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Application of natural coagulant for removal of dye from synthetic textile wastewater

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Abstract

The present study estimates the removal of dye by using natural coagulants from synthetic textile wastewater Aluminumsulfate (alum), ferrous sulphate, ferric chloride and ferric chloro-sulphate were commonly used as coagulants. However, a possible link of Alzheimer's disease with conventional aluminium based coagulants has become an issue in wastewater treatment. Hence, special attention has shift towards using biodegradable polymer, chitosan in treatment, which are more environmental friendly. Moreover, chitosan is natural organic polyelectrolyte of high molecular weight and high charge density which obtained from deacetylation of chitin. Experiments were carried out on textile industry wastewater by varying the operating parameters, which are chitosan dosage, pH and mixing time in order to study their effect in flocculation process by using chitosan. The results revealed that chitosan had successfully flocculated the anionic suspended particles and reduce the levels of chemical oxygen demand and turbidity in textile industry wastewater. The optimum conditions for this study were at 50 mg/l of chitosan, pH 4 and 20 minutes of mixing time with 100rpm mixing rate for 1 minute, 40 rpm of mixing rate for 20 minutes and 30 minutes of settling time. Moreover, chitosan showed the highest performance under these conditions with 74% of dye reduction.

Keywords: wastewater, synthetic textile, natural coagulant, removal of dye

Introduction

Access to safe drinking water is a human right. However, now-a-days more than 1100 million people live without access to safe drinking water, especially in developing countries. Solution to this global problem is aimed to develop simple, effective, low cost and easy to use technologies, which are able to reduce organic, inorganic and microbiological water contamination. Textile industries are one of the most common and essential sector of the world. Textile and dyeing mills use many kinds of artificial composite dyes and discharge large amounts of highly coloured wastewater. Textile waste water pollutants are generally caustic soda, detergents, starch, wax, urea, ammonia, pigments and dyes that increases its BOD, COD, solids contents and toxicity. Textile dyes are characterised mainly on the basis of its application characteristics and its chemical structure, (Zahren Carmen, *et al*) based on the general structure alone, textile dyes are also classified as anionic, non-ionic and cationic dyes. Direct, Acid and reactive dyes constitute anionic dyes. Anionic dyes are most popular colorants and they are used in large variety of applications, such as textile, papers, food stuff and cosmetics. Before water is used turbidity removal is an essential part of treatment process. It is generally achieved using coagulation with metal salts followed by aggregation of particle during flocculation and separation through sedimentation and filtration (Emelie *et al* 2008). The history of the use of natural coagulants is quite long. Natural organic polymers have been used for more than 2000 years in India, Africa, and China as effective coagulants and coagulant aids at high water turbidities. They may be manufactured from plant seeds, leaves, and roots and process are major factors that have caused a continuous effort to find appropriate technologies to treat textile industry wastewater. The removal of dyes from aqueous solutions can be carried out through several chemical and physical methods. One of the most popular processes in water treatment is coagulation.

The aim of study is to analyse the dye removal from synthetic waste by using natural coagulants.

Objectives

- Study of optimum condition for removal of dye from synthetic textile industry waste water using natural coagulants.
- Study of effect of contact time on removal of dye.
- Study of effect of coagulant dosage on removal of dye.
- Study of effect of PH on removal of dye.
- Study of effect of concentration of dye.

Methodology

Calibration Curve

A calibration curve is a method used in analytical chemistry to determine the concentration of an unknown sample solution. It is a graph generated by experimental means with the concentration of solution plotted on the X-axis and observerable variable for example, the solution's absorbance plotted on the Y-axis. The curve is constructed by measuring the concentration and absorbance of several prepared solutions, called calibration standards. Once the curve has been plotted, the concentration of the unknown solution can be determined by placing it on the curve based on its absorbance or other observable variables.

Chemical solution absorb different amounts of higher based on their concentration. This fact is quantified in an equation known as Beer's law, which shows a linear relation between a solution's light absorbance and its concentration. Researchers can measure the absorbance of a solution using a laboratory instrument called a spectrophotometer. This process as a whole is called spectrophotometry.

