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Effect of the chemical dosing by treatability study for the removal of color, odor and chemical oxygen demand for the textile industry waste water

Rajendra Singh Thakur, Rubina Chaudhary*

School of Energy and Environmental Studies, Devi Ahilya University, Takshshila Campus, Khandawa Road, Indore, Madhya Pradesh-452017, (INDIA)

E-mail : rsthakur.sees@gmail.com; rubina_chaudhary@yahoo.com

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ABSTRACT

This paper discusses on treating effluent in the textile Industry. Several countries, including India have introduced strict ecological standards. They are consumes large quantities of water and produces large volumes of wastewater in processes. Wastewater from textile industry has a high or low pH, high temperature and a high concentration of organic materials. Removing color and organics from wastewater is more important because the presence of small amounts of dyes is clearly visible and detrimentally affects the water quality. Simple chemicals such as alum, lime or iron salts can be added to wastewater to cause heavier masses which can be removed faster through physical processes. The analysis results were depicted in the stage-wise performance of the ETP of inlet and outlet effluent quality. The receiving influent pH 7.25 and effluent pH was 7.8. The removal efficiency of total dissolve solids, total suspended solids, chemical oxygen demand and chloride was hardly to be 22.66%, 69.52%, 90.46% and 9.93% respectively. The results of the Treatability study have shown that alum dosing individually and in combination with lime can remove color and COD from moderate to high degree of dose. 100 ppm of alum dose gives desired reduction of color and COD.

KEYWORDS

Effluent;
Influent;
pH;
Wastewater;
Treatability;
Coagulant;
Alum;
Lime.

INTRODUCTION

Numerous hazardous organic compounds are introduced into the environment as a result of several man made activities. Of all the organic compounds, dyes cause the most serious problem to the environment. A substantial amount of dyestuff is lost during the dyeing process in the textile industry, which poses a major problem for the industry as well as a threat to the environment. Decolorization of dye effluents has therefore acquired increasing attention[1]. Industrial textile processing comprises pre-treatment, dyeing, printing, and finishing operations. The textile dyeing industry consumes large quantities of water and produces large volumes of

