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The Study of Textile Industry Waste Water Treatment by Using Different Chemical Coagulants

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ABSTRACT

The study was based on the textile industry of Naroda GIDC. The textile industry uses high volume of water throughout its operations from the washing of fibres to bleaching, dyeing and washing of finished products. On average, approximately 200 litres of water are required to produce 1kg of textiles. The large volume of waste water generated also contains a wide variety of chemicals, used throughout processing. These can cause damage if not properly treated before being discharged in to the environment of all the steps involved in textiles processing, wet processing creates the highest volume of waste water. Industrial waste water pollution increase due to suspended and dissolved solids present so there is a need of alternative for such problems. Coagulation and flocculation processes are used to separate the suspended solids portion from the water. In this study different coagulants combination such as alum, lime, polyelectrolyte, ferrous sulphate is used. For the improvement the parameters like pH, COD, TDS, hardness, calcium hardness and magnesium hardness and chloride etc. standard method test with modification used in the laboratory analysis. In this process the combination of different coagulants like lime, ferrous sulphate, aluminium chloride, ferric chloride, poly- electrolyte and alum is used. For flocculation were employed to select the most suitable composition which has optimal removal efficiency. Settling characteristic of the flocks formed in the coagulation process were studied at laboratory scale. The optimal coagulant dose volume and pH were determined by comparing the effectiveness of these coagulants.

KEY WORDS: Textile waste water treatment, COD, TDS, pH, Total Hardness, Ca^{+2}, Mg^{+2}, Chloride, Coagulation.

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INTRODUCTION

Textile Industry answers one of the basic needs of human being and is of great significance. Besides meeting the needs of consumers, it supports number of other industries such as dyes, chemicals and packaging industries.[1]Wet processing operation during textile chemical processing, i.e. desizing, scouring, bleaching, dyeing, printing and finishing, are the major causes of water pollution.[2] The input of waste into surface water bodies has a negative impact not only on the aquatic life but also affects the self-purification property of the water body. The effluents from industries have a great deal of influence on pollution of water body by altering the physical, chemical and biological nature of receiving water body. This further resulted in vast degradation of the surface waters making them worse in their use for agricultural, drinking, industrial, recreation and other purposes.[3] Textile wastewater causes a big environmental problem due to the huge amounts of effluent generated from textile and dyeing processes. So wastewater treatment and reuses of treated effluent in textile industry is a must, especially in countries that suffer from water scarcy.[4] Methods for removal of surfactants involve processes such as chemical and electrochemical oxidation, membrane technology, chemical precipitation, photo catalytic degradation, adsorption and various biological methods. Each of them has limitation and some drawback in application.[5]Coagulation - flocculation is also an essential process in water and in industrial wastewater treatment.[6]in proper coagulation can cause high aluminium residuals in the treated water and the post treatment precipitation of particles causing turbidity deposition and coating of pipes in the water distribution system.[7]

Aboulhassanfound that coagulation- flocculation process using $FeCl_3$ can be used effectively for removal of surfactants and COD from micro-electronics plant waste water and removal efficiencies of 99% and 88% were obtained, respectively. Also they found that the rate of COD removal decreased if the pH was lower than 7 or higher than 9.[8] In the most water treatment plants, the minimal coagulant concentration and the residual turbidity of the water are determined by the jar test technique.[9] Coagulation or flocculation process was conducted for the treatment of industrial waste water to achieve maximum removal of COD, BOD, water sludge, colour and TSS. Aluminium sulphate (alum), ferrous sulphate, ferric chloride and ferric chloro sulphate were commonly used as coagulants.[10] Alum and ferric chloride were used to increase the size of flocks in various pH and color removal from water.[11] Waste water reuse in the textile Industry is necessary due to the high water consumption required for its processes.[12]Additionally, high COD removal capacities have been observed during the combined action of alum and lime for the treatment of stabilized leachates. However, it has been stated out recently that there may be a possibility for aluminium based coagulants to link with Alzheimer’s disease.[12,13]

The textile units use a number of dyes, chemicals and other materials to impart desired quality to the fabrics. These units generates a substantial quantity of which in most of the cases is unsuitable for further use and can cause environmental problem, if disposed of without proper treatment.[14] Source of pollution in textile manufacturing:-(source: - NIIR Board).[15]