Spectrophotometry can be useful in determining the concentration of an unknown solution. For example, if a researcher has a sample of river water and wants to know its lead content, s/he can determine it by using a spectrophotometer to plot a calibration curve. First, the researcher creates several standard solutions of lead, ranging from less to more concentrated. These samples are placed into the spectrophotometer, which records a different absorbance for each one.

Dye Absorbance Measurement

For reactive methyl orange dye, the reference frequency was found to be 520 nm by using digital spectrophotometer, based on the reference frequency the absorbance was measured for various known concentration of dye solutions. The calibration curve for reactive methyl orange dye was drawn using these values with this calibration curve, we can easily find out any unknown concentration of dye solution.

Table 1

S. No.	Concentration mg/l	Absorbance
1	1	0.004
2	2	0.029
3	3	0.065
4	4	0.112
5	5	0.135
6	6	0.149
7	7	0.162
8	8	0.175
9	9	0.187
10	10	0.199

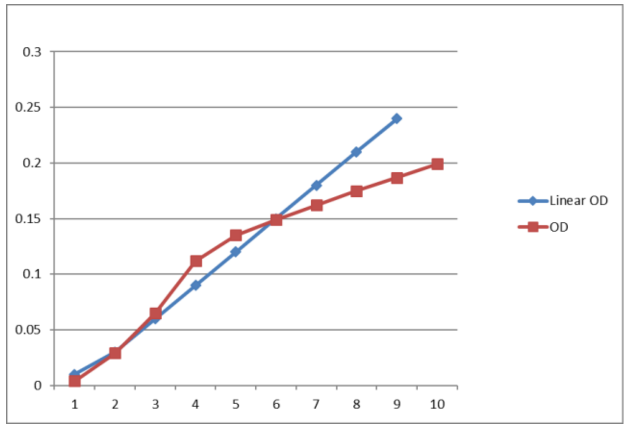

Fig 1: Calibration curve for Methyl Orange

Fig 2: Jar Test

Varying of Coagulant Dosages by Keeping Dye Concentration Constant

Table 2

S. No.	Initial Dye Concentration	Chitosan solution	Final Dye Concentration	% removal of dye
1	50mg/l	10 ml	19 mg/l	62 %
2	50mg/l	20 ml	16.15 mg/l	67 %
3	50mg/l	30 ml	15.09 mg/l	69 %
4	50mg/l	40 ml	14.85 mg/l	70 %
5	50mg/l	50 ml	14.63 mg/l	71 %
6	50mg/l	60 ml	14 mg/l	72 %
7	50mg/l	70 ml	14 mg/l	72 %

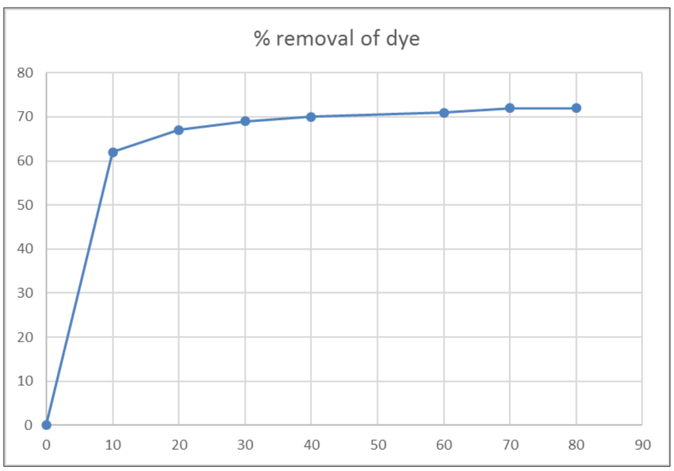

Fig 3: Removal dye percentage varying of coagulant dosages

Varying of Dye Concentration by Keeping Constantof Coagulant Dosages

Table 3

S. No.	Initial Dye Concentration	Coagulant dosage	Final Dye Concentration	% removal of dye
1	50mg/l	70 ml	14 mg/l	72 %
2	75mg/l	70 ml	25.3 mg/l	66 %
3	100mg/l	70 ml	46 mg/l	54 %
4	125mg/l	70 ml	66.2 mg/l	46 %
5	150mg/l	70 ml	87.2 mg/l	42 %

