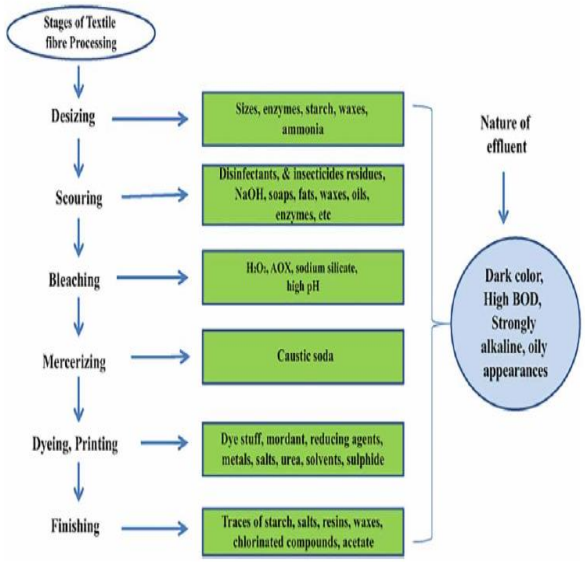


Fig 1.Textile industry manufacturing process

Table 1: CPCB standard for effluent discharge

STANDARDS FOR DISCHARGE OF EFFLUENTS FROM TEXTILE INDUSTRY

S. No.	Industry	Parameter	Standard (applicable for all modes of disposal*)
1	2	3	4
"6	All Integrated textile units, units of Cotton / Woollen / Carpets / Polyester, Units having Printing / Dyeing / Bleaching process or manufacturing and Garment units.	TREATED EFFLUENTS	Maximum concentration values in mg/l except for pH, colour, and SAR
		pH	6.5 to 8.5
		Suspended Solids	100
		Colour, P.C.U (Platinum Cobalt Units)	150
		Bio-Chemical Oxygen Demand [3days at 27°C] (BOD_3)	30
		Oil and Grease	10
		Chemical Oxygen Demand (COD)	250
		Total Chromium as (Cr)	2.0
		Sulphide (as S)	2.0
		Phenolic Compounds (as C_6H_5OH)	1.0
		Total Dissolved Solids , Inorganic (TDS)	2100**
		Sodium Absorption Ratio (SAR)	26**
		Ammonical Nitrogen (as N)	50

E) Parthenium is the very noxious weed which grown widely all over the world. a toxic plant which is known for its negative impact on agriculture, crop productivity , biodiversity & also on human too. It is an annual herbaceous weed with no economical importance. It is one among seven intolerance weed of world. It belongs to the kingdom plantae ,family of asteraceae , genus parthenium and species called parthenium

hysterophorus its is called in many names mainly santa maria , santa maria feverfew, white top weed , in our nation it is called as congress grass , carrot grass.

2. Materials & Methodology

Adsorption study will conduct by preparing the different synthetic dyes of various categories, also collecting the effluent samples from industries.

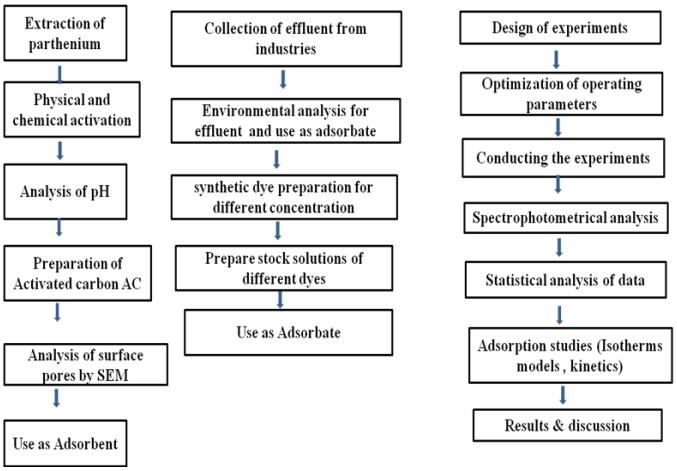
Parthenium hysteroporous a weed is used has adsorbent in this study, a healthy whole weed of parthenium is collected and it is cleaned to remove the dirt & soil and it is sun dried for 72 hrs. Dried parthenium powder was crushed to the powder and it is sieved in 300 micron. Then the powder is used for the activation process. The stock solution of different dyes was prepared with adding powder dyes with respective concentration And different concentration was prepared by series of dilution using RO water, synthetic sample was prepared and 50 ml of working solution is taken for analysis.The adsorbate is prepared by using N1*V1=N2*V2 formula for different concentration

A) Chemical Activation Process

Activation is done by using conc. H_2SO_4 which is called chemical activation process, Conc sulphuric acid is added to the powdered parthenium in ratio 1:1.5 (W:V) then it is kept in a hot air oven for 12 hrs at 120 C ,It was washed till the acid is removed and its ph should comes around 6.0 then it is soaked with 1% of sodium bi carbonate solution over night to remove free acids And washed it many times and kept in oven for 24 hrs at 105 C and is stored in a zip lock cover.

