ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

REMOVAL OF REACTIVE DYES USING DIFFERENT COAGULANTS FOR TEXTILE WASTEWATER

Mr. Riyaj K. Mulla*, Mr. Anil C. Ranveer
Department of Technology, Shivaji University, Kolhapur, India

ABSTRACT

Effluents of large variety of industries usually contain important quantities of dyes. The discharge of these colored compounds in the environment causes considerable non-aesthetic pollution and serious health-risk factors. Since conventional wastewater treatment plants cannot degrade the majority of these pollutants, powerful methods for the decontamination of dyes wastewaters have received increasing attention over the past decade. In this report a general review of efficient coagulation technology is developed to decolorize and/or degrade dyeing effluents for environmental protection. The effect of coagulant dosage and pH of wastewater on the color removal was examined, and the % of color removal results treated by different doses of coagulants like alum, ferric chlorite and ferrous sulphate at constant contact duration (4 hours), optimum pH from 6-8 using more coagulant doses and room temperature.Color removal percentage reduction (maximum) corresponds to 75.0 % to 85.0% , on reactive dyes The efficiency of color removal increased with increasing coagulant dose.

KEYWORDS: Reactive dyes,Color removal,Coagulation,Flocculation.

INTRODUCTION

The textile industry has been condemned as being one of the world's worst offenders in terms of pollution because it requires a great amount of two components: Chemicals: as many as 2,000 different chemicals are used in the textile industry, in form dyes to transfer agents; and Water: a finite resource that is quickly becoming scarce, and is used at every step of the process both to convey the chemicals used during that step and to wash them out before beginning the next step. The water becomes full of chemical additives and is then expelled as wastewater; which in turn pollutes the environment: Water saturated with dyes, de-foamers, bleaches, detergents, optical brighteners, equalizers and many other chemicals used during the process. The environmental impact of the textile industries is associated with its high water. It is estimated that up to 15% of the dye is lost during this operation and disposed out in the textile effluents with a remarkable spent of water The wastewater from the textile industry is known to be strongly colored, presence of large amount of suspended solids, broadly fluctuating pH, high temperature, besides high chemical oxygen demand. Color is the first contamination to be recognized in this wastewater. A very small amount of dye in water is highly visible and reduces penetration of light in water systems, thus causing a negative effect on photosynthesis & serious health-risk factors Color removal from textile effluents has been the target of great attention in the last few years, not only because of its potential toxicity, but mainly due to its visibility problems

TECHNOLOGIES AND EFFLUENT CHARACTERISTICS

In industry, the technologies applied in color removal of effluents are:

i. *Physical* - Carbon Adsorption
ii. *Chemical* - Coagulation and precipitation, Chemical oxidation, Electrochemical oxidation etc.
iii. *Biological*- Aerobic and Anaerobic biological processes ,
iv. *Advance treatment processes* - Membrane technology

However, many of these technologies are cost prohibitive, especially when applied for treating large waste streams. Also To conduct and evaluate empirical work, it is necessary to consider only the most critical controlling parameters. Several authors have consider the most important parameters to be considered in coagulation are pH and the concentration of the applied metal ion (coagulant) such as alum [Al III], FeCl3, and ferrous sulfate The present study deals with the color removal by coagulants like alum, ferrous sulphate and ferric Chloride at different doses.

TYPES OF DYES POLLUTANTS ASSOCIATED WITH THE DYES

1. Reactive dyes:

These dyes form a covalent chemical bond with fiber is ether or ester linkage under suitable conditions. The major chemical classes of reactive dyes are azo that including metallized azo, triphendioxazine, phthalocyanine, formazan, and anthraquinone. These chemical classes are used for dyeing and printing of cotton, wool, etc. The molecules structures of reactive dyes have much simpler than direct dyes and the dyeing are brighter.

2. Disperse dyes*:*

These are substantially water–insoluble nonionic dyes for application to hydrophobic fibers from microfine aqueous dispersion. They are used predominantly on polyester, polyamide, polyacrylonitrile, polypropylene fibers and a lesser on nylon, cellulose acetate, and acrylic fibers. Chemical classes of dyes mainly belong to azo and anthraquinonoid involving low molecular weight of structure and containing group which aid in forming stable aqueous dispersions.

3. Direct dyes*:*

These are water–soluble anionic dyes when dyed from aqueous solution in the presence of electrolytes, which are substantive to have high affinity for cellulose fibers. They are applied on cotton, cellulose, paper, leather, and nylon. Most of the dyes in this class are polyazo compounds, along with some stilbenes, phthalocyanines, and oxazines. Commonly, chelations with salts of metals such as copper and chromium are applied to the dye material for improving wash fastness properties. Also, their treatment with formaldehyde or a cationic dye–complexing resin.

