

Treatment of Textile Wastewater Using Combination of Abelmoschus Seed and Inorganic Coagulants

Aathavan M¹, Sivanesan C², Abuthahir S³

PG Student, Department of Civil Engineering, Alagappa Chettiar Government College of Engineering and Technology,
Karaikudi, India¹

Assistant professor, Department of Civil Engineering, Alagappa Chettiar Government College of Engineering and
Technology, Karaikudi, India²

PG Student, Department of Civil Engineering, Annamalai University, Chidambaram, India³

ABSTRACT: The requirements of dye concentration, COD and BOD removal has promoted the research in this study, the feasibility of using natural and chemical coagulants for removal of dye concentration and COD from the Reactive dyes containing textile wastewater. Removal efficiency was observed at pH 6-9 for different coagulants and optimum coagulant dosage of combination of Abelmoschus seed with PAC, Aluminium sulphate, ferric chloride such as 1.4mL, 1.6mL, 1.5mL per liter respectively, and optimum pH 7,8,9 respectively. Finally the result were obtained for removal efficiency from combination of Abelmoschus and PAC such as dye concentration removal efficiency 74%, and COD removal 68.01%, respectively at optimum pH of 7.

KEYWORDS: Textile wastewater, Abelmoschus seed, PAC, Aluminium sulphate, Ferric chloride, Optimum Coagulant dosage, jar test, pH and so on.

I. INTRODUCTION

Textile industry is one of the complicated industries which use chemicals like dyes, acids, alkalies, starch etc., for their processes. The textile industry consumes large quantities of water and generates large volume of waste water from different steps in the printing, dyeing and finishing process. Textile colors are regarded as one of the largest groups of organic compounds produced yearly about 700,000 tons, and also around 1-20 percent of total colors world productions get into textile effluents during dyeing processes. Numerous physicochemical processes like coagulation, flocculation, precipitation, oxidation, irradiation, incineration, and membrane adsorption have been used for the treatment of dye contaminated effluents. The physical-chemical technologies for wastewater treatment, including the advanced oxidation processes (i.e. application of ozone, hydrogen peroxide and ultraviolet), are expensive, not always effective and often do not reduce the toxicity of the effluents.

Table-1: Initial characteristics of textile wastewater

S.no	Parameters	Value	Units
1	pH	11.06	NIL
2	Total solids	10610	mg/L
3	Total suspended solids	6560	mg/L
4	Total dissolved solids	4050	mg/L

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

5	DYE	310	mg/L
6	COD	3200	mg/L
7	Alkalinity	1800	mg/L
8	Sulphate	2700	mg/L
9	Chloride	1879	mg/L

II. MATERIALS AND METHODOLOGY

The coagulants which are used in this study are abelmoschus esculentus , aluminium sulphaate , ferric chloride for treatment of textile wastewater. The natural coagulants (ladies finger seed) collected from local market of Karaikudi , Tamilnadu , India.



Figure -1: Abelmoschus plant



Figure -2: Abelmoschus seed

2.1 PREPARATION OF NATURAL COAGULANTS

Preparation of organic coagulant Seed of abelmoschus are collected and then collected seed dried by sunlight for 48 hours. Then dried sample grained by using domestic blender, this grained particle was sieved through 600 micrometer sieve by using sieve shaker.

2.2 COAGULATION CUM FLOCCULATION

Coagulant chemicals with charges opposite those of the suspended solids are added to the water to neutralize the negative charges on non-settable solids and settle down under the gravity force, More coagulant chemicals may need to be added. A high-energy, rapid-mix to properly disperse 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.

2.3 COAGULATION STUDY

For the study of coagulation jar test apparatus has been used. Combination of organic and inorganic dosage of coagulant considered as abelmoschus seed powder combined with Polyaluminium chloride, Aluminium sulphate, and Ferric chloride such as 0.8ml, 1.0ml, 1.2ml, 1.4ml, 1.6ml respectively. Preparation of coagulants by 2:1 ratio of organic and inorganic coagulants

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

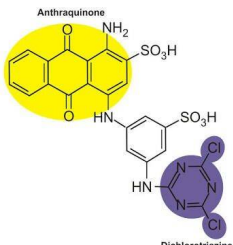
Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

2.4 JARTEST

The jar test is a laboratory procedure to determine the optimum pH and the optimum coagulant dosage. A jar test simulates the coagulation and flocculation processes. There are five beakers and steel paddles which help in agitation process. The initial speed of agitation is 120 rpm for 2 minutes, followed by 30 rpm for 20 minutes. The setting time applied for this coagulation cum flocculation process is 60 minutes.