B) Physical Activation Process:

Powdered parthenium dust was soaked in de-ionized water for 3 days and washed several times with water until all the coloured ex tract was removed and clean water obtained. It was oven dried at 60 C for 24 h. It was sieved using a 50–100 µm sieveto obtain particles in this range. This was stored in a plastic container prior to use for adsorption studies.



For the batch adsorption process study adsorption was performed in a batch with 250 ml conical flask, adsorbent dose is mixed with adsorbate by varying a different parameters like ph, contact time , adsorbate and adsorbent dosage placed in an orbital shaker and further investigations were carried out under respective wavelength

The stock solution of dye was prepared with adding 1.5g powdered dye in 1 litre of water concentration of 1500 ppm was prepared. And different concentration was prepared by series of dilution using RO water, synthetic sample was prepared and 25 ml of working solution is taken for analysis

Fig 2.Stock Solution of Dye

C) Crystal Violet:

Increasing the adsorbent increase the percentage removal, Crystal violet or genatin violet, also known as methyl violet 10B or hexamethyl pararosaniline chloride, is a triarylmethane dye used as a histological stain, wavelength 592nm

III. Result and discussion

Table 2: increasing the adsorbent increase the percentage removal and constant at 2.5g/25ml

SI. NO	pH	Adsorbate(ml)	Time(min)	Adsorbent g	% removal
1.	8	25	60	**0.5**	90.9
2.	8	25	60	**1.0**	92.3
3.	8	25	60	**1.5**	93.8
4.	8	25	60	**2.0**	95.6
5.	8	25	60	**2.5**	98.1
6.	8	25	60	**3.0**	98.4
7.	8	25	60	**3.5**	98.4

It was observed that in the batch studies which conducted for Crystal violet dye by keeping pH, Adsorbate and contact time constant and varying the adsorbent dosage from 0.5 g to 3.5 g, the percentage of removal increase with increasing the adsorbent and its remain constant from 2.5g, so it is considered as optimum dosage.

Table 3: variation in pH by other parameters constant

SI.NO	**pH**	Adsorbate (ml)	Time(min)	Adsorbent	% removal
1.	**6.5**	25	60	2.5	95.6
2.	**7.0**	25	60	2.5	97.8
3.	**7.5**	25	60	2.5	98.1
4.	**8.5**	25	60	2.5	98.4
5.	**9.5**	25	60	2.5	98.6
6.	**10.5**	25	60	2.5	99.1
7.	**11**	25	60	2.5	99.1

the batch studies which conducted for Crystal violet dye by keeping Adsorbate, Adsorbent and contact time constant and varying the pH frpm 6.5 to 11, the percentage of removal increase with increasing the pH and its remain constant from 10.5, so it is considered as optimum pH, dyes show high removal efficiency in alkaline condition compare to acidic.

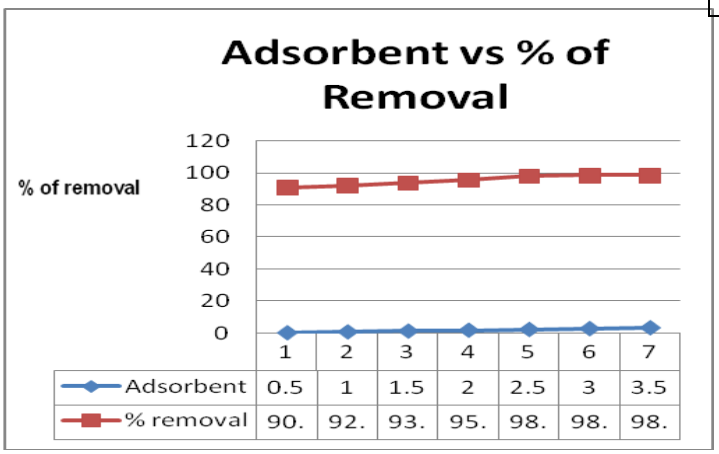


Fig 3: Graph Adsorbent vs % of Removal

D) Congo Red

Is the sodium salt of benzidinediazo-bis-1-naphthylamine-4-sulfonic acid; a diazo dye that is red in alkaline solution and blue in acid solution and used especially in textile industries,wavelength 482nm

Table 4: Increasing the adsorbent increase the percentage removal and constant at 2.5g/25ml

Sl. No	pH	Adsorbate (ml)	Time (min)	Adsorbent (g)	% removal
1.	8.0	25	60	**0.5**	93.2
2.	8.0	25	60	**1.0**	93.9
3.	8.0	25	60	**1.5**	95.6
4.	8.0	25	60	**2.0**	96
5.	8.0	25	60	**2.5**	96.4
6.	8.0	25	60	**3.0**	96.6
7.	8.0	25	60	**4.0**	96.6

It was observed that in the batch studies which conducted for **Congo Red** dye by keeping pH, Adsorbate and contact time constant and varying the adsorbent dosage from 0.5 g to 4.0 g, the percentage of removal increase with increasing the adsorbent and its remain constant from 3.0g, so it is considered as optimum dosage.