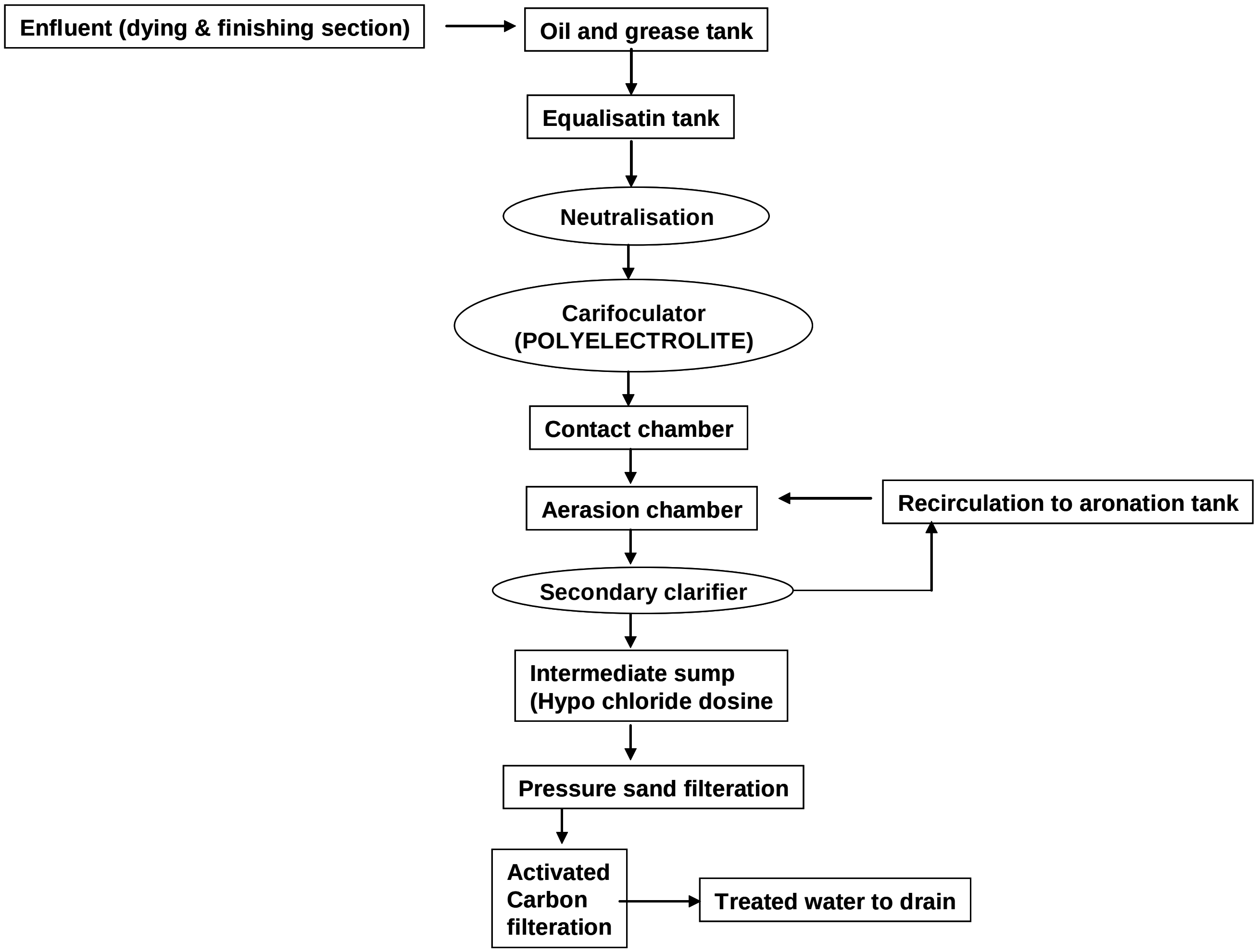

Figure 1 : Flow diagram of effluent treatment plant

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[2]. Wastewater from the textile dyeing industry has a high or low pH, high temperature and a high concentration of coloring material. Numerous dyes represent environmental hazards owing to their toxicity. Treatment costs are very large for most textile factories, explaining the need to develop more efficient and economic methods, which consume less chemical and energy[3]. Many of these dyes find their way into the environment via wastewater facilities. These compounds retain color and structural integrity under exposure to sunlight, soil, bacteria and sweat. They also exhibit a high resistance to microbial degradation in wastewater treatment systems[4]. Therefore, textile wastewaters introduce intensive color and toxicity to aquatic systems. Thus, much attention has been paid to the techniques to remove or to degrade such reactive dyes[5]. Removing color from wastewater is more important than treating other organics, because the presence of small amounts of dyes is clearly visible and detrimentally affects the water quality. Enhanced coagulation, which has been widely employed to remove refractory pollutants from textile wastewaters, is fairly effective in removing pollutants. However, these techniques transform dyes in solution into solid forms, such that the waste must be expensively post-treated[6].

MATERIALS AND METHODS

Physical characteristics of the effluent

Physical processes are some of the earliest methods to remove solids from wastewater, usually by passing wastewater through screens to remove debris and sol-