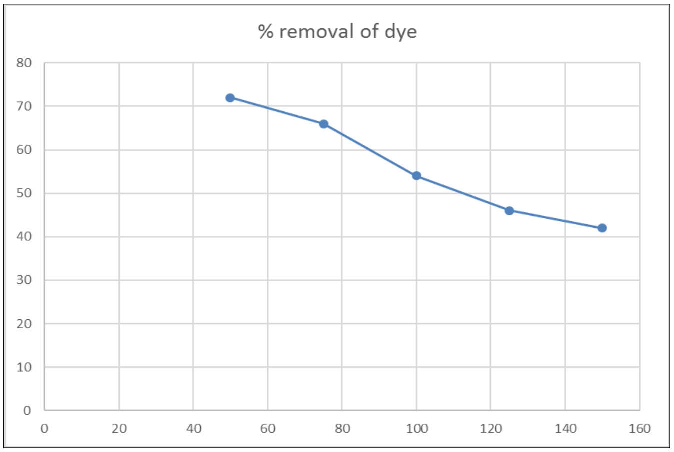

Fig 4: Varying of dye concentration by using coagulant dosages constant

Varying of pH by keeping Constant Dye Concentration and Coagulant Dosages

Procedure

- **Prepration of pH Solution**
  0.1NH$_2$SO$_4$
  3ml H_2SO_4 solution is added to 1020 ml of distilled water.
  0.1N NaOH
  4gram NaOH is added to 1 litre distilled water
- **Prepration of Dye Solution**
  - 50 mg methyl orange added to 1 litre of distilled water in 6 jars each having 50 mg solution.
  - pH has been varied in each jar. i.e., 2, 4, 6, 8, 10, 12 respectively.
  - Jar test has been done.
  - OD values are been checked with the help of digital spectrometer.

Table 4

pH	Initial Dye Concentration	Coagulant dosage	Final Dye Concentration	Percentage %
2	50mg/l	70 ml	48.9 mg/l	2.2 %
4	50mg/l	70 ml	22.2 mg/l	55.6 %
6	50mg/l	70 ml	15.5 mg/l	71 %
8	50mg/l	70 ml	15.5 mg/l	71 %
10	50mg/l	70 ml	17.40 mg/l	65.2 %
12	50mg/l	70 ml	24.5 mg/l	51%

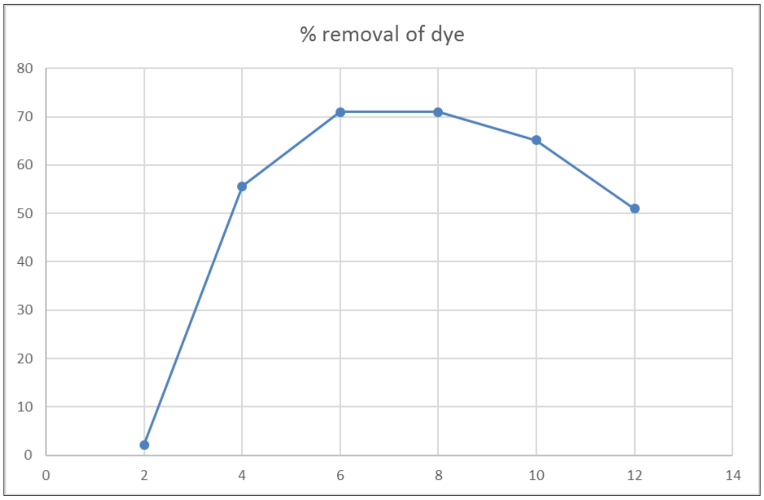

Fig 5: Removal of dye Varying of pH by keeping constant dye concentration and coagulant dosage

Varying of Contact Time Constant Dye Concentration and Constant Coagulant Dosage

- 50 mg methyl orange added to 1 litre of distilled water in 6 jars each having 50 mg solution.
- Contact time has been varied in each jar. i.e., 10, 20, 40, 60, respectively.
- Jar test has been done.
- OD values are been checked with the help of digital spectrometer.

