LOW COST NATURAL COAGULATION AND ADSORPTION TREATMENT FOR COLOUR REDUCTION OF TEXTILE WASTEWATER

Sushma G M[1], Kishor Kumar S [2], Suhani K S [3] and Rashmitha H R [4]
UG Student [14], Assistant Professor [2],Associate[3]
Department of Civil Engineering[1234]
[1234]*Malnad College of Engineering, Hassan, Karnataka state, India.*

Abstract: The textile dye industry is the largest consumer of dye stuffs. During the coloring process a large amount of synthetic dye does not bind and is lost to the waste system. These dyes are difficult to remove in conventional wastewater treatment processes and can be transported easily through sewers and rivers especially because they are designed to have high water solubility. The effluent streams from these textile industries leads to serious water pollution problems. For separation of dyes from these effluent streams, coagulation and adsorption technique is used in this study. Coagulation is the process of settling of suspended particles and subsequent removal of turbidity, Adsorption is a surface phenomenon in which the liquid phase solutes in liquid phase are adsorbed on the surface of the adsorbents. Adsorption using natural adsorbents is more feasible and economical as the natural adsorbents are available in bulk and majorities are usually waste products. Coagulation and Adsorption can be done using lab apparatus such as jar apparatus and orbital shaker with constant stirring where the adsorbent and dye solutions are intimated for a specific period. Coagulant and Adsorbent used in this study are zee maize and sugarcane leaves . Different parameters were altered during the experimentation such as coagulant and adsorbent dosage, time of contact and keeping temperature constant. Coagulation and Adsorption is a low-cost waste water treatment process and is comparatively economical than advanced oxidation processes and filtration processes. The optimum coagulant dosage was 2.5 ml in 1000 ml dye sample, Coagulation using zee maize has achieved upto 70% of removal of turbidity using jar test apparatus .Adsorption using sugarcane leaves has gained up to 98% removal of colour using orbital shaker .

Index terms – coagulation ,zee maize ,sugarcane leaves, Textile Wastewater, Turbidity, colour

1.INTRODUCTION

Most industries use dye and pigments to colour their products. More than 8000 chemically different types of dyes are being manufactured and the biggest consumers of these dyes are textile, tannery, and paper pulp industries and perhaps these are the serious polluters of our an agricultural byproduct such as sugar cane leaves environment as far as colour pollution is concerned. Many dyes used in the textile industry are difficult to remove by conventional waste treatment methods since they are resistant to aerobic digestion. Presence of very minute concentration of colouring substance makes water unsuitable for several domestic applications. The removal of dyes from effluent in an economic fashion remains a major problem. Adsorption is the widely used technique for removal of dyes from aqueous solution. Carbon adsorption is one of the most dependable and efficient treatment process to provide high quality effluent. Several works has been reported in literature on colour removal from aqueous solution and several investigations have concentrated their work on low cost, non-conventional materials. India is an agricultural based country and huge amounts of wastes are being generated from agricultural operations. Hence, in the present study we use an agricultural byproduct such as sugar cane leaves and zee maize. an agricultural byproduct such as sugar cane leaves

2.MATERIALS AND METHODOLOGY

2.1 Coagulation treatment:

Zee maize:

For this study, zee maize has been chosen as coagulant because it is naturally available and may function as an effective and less expensive coagulant in removing solids and turbidity.

Zee maize used in the study, was collected from local super market. It was ground to fine powder and sieved through 0.3 mm sieve. the fraction with particle size less than 0.3 mm was used in the experiment.

The active component from coagulant was extracted using sodium chloride (NaCl).10gms of seed powder was suspended in 1L of NaCl water solution (0.5 mol/L). The suspension was stirred using a magnetic stirrer for 10 minutes to extract active coagulant component. The solution was then filtered using whatman filter paper. The coagulation activity due to microbial decomposition of organic compounds during storage of fresh solution was prepared for each sequence of experiments.

