Treatment Of Textile Dyeing Effluent By Natural Adsorbents Using Prosopis Juliflora

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Abstract:

Wastewater pollution is the major environmental issue of the textile industries. It is the serious problem in almost every industry using the dyes to color their product. Removal of color and heavy metal ions from the water is essential for public health. Various coagulants are being used for removal of color by coagulation process (jar test). Among these alum is used because of its removal efficiency. The % of color removal in the effluent after coagulation was found by using UV-Visible Spectrophotometer. Among these natural adsorbent obtained from leaf like Prosopis juliflora is used due to its large surface area, high adsorption capacity and surface reactivity. The % absorption was estimated using UV-Visible Spectrophotometer. The metal ion concentration present in the effluent after absorption was found using Atomic Adsorption Spectroscopy. Thus the % of heavy metal ion removal was calculated. The result confirms that the color removal efficiency increases as the coagulant dosage increases .Thus it is observed that the percentage removal of Pb and Cd ions was found to be higher for Prosopis juliflora adsorbent.

Keywords— Textile effluent, Cadmium, Lead, coagulation, Adsorbent, Prosposis juliflora, AAS.

I.INTRODUCTION:

The textile dyeing industry consumes large quantities of water and produces large volumes of wastewater from different steps in the dyeing and finishing processes. Wastewater from printing and dyeing units is often rich in color, containing residues of reactive dyes and chemicals, and requires proper treatment before being released into the environment. " Color the earth beautiful and kill it with sweet poison " Strong color of the textile waste water is the most serious problem of the textile industrial effluent. Non-critical metals, like sodium, potassium, magnesium and calcium, belong to class A, whereas toxic metals, generally, belong to class B or border line. But essential trace metals, like Fe, Zn, Co, etc. also belong to border line.

Criteria	Elements
Non-critical	Na, K, Mg, Ca, H, O, N, P, Fe, S, Cl, Br, F, Li, Rb, Sr, Al, Si
Toxic, insoluble/rare	Ti, Hf, Zr, W, Nb, Ta, Re, Ga, Lanthanides,Os, Rh, Ir, Ru, Actinides
Toxic and relatively abundant	Be, Co, Cu, Zn, Ni, Sn, As, Se, Te, Pb, Ag, Cd, Pt, Au, Hg, Pb, Sb, Bi

Table 1.2 Elemental composition of an adult human being (Bhattacharya and Venkobachar 1984)

Element	Mass(g)	Element	Mass(g)
Aluminium	0.100	Iron	004.20
Arsenic	0.010	Lead	000.08
Antimony	0.070	Magnesium	035.00
Barium	0.020	Manganese	000.02
Boron	0.010	Nickel	000.01
Cadmium	0.030	Potassium	140.00
Calcium	1050	Sodium	105.00
Chromium	0.005	Tin	000.03
Cobalt	0.003	Vanadium	000.02
Copper	0.110	Zinc	002.30

1. TOXICITY OF CADMIUM

Cadmium is an extremely toxic metal which has no known necessary function in the body. Cadmium toxicity contributes to a large number of health conditions, including the major killer diseases such as heart disease, cancer and diabetes. Cadmium concentrates in the kidney, liver and various other organs and is considered more toxic than either lead or mercury. It is toxic at levels one tenth that of lead, mercury, aluminum, or nickel.Cadmium toxicity is increasing in incidence today for several reasons. Often these industries then pollute water, air and food with this metal.

2. TOXICITY OF LEAD

Lead poisoning has been recognized as a major public health risk, particularly in developing countries. . This review provides a comprehensive account of recent updates describing health effects of lead exposure, relevant biomarkers and mechanisms involved in lead toxicity. It also updates the readers about recent advances in chelation therapy and newer therapeutic strategies, like nano encapsulation, to treat lead induced toxic manifestations.

3. COAGULATION

A clumping of particles in wastewater to settle out impurities, it is often induced by chemicals such as lime, alum and iron salt. Coagulation is the most common treatment for decolorization. Many of the contaminants in water and wastewater contain matter in the colloidal form. .So they need special treatment to remove them from the aqueous phase. This destabilization of colloids is called “coagulation”

4. COAGULANTS

Coagulant is an agent that cause the liquid or solid to coagulate. The amount of coagulant required for coagulation depends on the turbidity of the wastewater

a) Inorganic coagulants

There are various inorganic coagulants which can be used as coagulants such as ferric chloride, lime, alum, magnesium chloride.

b) Organic coagulants

Organic coagulants including poly electrolytes, synthetic polymers and natural polymer can be used for coagulation process.