Table 5

Contact time	Initial Dye Concentration	Coagulant dosage	Final Dye Concentration	Percentage %
10 min	50mg/l	70 ml	35 mg/l	30 %
20 min	50mg/l	70 ml	29 mg/l	42 %
30 min	50mg/l	70 ml	21 mg/l	58 %
40 min	50mg/l	70 ml	13 mg/l	74 %
50 min	50mg/l	70 ml	13 mg/l	74 %
60min	50mg/l	70 ml	16 mg/l	68 %

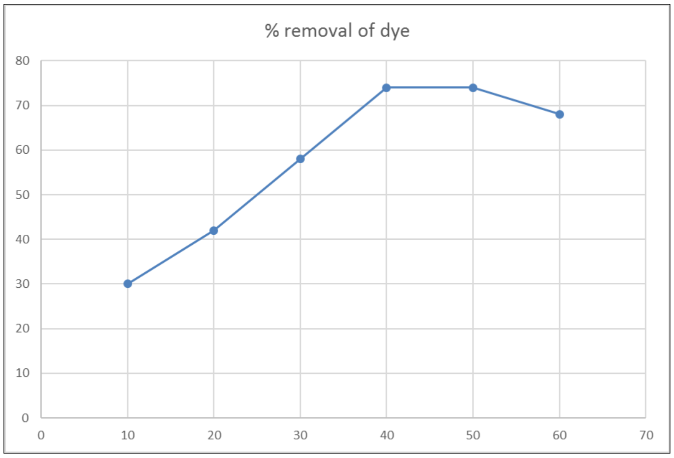

Fig 6: Removal of dye varying of contact time by keeping constant dye concentration and coagulant dosage

Conclusions

In this project has been about the study of the effect of coagulants on synthetic textile wastewater, and all the tests for the removal of dye concentration were done eg varying of pH, varying of coagulants, varying of contact time, It is found that the maximum removal is 74%. So It has been concluded that natural coagulant (Chitosan) is the best removable and eco-friendly coagulant.

References

1. Vijayaraghavan G, Rajasekaran R. Removal of reactive yellow dye using natural coagulants in synthetic textile wastewater, International journal of chemical science, 2013, 1824-1830.
2. Nabi Bidhendi GR *et al*. Evaluation of industrial dyeing waste water treatment with coagulants and polyelectrolyte as a coagulant aid, Iran Journal of environmental health science engineering. 2006, 29-36.
3. Gobinath R *et al*. Removal of color from textile industry waste water using natural coagulants, A scholar journal of engineering and technology. 2013, 149-153.
4. Beltran Heredia J, Sanchez-Martin J. Textile waste water purification through natural coagulants, Application of water science. 2011, 25-33.
5. Mena Solanki, Suresh S, Shakti Natha Das. Treatment of real textile wastewater using coagulation technology, International conference of global scenario in environmental and energy, 2013, 610-616.
6. Sarah Wilson A, Susan Andrews A. Impact of natural coagulants pretreatment for color removal on solar water disinfection (SODIS), Journal of water, sanitation and hygiene for development. 2011, 57-67.
7. Sujith Alen, Vinodha. Color removal efficiency of textile dyeing waste wate using moringoolifera SSRG, International journal of civil engineering, 2014, 7-11.
8. Sonal Choubey, Rajput SK. Comparison of efficiency of some natural coagulants- Bioremediation, International journal of emerging technology and advanced engineering, 2012, 429-434.
9. Simphiwe Buthclezi P, Ademola Olaniran O. Textile dye removal from wastewater effluents using bio flocculants reduced by indigenous bacterial isolates, Molecules, 2012, 14260-14274.
10. Tansneembano Kazi, Arjun Virupakshi. Treatment of tannery waste water using natural coagulants, International journal of innovative research in science engineering & technology. 2013, 4061-4068.