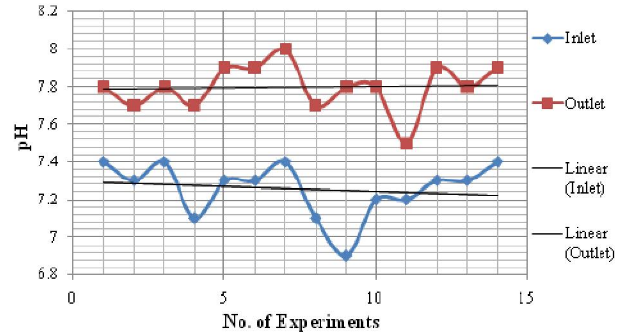

Figure 2 : Effects on pH

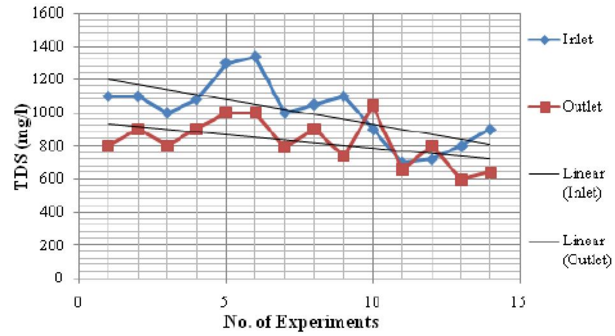

Figure 3 : Effects on TDS

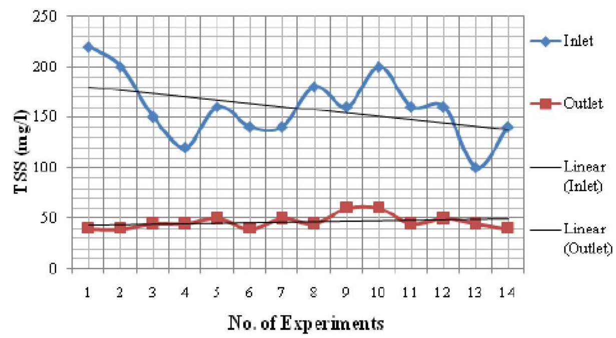

Figure 4 : Effects on TSS

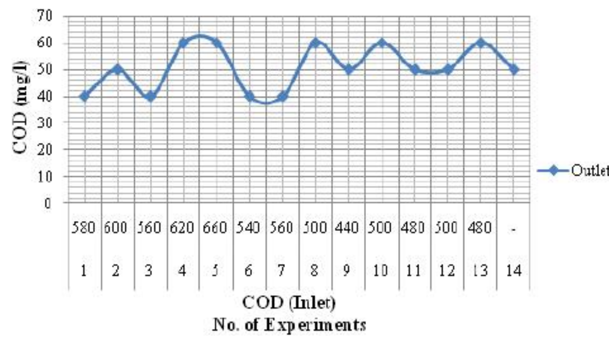

Figure 5 : Effects on COD

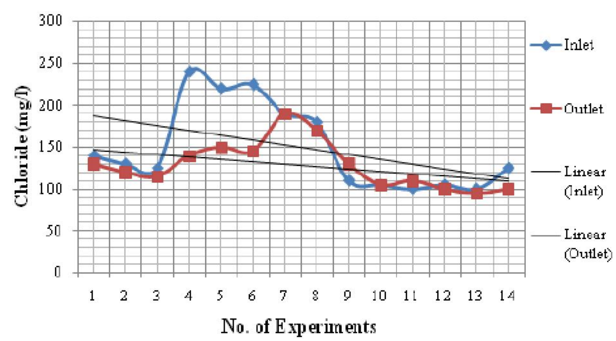

Figure 6 : Effects on chloride

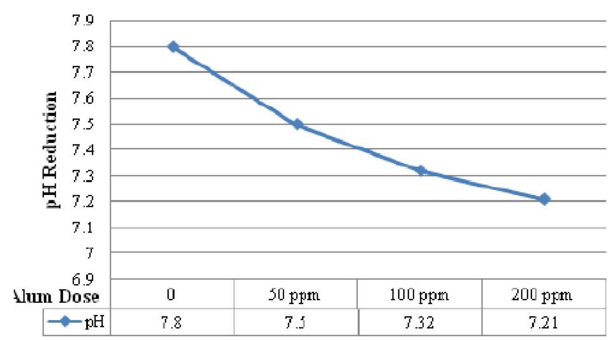

Figure 7 : pH Reduction with alum dose

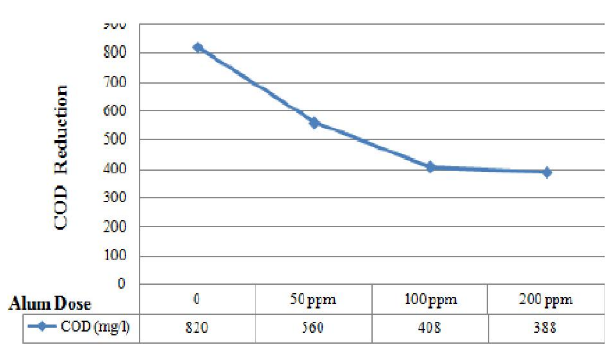

Figure 8 : COD Reduction with alum dose

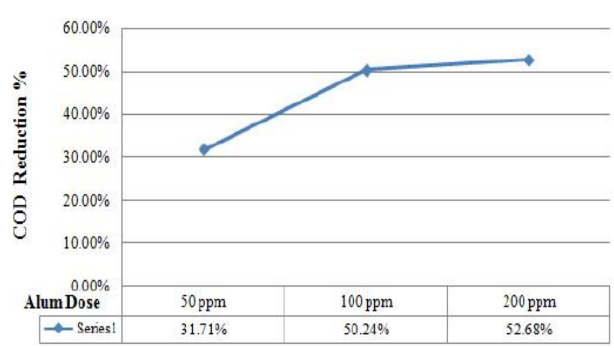

Figure 9 : COD Reduction % with alum dose

ids. In addition, solids that are heavier than water will settle out from wastewater by gravity. Particles with entrapped air float to the top of water and can also be removed. These physical processes are employed in much modern wastewater treatment facilities today[7].

The basic characteristic of effluent was determined, includes its physical as well as chemical parameters as TABLE 1.

Generally the physical parameters determined in any effluent are color, odor and flow rate.

TABLE 1: Physical characteristics in different units of effluent

Sr.	Sample	pH	Flow rate
1	Equalization Tank (Inlet)	7.4	1200 m3/day
2	Aeration tank	7.9	1200 m3/day
3	Activated carbon filter outlet	7.8	1200 m3/day

TABLE 3 : Chemistry of different coagulants in effluent treatment process

Coagulant	Molecular Formula	Mol. Weight	Density lb/feet^3	
			Dry	Liquid
Alum	$Al_2(SO_4)_3.18H_2O$	666.7	60-75	78-80 (49%)
	$Al_2(SO_4)_3.14H_2O$	594.3	60-75	83-85 (49%)
Ferric sulfate (Copperas)	$FeSO_4.7H_2O$	278	62-66	
Lime	$Ca(OH)_2$	56 as CaO	35-50	

Chemical characteristics of the effluent