5. ADSORPTION

Adsorption is a process that occurs when a gas or liquid solute accumulates on the surface of a solid or a liquid (adsorbent), forming a molecular or atomic film (the adsorbate). It is different from absorption, in which a substance diffuses into a liquid or solid to form a solution

Physisorption or physical adsorption is a type of adsorption in which the adsorbateadheres to the surface only through Van der Waals (weak intermolecular) interactions, which are also responsible for the non-ideal behaviour of real gases.

Chemisorption is a type of adsorption whereby a molecule adheres to a surface through the formation of a chemical bond, as opposed to the Van der Waals forces which cause physisorption.

II.MATERIALS AND DESCRIPTION:

Fig 1.

Binomial name : Prosopis juliflora

Prosopis juliflora has become an invasive weed in several countries where it was introduce. It is considered a noxious invader in Ethiopia Hawaii Sri Lanka, Jamaika the middle East, India, Nigeria, Sudan, Somalia .It is also a major weed in the southwestern united states. It is hard and expansive to remove as the plant can regenerate from the roots.

III.METHODOLOGY:

1. SAMPLE COLLECTION:

The textile dye wastewater was collected from a private small-scale industry located at Tiruppur, Tamilnadu, India. The wastewater was analysed for various parameters as per the procedure. The wastewater was stored at room temperature (35°C) in airtight plastic containers.

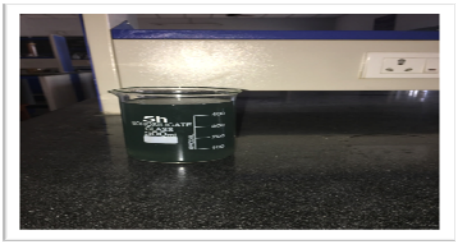


Fig 2.Collected Sample

2. SAMPLE ANALYSIS:

The parameters analyzed includes the following.

- pH
- Turbidity
- Chemical oxygen demand
- Total suspended solids
- Total dissolved solids
- Total solids

3. REAGENTS AND STANDARDS:

Analytical grade nitric acid, hydrochloric acid and hydrogen peroxide (Merck. India were used as received.Standard sample solutions of Cd, Cu, Pb, Mn, Fe, Mg, Zn and Ni (1000 mg/ml) were obtained from Merck (Germany). All the solutions were prepared using triply distilled water.

PROCEDURE:

Heavy metals like Cd, Cu, Pb and Minerals like Fe, Na, Mg, K and Zn, in effluent samples were analyzed using atomic absorption spectrophotometer (AA 6300, Shimadzu, Japan) equipped with flame and graphite furnace. Atomic absorption spectrometry (AAS) uses the phenomenon that atoms in the ground state absorb light of a specific wavelength; characteristic of the particular atom, when the light passes through an atomic vapour layer of the element to be determined. coagulation –flocculation by jar test.

4. PREPARATION OF ADSORBENTS:

Initially Prosopis Juliflora leaves were washed repeatedly by using distilled water to remove moisture and soluble impurities. Then Prosopis Juliflora leaves kept in hot air oven at 110degree,for 4-5hrs till leaves turn pale yellow. Then crushed and screen by 10-15um mesh size. The leaves powder washed to remove moisture and free acid and kept in hot air oven at 110 degree for 2-3 hrs. After drying powder was mixed with phosphoric in borosil beaker and kept in furnace at 260 degree for 15-20 minutes. The heating period depend on atmospheric temperature then solution was cooled & repeatedly washed using hot water to remove free acid and moisture. They are washed 7 times and kept in a hot air oven for 2hrs.The prepared black colored adsorbent is

kept in bottle for further use. The sample is removed and cooled. After cooling, the sample is washed repeatedly using hot water, The washing is continued till the color of the water remains blue while adding EBT.EBT is added to check whether there is presence of impurities. Reddish brown indicates presence of impurities, Blue indicates absences of impurities Then the sample is kept in hot air oven for 2hrs to dry.Thus the black colored adsorbent is obtained

6. MEASUREMENT OF ABSORPTION BY SPECTROPHOTOMETRY PROCEDURE:

The sample of 50ml was taken in each of 5 beakers. The samples were examined in UV-visible spectrophotometer to check the % of absorption.0.1g of Prosopis Juliflora adsorbent was added in each beakers and it was kept for 24hr periodic shaking.After 24hrs % of absorption was measured.Same procedure was followed for 0.2g, 0.3g, 0.4g and 0.5g to study the effect of absorption.