Table-2: Dye details

DYE NAME	MOLECULAR STRUCTURE	WAVE LENGTH
Turquoise blue H5G	<p>Procion Blue MX-R (reactive blue 4)</p>  <p>Anthraquinone NH₂ SO₃H SO₃H HN HN Cl Cl Dichlorotriazine</p>	550 nm

III. RESULTS AND DISCUSSIONS

3.1 OPTIMUM COAGULANT DOSAGES

The optimum coagulants are determined by varying the coagulant dosages are 0.8ml, 1.0ml, 1.2ml, 1.4ml, 1.6ml of combination of Abelmoschus seed powder with Polyaluminium chloride, Aluminium sulphate, Ferric chloride at initial pH of textile wastewater(pH = 11.07)

Table-3: Optimum coagulant dosage

S.NO	Coagulants	Optimum dosage in ml
1	PAC+ abelmoschus coagulant	1.6
2	Aluminium sulphate + abelmoschus coagulant	1.4
3	ferric chloride + abelmoschus coagulant	1.4

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

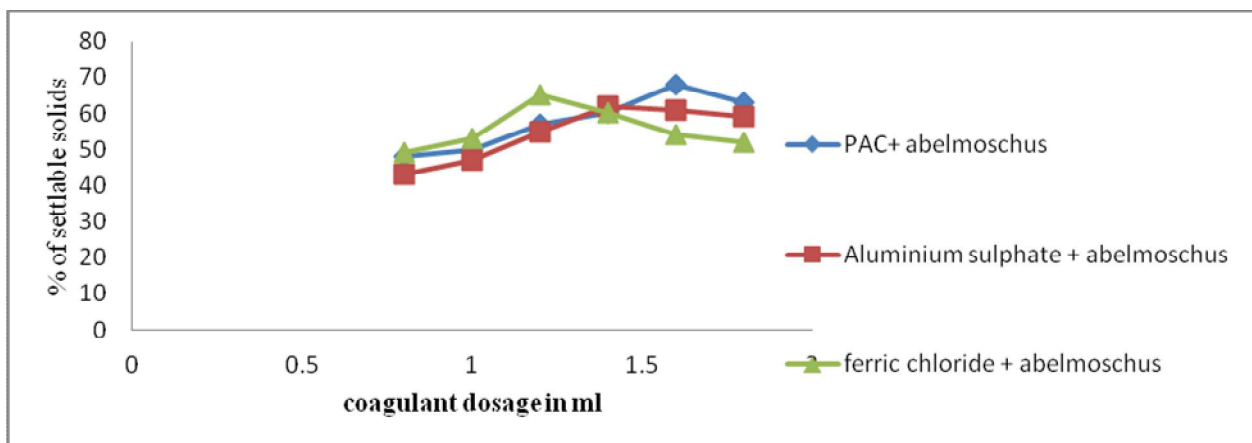


Figure 3: optimum coagulant dosage

The combination of organic and inorganic coagulants, optimum coagulant dosage of PAC+ abelmoschus coagulant, Aluminium sulphate + abelmoschus coagulant and ferric chloride + abelmoschus coagulant are 1.6ml, 1.4ml, 1.4ml respectively.

Figure 3 shows that optimum coagulant dosage, The precipitation of $Al(OH)_2$ and $Fe(OH)_2$ requires the combined use of organic and inorganic coagulants such as PAC, Aluminium sulphate, ferric chloride & abelmoschus seed, we studied the effect of organic and inorganic coagulant dosage on dye and COD removal efficiency by varying the

amount of coagulant dosage to the solution. It was found that this NaOH dosage was sufficient to maintain a pH above 12.0 during treatment

3.2 OPTIMUM pH OF THE SAMPLE

Optimum pH is at pH maximum reduction of turbidity take place. Optimum pH can be determined by varying the pH value as 2, 3, 4, 7, 8, 9. below chat shows optimum pH. To study the effect of pH on concentration removal of dye and COD, we kept the combination of organic and inorganic coagulant dosage constant at different pH of the sample, while varying the pH of the solution with H_2SO_4 solution and NaOH solution. It was considered that the pH of the samples could affect the molecular structure of the dyes, which would change the absorbance of the solutions (Gao et al., 1999). So the pH of the untreated and treated solutions was adjusted to 7.0

Table-4: Optimum pH of the sample

S.NO	Coagulants	Optimum pH of sample
1	PAC+ abelmoschus coagulant	7
2	Aluminium sulphate + abelmoschus coagulant	8
3	ferric chloride + abelmoschus coagulant	7