4. Vat dyes:

These are insoluble in water that can apply mainly to cellulose fiber by converting them to their leuco compounds by reduction and solubilization with sodium hydrosulphite and sodium hydroxide solution that is call as vatting process. The main chemical classes of vat dyes are anthraquinone and indigoid.

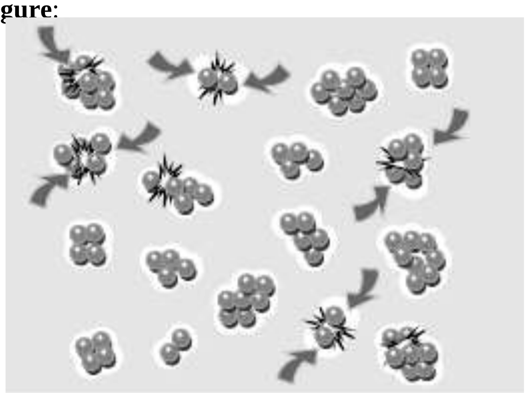
THEORETICAL BACKGROUND OF COAGULATION

1. Coagulation :

The first step destabilizes the particle’s charges. Coagulants with charges opposite those of the suspended solids are added to the water to neutralize the negative charges on dispersed non-settable solids such as clay and color-producing organic substances. Once the charge is neutralized, the small suspended particles are capable of sticking together. The slightly larger particles formed through this process and called microflocs, are not visible to the naked eye. The water surrounding the newly formed microflocs should be clear. If it is not, all the particles’ charges have not been neutralized, and coagulation has not been carried to completion. More coagulant may need to be added.

A high-energy, rapid-mix to properly disperse the coagulant and promote particle collisions is needed to achieve good coagulation. Over-mixing does not affect coagulation, but insufficient mixing will leave this step incomplete. Coagulants should be added where sufficient mixing will occur. Proper contact time in the rapid-mix chamber is typically 1 to 3 minutes.

Figure:



Unharged particle are free to collide and aggregate.

2. Flocculation :

Following the first step of coagulation, a second process called flocculation occurs. Flocculation, a gentle mixing stage, increases the particle size from submicroscopic microfloc to visible suspended particles. The microflocs are brought into contact with each other through the process of slow mixing. Collisions of the microfloc particles cause them to bond to produce larger, visible flocs called pinflocs. The floc size continues to build through additional collisions and interaction with inorganic polymers formed by the coagulant or with organic polymers added. Macroflocs are formed. High molecular weight polymers, called coagulant aids, may be added during this step to help bridge, bind, and strengthen the floc, add weight, and increase settling rate. Once the floc has reached it optimum size and strength, the water is ready for the sedimentation process. Design contact times for flocculation range from 15 or 20 minutes to an hour or more.

Coagulation and flocculation can be caused by

- Double layer compression
- Charge neutralization
- Bridging
- Colloid entrapment

Procedure Set Up

The efficiency of coagulation depends on many factors for example, a kind and quantity of coagulants, pH, the order of chemical adding and condition controlling. the laboratory procedure that is used to control coagulation process is Jar Test. It Consist of series of six stirring paddle which can be rotated at a variable controlled speed to mix content of liter beaker. this permits the simultaneous treatment and observation of six sample under identical mixing condition in order to determine the relative merits of various chemical treatments, or to determine the optimum dosage of particular chemical.

Figure:

Controlling of Coagulation by Jar Test.

Different concentration of each dye were prepared;20, 40, 70, and 90 mg/L. Effectiveness of chemical coagulation of H2O or wastewater have been experimentally evaluated in the laboratory by using the jar testing device, which consists of six paddles capable of variable speed operation between zero and 100 r.p.m. In making tests, one liter of wastewater is placed in each of six beakers, and is dosed with different amounts of coagulants. The beakers are mixed at a preliminary speed of 60 to 80 r.p.m. for one minute after adding the coagulant solution and then are stirred at a speed of 30 r.p.m. for 15 minutes. After stopping the stirrer the samples are allowed to settle under quiescent conditions.

Results and discussion

1. **Aluminum Sulfate (Alum) $Al_2(SO_4)_3$**

Alum is one of the most widely used coagulants and will be used as an example of the reactions that occur with a metal coagulant. Ferric coagulants react in a generally similar manner, but their optimum pH ranges are different. When aluminum sulfate is added to water, hydrous oxides of aluminum are formed. The simplest of these is aluminum hydroxide ($Al(OH)_3$) which is an insoluble precipitate.But several, more complex, positively charged soluble ions are also formed, including:

- $Al_6(OH)_{15}^{+3}$
- $Al_7(OH)_{17}^{+4}$
- $Al_8(OH)_{20}^{+4}$

The proportion of each will vary, depending upon both the alum dose and the pH afteralum addition. To further complicate matters, under certain conditions the sulfate ion (SO_4^{-2}) may also become part of the hydrous aluminum complex by substituting for some of the hydroxide (OH-1) ions. This will tend to lower the charge of the hydroxide complex