IV.RESULT AND DISCUSSION:

Table 3.1: Characterization of sample before coagulation process:

S.NO	Parameters	Result	WHO
1	pH	8.60	7-8.5
2	Turbidity	358NTU	5-50NTU
3	Total solids	11000mg/l	350-2000mg/l
4	TDS	10625mg/l	500-2000mg/l
5	TSS	375mg/l	500-1000mg/l
6	COD	960mg/l	250mg/l

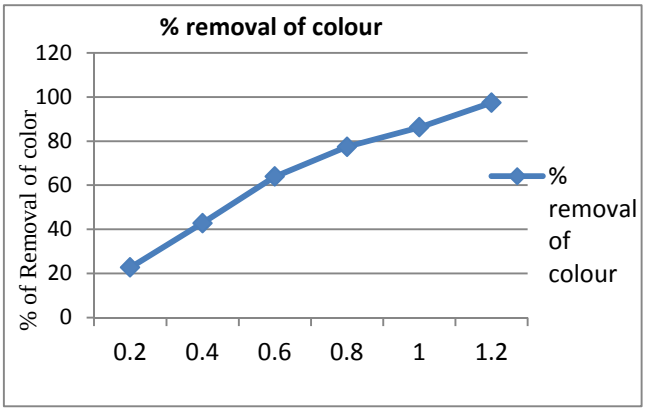
1. **Effect of the dose rate**:

The removal of color was studied with the different dose of alum(0.2g/L to 1.2g/L) with rapid stirring for about 10min and gentle stirring for about 20min. The result are given in the table and pictorially represented in figure

Table 3.2: Effect of the Dose rate of the Coagulant alum on Percentage Removal of Color

S.NO	Dose of the alum (g/L)	% removal of color
1	0.2 g/L	22.61%
2	0.4 g/L	42.77%
3	0.6 g/L	63.87%
4	0.8 g/L	77.44%
5	1 g/L	86.26%
6	1.2 g/L	97.45%

It is noted that the removal of color increases as the coagulant dosage increases. The higher removal efficiency (97.45%) with the dosage of alum(1.2g/L)



2. **Determination of heavy metals by atomic absorption spectrometry**

Table 3.3: Concentration of heavy metals

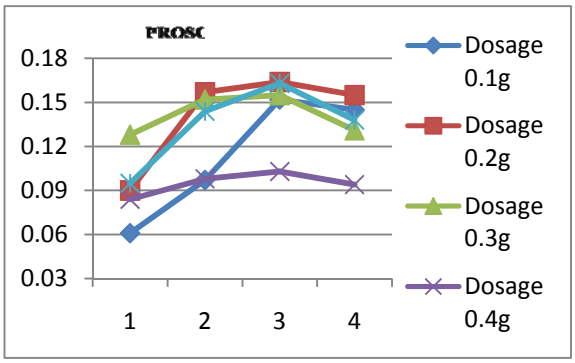
S.NO	Heavy Metals	Concentration (ppm)	WHO (ppm)
1	Cadmium	0.76	0.003
2	Copper	0.45(BDL)	1.000
3	Lead	0.15	0.010
4	Iron	0.7(BDL)	0.1-1.0
5	Chromium	0.12	0.05

BDL – Below Detectable Limit
WHO – World Health Organization

3. Spectrophotometer readings for % absorption using prosopis juliflora adsorbent

Table 3.4: Spectrophotometer readings for % absorption

Day	Dosage 0.1g	Dosage 0.2g	Dosage 0.3g	Dosage 0.4g	Dosage 0.5g
1st day	0.185%	0.058%	0.086%	0.090%	0.060%
2nd day	0.195%	0.072%	0.109%	0.160%	0.079%
3rd day	0.196%	0.178%	0.130%	0.183%	0.209%
4th day	0.180%	0.165%	0.115%	0.162%	0.190%



4. Result for Cadmium from Atomic Absorption Spectroscopy using Prosopis juliflora Adsorbent

Table3.5: % Removal of cadmium

S.NO	Dose of the Prosopis Juliflora (g/L)	Concentration (ppm)	Percentage of Removal
1	2 g/l	0.0081	99.46%
2	4 g/l	0.0059	99.60%
3	6 g/l	0.0047	99.68%
4	8 g/l	0.0015	99.90%
5	10 g/l	0.0012	99.92%

5. Result for Lead from Atomic Absorption Spectroscopy Prosopis juliflora Adsorbent

Table3.6: % Removal of lead

S.NO	Dose of the Prosopis Juliflora (g/L)	Concentration (ppm)	Percentage of Removal
1	2 g/l	0.1130	91.22%
2	4 g/l	0.1066	92.68%
3	6 g/l	0.1041	93.10%
4	8 g/l	0.0977	94.56%
5	10 g/l	0.0953	94.98%

V. CONCLUSION

The removal of toxic chemicals from the waste water using low cost adsorbent prepared from leaf like Prosopis Juliflora is more effective. It is the very cheap method for treating the waste water, so it is very useful treating the waste water from the small scale industry.

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