The wastewater from textile industry was generally colored, high in BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand), TSS (Total Suspended Solids), highly alkaline and has a fairly high temperature. The combined wastewater from an integrated textile mill contains a large variety of organic and inorganic chemicals such as dyes, pigments and other substances used in different process such as Starch, carboxy methyl cellulose, dextrin soap detergents and heavy metals like Chromium.

The basic chemical parameters analyzed in any industrial effluents are BOD, COD, TSS and TDS (Total Dissolved Solids)[8-11] and the results are given in TABLE 2.

Jar test

The coagulation-flocculation test was carried out to determine the chemicals, dosages and conditions required to achieve optimum results. The primary variables to be investigated,

1. Chemical additives
2. pH
3. Temperature
4. Order of addition and mixing conditions.

The procedure is use to evaluate color, turbidity and hardness reduction. General procedure for the evaluation of a treatment to reduce dissolved suspended solids, colloidal, and non settable matter from effluent by chemical coagulation-flocculation followed by gravity settling.

TABLE 2 : Analysis of the different parameters in the raw effluent

Parameter	Result
pH	5.9-6.5
TDS	720-790 mg/L
TSS	130-220 mg/L
Total solid	850-1010 mg/L
COD	800-1100l mg/L
Alkalinity	220-330 mg/L
Sulphide	33.19-37.25 mg/L
Sulphate	39.04-46.25 mg/L
Phosphate	3.69-4.83 mg/L

- This practice permits the evaluation of various coagulants and coagulant aids used in the treatment of wastewater.
- The effects of concentration of the coagulants and coagulant aids and their order of addition can also be evaluated by this practice.

Chemicals

Chemicals can be used to create changes in pollutants that increase the removal of these new forms by physical processes. Simple chemicals such as alum, lime or iron salts can be added to wastewater to cause certain pollutants given in TABLE 3. Such as phosphorus, to flock or bunch together into large, heavier masses which can be removed faster through physical processes[7].