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

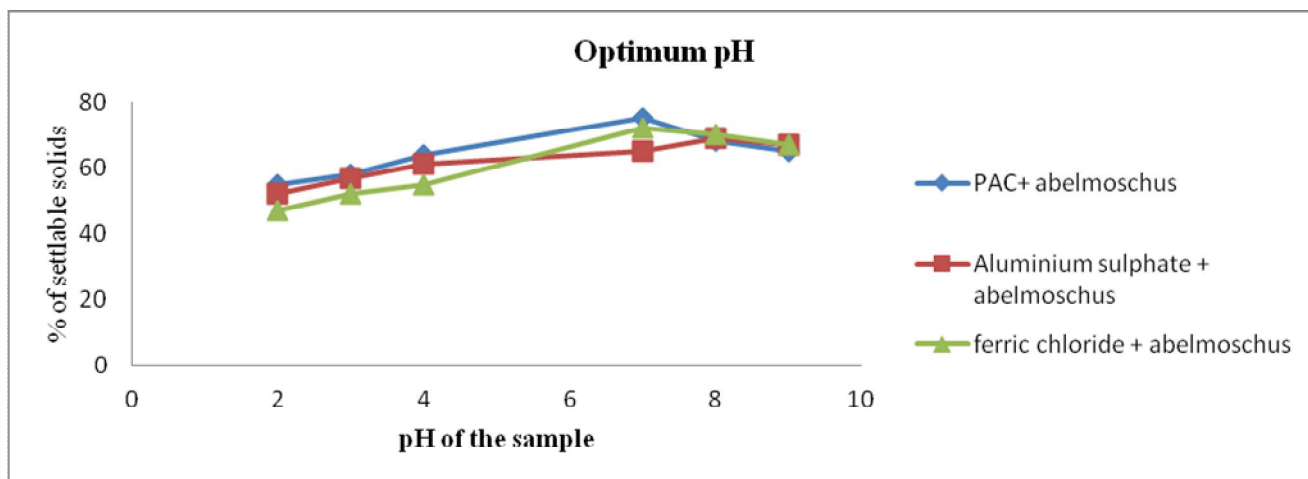


Figure 4: Optimum coagulant dosage

The combination of organic and inorganic coagulants, optimum pH of the sample such as PAC+ abelmoschus coagulant, Aluminium sulphate + abelmoschus coagulant and ferric chloride + abelmoschus coagulant are 7, 8, 7 respectively.

Figure 4 shows optimum pH results shows that the dye and COD removal efficiency increased with increasing pH from 2–9 the optimum removal efficiency both for the reactive dyes and for the dispersed dyes was achieved when the pH was above 7.0 When the pH value is higher than 7.0, almost all the Aluminium and ferric ions are converted into precipitable hydroxide.

Table-5: Removal efficiency of COD and Dye concentration

S.NO	Coagulants	Optimum pH of sample	% of COD removal efficiency	% of DYE removal efficiency
1	PAC+ abelmoschus coagulant	7	65	70
2	Aluminium sulphate + abelmoschus coagulant	8	48	63
3	ferric chloride + abelmoschus coagulant	7	52	68

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

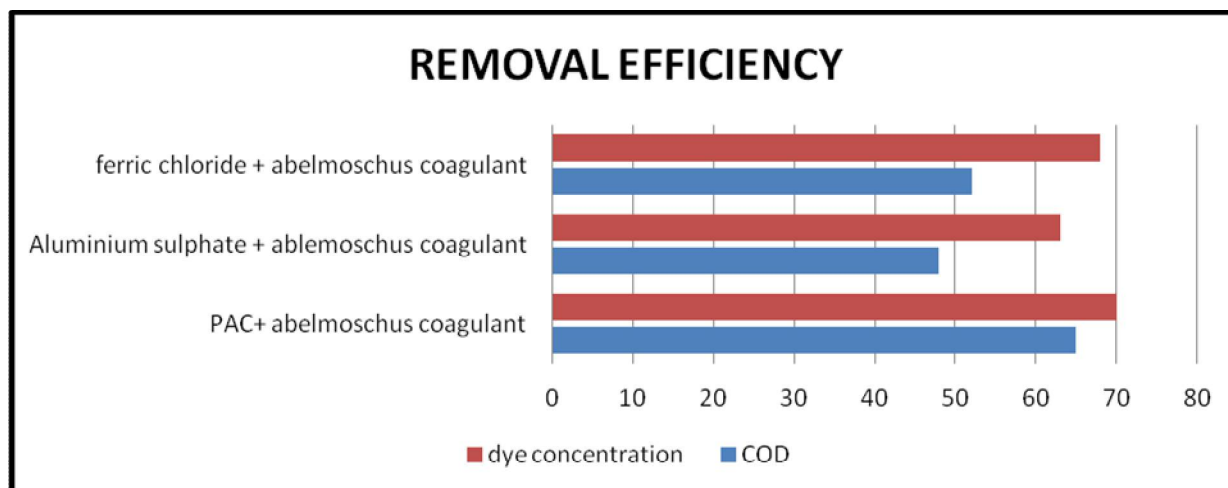


Figure 5: Removal efficiency

IV. CONCLUSION

In this study, the industrial textile wastewater was treated using a chemical-based technique such as coagulation cum flocculation. Coagulation/flocculation using combination of abelmoschus & PAC is a suitable process for the removal of highly concentrated Reactive dye especially when the operating parameters are optimized. In fact, failure in optimizing the process parameters may lead to inefficiencies of the coagulation process