Table 5: variation in pH by other parameters constant

Sl. No	pH	Adsorbate (ml)	Time (min)	Adsorbent (g)	% removal
1.	**5.5**	25	60	2.0	90.1
2.	**6.5**	25	60	2.0	91.6
3.	**7.5**	25	60	2.0	93.6
4.	**8.5**	25	60	2.0	96.1
5.	**9.5**	25	60	2.0	96.3
6.	**10.5**	25	60	2.0	96.3

the batch studies which conducted for **Congo Red** dye by keeping Adsorbate, Adsorbent and contact time constant and varying the pH frpm 5.5 to 10.5, the percentage of removal increase with increasing the pH and its remain constant from 8.5, so it is considered as optimum pH, dyes show high removal efficiency in alkaline condition compare to acidic.

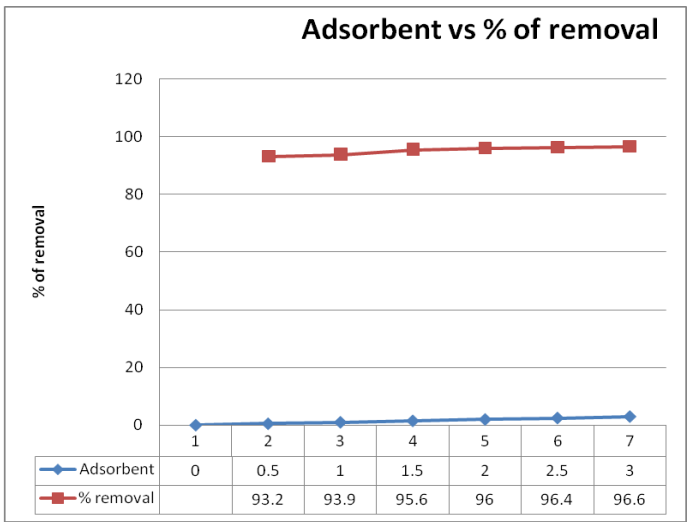


Fig 4: Graph Adsorbent vs % of Removal

IV. CONCLUSION:

Based on results of studies Adsorption is the best method for dye removal Low cost adsorbents will give good results in dye removal Parthenium will be the best low cost adsorbent because of its wide availability compare to other adsorbents, expecting 95 to 99 percent of removal efficiency. It helps industrial ecology for sustainability and hold promising benefits for industrial application In general, it can be concluded that the activated carbon produced from P. hysterophorus is a promising adsorbent, but still it is highly recommendable to work on the detailed investigation of the precursor material before its application at industrial level for water and wastewater treatment. Among various techniques adsorption became most efficient technique to treatment of waste water because of its ease of operation and design, adsorption employs adsorbate and adsorbent it is an surface phenomenon and activation process is the important step in adsorption process, activated carbon is most commonly used adsorbent because of its high adsorption capacity and economic in the selection of adsorbent for removal of constituent

Fig 5: Chemical activation using H2SO4

Fig 6: Physical Activation

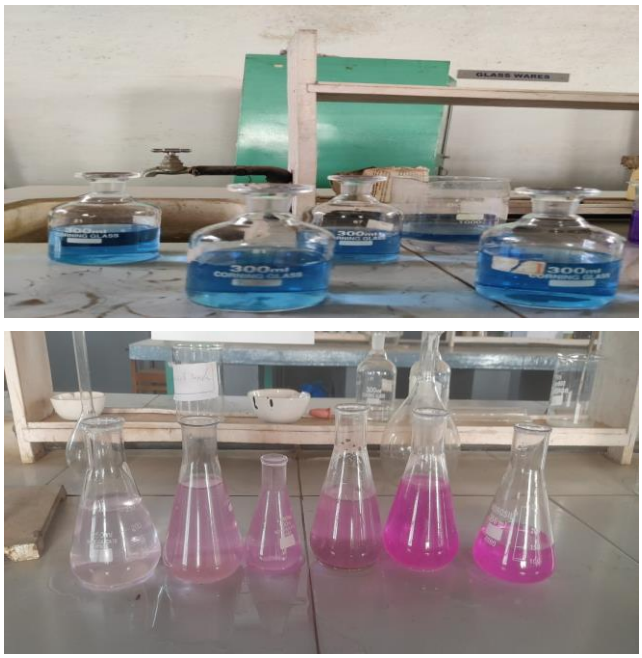


Fig 7: Dyes with different concentration

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