Fig 2(a)Preparation of maize solution

2.2: Treatment of coagulation

The coagulation studies were conducted in a jar test apparatus with 6 beakers of 1litre capacity each. Each of the beakers contains 1litre of settled textile waste water. The coagulant zee maize (solution) is added into the beakers without pH adjustment. Rapid mixing at 150rpm for 4 min followed by slow mixing at 40rpm for 20 min. The flocs was allowed to settle for 1h and the supernatant was carefully extracted by pipetting just below the surface of settled water. Afterward, the supernatant is examined for turbidity of the treated wastewater. After coagulation supernatant was used for further process. coagulation supernatant was used for further process.

Fig 2(b) Jar test apparatus

2.3 Adsorption treatment

Sugarcane leaves:

Sugar cane leaves were selected from the local farms and dried. Dried sugar cane leaves with mass of 50 g were soaked in $ZnCl_2$ solution for 24 hrs at room temperature. Then soaked sugar cane leaves were dried in oven at 120^0C for 24 hrs and heated in muffle furnace at a temperature of 400^0C for 2 hrs and then leaves are crushed and sieved to obtain smaller particle size.

.

Fig2(c) preparation of activated charcoal

Adsorption experiments with the sugarcane leaves adsorbents as a low-cost adsorbent is carried out in 500mL flasks. Each test consists of 400mL of supernatant with a desired initial concentration of adsorbent without pH adjustment and Different doses of sugarcane leaves charcoal is added to the wastewater sample, and the obtained suspension is immediately stirred for 2 hrs by using orbital shaker(200 rpm shaking speed). After 1 day of contact time, the samples are withdrawn from mixture using a micropipette and are analyzed for the determination of the colour using spectrophotometer.

Fig 2(d) orbital shaker

3.RESULT

3.1 Raw wastewater characteristics

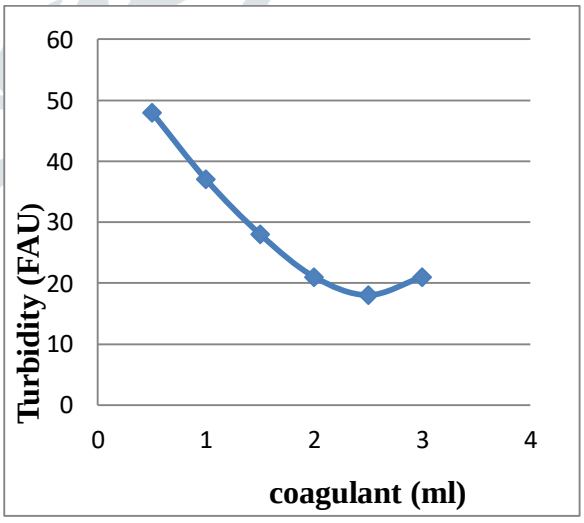
Characteristics of raw textile wastewater

Sl.no	Characteristics	BIS Standards	Values
1	Turbidity (FAU)	10	59
2	Colour (PCU)	25	824
3	Ph	5.5-9	5.77

Fig 3(a) Raw wastewater

3.2 Coagulation results of Maize

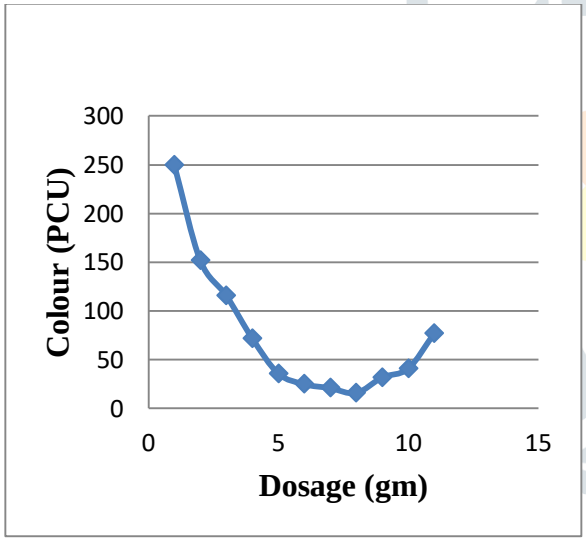
Jar no	Coagulant (ml)	Turbidity (FAU)
1	0.5	48
2	1	37
3	1.5	28
4	2	21
5	**2.5**	**18**
6	3	21