2. **ALUM**

$A1_2(SO_4)_3 + 3\ Ca(HCO_3)_{2\ -} \Rightarrow 2\ Al(OH)_3 + 3CaSO_4 + 6\ CO_2$

3. **FERRIC SULFATE**

$Fe_2(SO_4)_3 + 3\ Ca(HCO_3)_2 \Rightarrow 2\ Fe(OH)_3 + 3CaSO_4 + 6\ CO_2$

4. **FERRIC CHLORIDE**

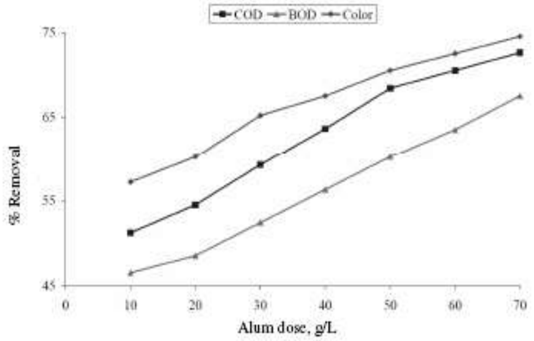
$2\ Fe\ Cl_3 + 3\ Ca(HCO_3)_2 \Rightarrow 2\ Fe(OH)_3 + 3CaCl_2 + 6CO_2$

5. **FERROUS SULFATE**

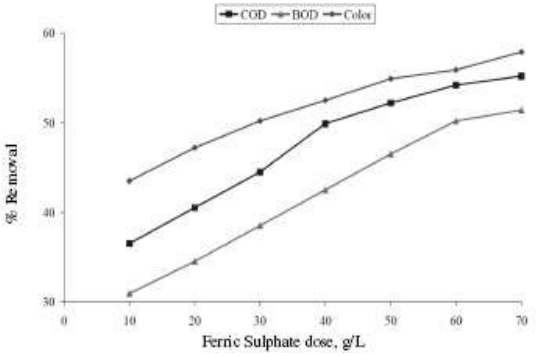
$FeS0_4 + Ca(HCO_3)_2 \Rightarrow Fe(OH)_2 + CaS04 + 2CO_2$

Figurs:

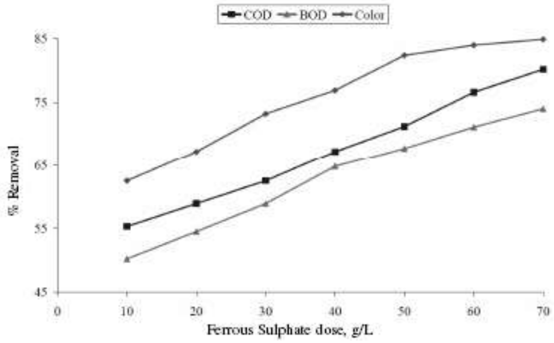
ISSN: 2277-9655
Scientific Journal Impact Factor: 3.449
(ISRA), Impact Factor: 2.114



Influent of different dose for COD, BOD and color removal by Alum



Influent of different dose for COD, BOD and color removal by ferric sulphate



Influent of different dose for COD, BOD and color removal by ferrous sulphate

CONCLUSION

1. The wastewater was treated with various doses of coagulants like alum, ferric sulphate and ferrous sulphate. The ferrous sulphate is more competent than other coagulation for COD,BOD and Color removal.
2. Waste minimization is of great importance in decreasing pollution load and production costs which above Coagulant Fails so various research are been Done to minimize the volume of the sludge & consumption of the Chemical. So above coagulants to be used in combination with other coagulant to overcome the disadvantage.
3. Different dyes have different respond toward the same coagulant at different pH and vice versa.

REFERENCES

[1] Himanshu Patel and R.T. Vashi, “Treatment of textile wastewater by adsorption and coagulation”, *E-Journal of Chemistry*, Volume no. 7(4), PP 1468-1476, 2010

[2] Dr: Hoda Roushdy Guendy, “Removal of Azo Reactive, Direct Dyes from Wastewater Using Different Coagulants at Different pH”, *Journal of Applied Sciences Research*, Volume no 6(8): 956-963,

[3] Dr. Subrata Das , Textile effluent treatment – a solution to the environmental pollution.

[4] Jarussaeng Molen Chakravarthy, “Treatability studies on the wastewater from a dye manufacturing industry” Thesis in Asian Institute of Technology, Thailand, May 2008.

[5] Zeta-Meter, Inc., “everything you want to know about coagulation & flocculation”, April 1993.

AUTHOR BIBLOGRAPHY

	**Riyaj K Mulla** Persuing M.Tech in Environmental science & Technology
	**Anil C. Ranveer** Persuing Ph.D in Chemical Engineering.