Polyaluminium chloride and abelmoschus effectively removes concentration dye and COD from textile wastewater. The removal rate of the reactive dye Turquoise blue H5G by PAC depends significantly on the pH of the textile wastewater. The effective pH range for PAC Treatment is at 7.0 and above. For both the reactive and dispersed dye

waste, combination of abelmoschus & PAC was shown to be Superior to, $Al_2(SO_4)_3$, and natural coagulant (Abelmoschus) for removing dye concentration and COD removal efficiency. So, the PAC system is a viable alternative to some of the more conventional forms of chemical treatment, especially for treatment of actual textile waste with high natural pH. The results of this study indicate that combination of abelmoschus & PAC may remove the dyes through charge neutralization and an adsorptive coagulating mechanism.

V. ACKNOWLEDGMENTS

I am very thankful to Alagappa Chettiar Government College of Engg and Tech, Karaikudi for their kind help and support and I express my sincere thanks to my project guide **Dr. C. SIVANESAN ME., Ph.D.**, Assistant professor, Department of Civil Engineering, Alagappa Chettiar Government College of Engineering and Technology, Karaikudi for his excellent guidance, support, encouragement and blessings throughout this project.

REFERENCES

- [1] Wang et al (2004) 2004. Color removal from wastewater containing dye by chemical oxidation and coagulation. Research of Environmental Sciences. 12 (1), 5–9.
- [2] Neethu.p, navami, J.F., Hornsby, J.J.S., 2008. Color removal from textile dye waste using magnesium carbonate. Journal Water Pollution Control Federation 50, 2446–2456.
- [3] chidanand patil Kang, S.F., Chen, M.C., 2015. Coagulation of textile secondary effluents with electro fenton's reagent. Water Science and Technology 36 (12), 215–222.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 6, June 2017

- [4] D S Bhutada ,Kaul Kang, S.F., Liao, C.H., Po, S.T., 2006 . Decolorization of textile wastewater by electro-fenton oxidation technology. Chemosphere 41 (8), 1287–1294.
- [5] seyedali S.F., Liao, C.H., Chen, M.C., 2009 Pro-oxidation and coagulation of textile wastewater by the electro fenton process. Chemosphere 46 (6), 923–928.
- [6] mohamad malakootian J., Rebhun, M., 2016 . Effect of magnesium and calcium precipitation on coagulation-flocculation with lime. Water Research 16, 655–663.
- [7] Yao et al Liao, M.Y., Randtke, S.J., 2008. Predicting the removal of soluble organic contaminants by lime softening. Water Research 20, 27–33.
- [8] zhou al Lin, S.H., Chen, M.L., 2007. Treatment of textile wastewater by chemical methods for reuse. Water Research 31, 868–876.
- [9] zhou et al 2007 McKay, G., 2000. Waste color removal from textile effluents. Journal of American Dyestuff Reporter 68, 29–36.
- [10] Pagga, U., Brown, D., 2008. The degradation of dyestuffs part II: behaviour of dyestuffs in aerobic biodegradation tests. Chemosphere 15 (4), 479–491.
- [11] Md. Asrafuzzaman, A.N.M. Fakhruddin, and Md. Alamgir Hossain ,2007 “Reduction of Turbidity of Water Using Locally Available Natural Coagulants”ISRN Microbiology Volume .
- [12] Datar, M.T. and Kale S.B. 1997. Performance of a Dairy Effluent Treatment Plant. Indian Journal of Environmental Health. 39 (1) : 52- 60.
- [13] Howard, S. and Peavey, S., George Tchobanoglous 1995. Environmental Engineering. IS: 8682-1977. Guide for Treatment of Effluent of Dairy Industry.
- [14] James, M. Montgomery 1994. Water Treatment Principal and Design. John Wiley & Sons NY .Khurody, D.N. 1972. Disposal of wash from large dairies. Indian Journal of Environmental Health. 14 (3) : 259 -265.
- [15] Kawamura, S. 1991. Effectiveness of Natural Polyelectrolyte in water treatment. J. Am. Wat. Wks. Association. 83 : 88 - 91.
- [16] Li Guibai, John Gregory 1991. Flocculation and sedimentation of high turbid waters. Water Research. 25 (9) : 1137-1143.
- [17] Metcalf and Eddy, 2004. Wastewater Engineering - Treatment Disposal and Reuse’ McGraw Hill, Fourth Edition.