Graph no 3(a) Coagulant v/s turbidity

3.3 Adsorption results of sugarcane leaves

Sl.no	Dosage (gm)	Colour (PCU)
1	1	250
2	2	152
3	3	116
4	4	72
5	5	36
6	6	25
7	7	21
8	**8**	**16**
9	9	32
10	10	41



Graph 3(b). dosage v/s colour

Fig 3(b) colour removal

3.4 Results and % Removal of treated wastewater

characteristics	BIS Standards	Raw Wastewater	Treated Wastewater	%Removal
Turbidity (FAU)	10	59	18	70
Colour (PCU)	25	824	16	98
Ph	5.5-9	6.77	7.5	--

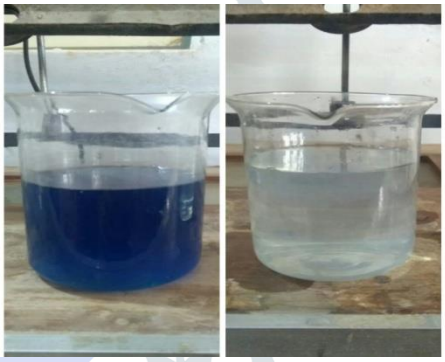


Fig 3(c) comparison of raw and treated water

4. CONCLUSION

It is important to develop a bio-degradable and eco-friendly organic coagulant without secondary pollution for wastewater treatment. Zee maize, sugarcane leaves contain characters that are effective as coagulant and adsorbent. Coagulant dose and adsorbent dosage is a important factors influencing the mechanism of coagulation and Adsorption. These alternative natural coagulants have several advantages compared to alum. The sludge volume is much lower than that produced with alum and the natural alkalinity is not consumed during the treatment process.

The physico-chemical characteristics of prepared activated charcoal reveal that sugar cane leaves could be used as the raw material. As this material is disposed as agricultural wastes/byproducts, the activated charcoal is expected to be economical. Also activation catalyst like zinc chloride will provide a viable option to remove colour.

5 REFERENCEs

1.Asghar, A., A.A.A. Raman, and W.M.A.W. Daud, Advanced oxidation processes the for in-situ production of hydrogen peroxide/hydroxyl radical for textile wastewater treatment: a review. Journal of Cleaner Production, 87, 826–838, 2015.

2.Dasgupta, J., J. Sikder, S. Chakraborty, S. Curcio, and E. Drioli, Remediation of textile effluents by membrane-based treatment techniques: A state of the art review. Journal of Environmental Management, 147, 55-72, 2015.

3.Hudaya, T., J. Anthonios, and E. Septianto, UV/Fenton photooxidation of Drimarene Dark Red (DDR) containing textile-dye wastewater. IOP Conf. Series: Materials Science and Engineering, 162, 012022, 2017.

4. Imran, M., D.E. Crowley, A. Khalid, S. Hussain, M.W. Mumtaz, and M. Arshad, Microbial biotechnology for decolorization of textile wastewaters. Reviews in Environmental Science and Bio/Technology, 14(1), 73-92, 2015.

5.Michalak, I., K. Chojnacka, and A. Witek-Krowiak, State of the Art for the Biosorption Process—a Review. Appl Biochem Biotechnol, 170(6), 1389–1416, 2013.

6. Robinson, T., G. McMullan, R. Marchant, and P. Nigam, Remediation of dyes in textile e,uent: a critical review on current treatment technologies with a proposed alternative. Bioresource Technology, 77, 247-255, 2001.

7. Singh, K. and S. Arora, Removal of Synthetic Textile Dyes From Wastewaters: A Critical Review on Present Treatment Technologies. Critical Reviews in Environmental Science and Technology, 41(9), 807-878, 2011.

8. Solís, M., A. Solís, H.I. Pérez, N. Manjarrez, and M. Flores, Microbial decoloration of azo dyes: A review. Process Biochemistry, 47, 1723–1748, 2012.

9.Verma, A.K., R.R. Dash, and P. Bhunia, A review on chemical coagulation/flocculation technologies for removal of color from textile wastewaters. Journal of Environmental Management, 93, 154168, 2012.