The effluents were characterized for the significant parameters. An overview of the existing effluent treatment scheme of industry was made. Treatability studies on the effluents were conducted for lime, alum based coagulation/flocculation process which was subsequently optimized on the basis of performance and cost both. The main parameters like pH, turbidity, total dissolved solids etc. were checked by digital instruments on spot and if necessary than COD can also be determined[8-11].

Procedure

The treatability study was carried out to determine the qualitative and quantitative characteristics of effluent and to determine its treatment units. Normally beakers are used with electrically operated stirrer whose speed can be controlled and filled with equal volume (500ml). Since many of the waste streams are acidic, it was necessary to adjust the pH to optimum, prior to the initiation of treatment. Varying amounts of coagulants, alkalinity agents and coagulant aids are added at the same time to the jars that contain the water to be treated. Typical rapid mix period employed was one minute at 100 rpm for proper mixing and 5 minute of slow mixing at 20 rpm to promote formation of flocks. After flocculation, the samples were removed from the jar test apparatus and allowed to settle for half an hour. Samples of the supernatant were then collected for subsequent analysis. Comparison of initial and final turbidity determines the choice and effective dosages of reagents and other conditions such as delivery systems determine the coagulant to be used.

RESULTS AND DISCUSSION

Performance of different parameters in the effluent treatment plant

The analysis results were depicted in the stage-wise performance (average of 14 days) of the ETP is shown in schematic diagram (Figure 1) with inlet and outlet effluent quality.

The analysis parameters and data's are shown in the graphically mentioned even after mixing the final treated effluent. The effluent receiving pH 7.25 and final treated water pH 7.8 are given in figure 2.

The TDS concentration at ETP (Effluent Treatment Plant) inlet was very high i.e. 1006.43mg/l which due to high chloride concentration & dye-intermediates industries, these were over the influent parameter limit and maintained with finally 826.43mg/l (Figure 3).

The TSS concentration at inlet was 159.29mg/l and the decrease in suspended solids concentration from alternate units and finally maintained 46.79mg/l (Figure 4).

Figure 5 reveal the COD concentration at inlet 540mg/l and final treated water was 50.71mg/l respectively and the chloride concentration was similarly 149.64 mg/l and 128.57mg/l respectively shown in Figure 6.

The removal efficiency (average of 14 days) of TDS, TSS, COD and chloride was hardly to be 22.66%, 69.52%, 90.46% and 9.93% respectively.

Result after dosing

Requirement of treated water in textile effluent was mainly color removal, clarity of treated water & COD reduction at primary treatment followed by secondary treatment. The performance of various type of coagulant for decolorization of wastewater was investigated in the study. Various commercially available coagulants such as tries to be lime with ferrous sulphate and alum only. The results of the study have shown that all coagulants except lime with alum individually and in combination can remove color from moderate to high degree of dose. The analysis results of treatability study using alum were given in figure 7, 8 and 9.

Based on jar test results can be explained treatability study using average of dose 0ppm, 50ppm, 100ppm and 200ppm maintained for pH of 7.8, 7.5, 7.32, and 7.21 respectively. The corresponding sludge volume recorded after 30 min. was found to increase with increasing dose. The pH of the sample gradually decreases on increasing usage of alum dose. The optimum dose for maintained pH is 100ppm with alum, given in figure 7. The graph represents the value of pH decreases gradually with dose of alum. The Optimum dose of 100ppm alum (Figure 8) was maintained 408mg/l of COD with lower quantity of sludge settling with color removal.

Finally the performance of the alum with COD reduction was 31.71%, 50.24% and 52.68% with 50ppm, 100ppm and 200ppm respectively (Figure 9).

CONCLUSIONS

The results of the study have shown that coagulants except alum individually and in combination can remove color, odor and COD from moderate to high degree of dose. Treatability studies represent a variable option for demonstrating available and innovative technologies on mixed waste. On the basis of above treatability study the 100ppm of alum dose gives desired reduction of color and COD than 50ppm and 200ppm of alum.

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