Process waste water characteristic

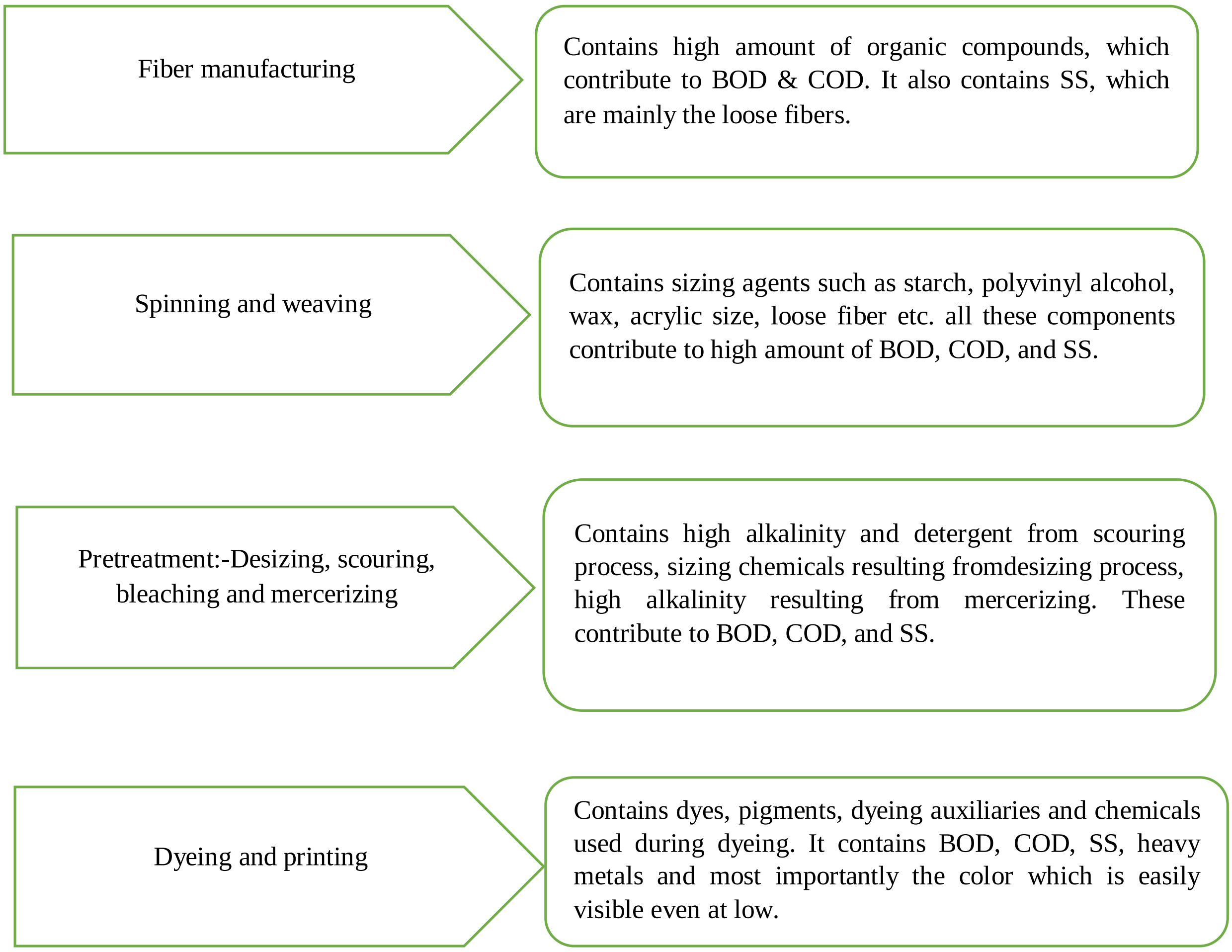

Figure1.Source of Pollution in Textile Manufacturing

MATERIALS AND METHODS

Sample Collection and Materials:-

The textile grab effluent sample were collected from NEPL to Prem industry through pipeline, which is situated in Gujarat, India. From this textile industry waste water sample collected in one litre double cap acid washed polythene bottle was washed with diluted acid and distilled water. Chemical coagulants like Alum, poly-electrolyte, ferrous sulphate, aluminium chloride, ferric chloride, caustic soda and lime are used to treat waste water in laboratory analysis in NEPL GIDC Naroda.

Coagulant Preparation:-

Stock solution of Alum, poly-electrolyte, ferrous sulphate, aluminium chloride, ferric chloride, caustic soda and lime should be prepared before analysis.

The solutions were prepared by dissolving 10g of each substance in distilled water and the solution were increased in distilled water and the solution volumes were increased to 1 litter. Each 1 ml of these stock solutions was equivalent to 20 mg/l when added to500 ml of waste water. They have been prepared in different concentrations, i.e. 10,20 up to 150mg/l in to distilled water.[9]

Experiments Set Up:-

In treating textile effluents with coagulants, positive ions with high valence are preferred. Beaker of 1 litre is used and 0.5 litre of effluent was treated with a specific dose of coagulant. The sample was stirred rapidly for 90 seconds and then stirred slowly for 20 minutes for flocculation. To promote the formation of flocks in water that contains suspended solids, polymer flocculants (poly-electrolytes) were applied. Flocks formed were allowed to settle for one hour minutes. Before withdrawing the sample. After settlement of flocks filtrations processes used to filtrate the effluent. For filtration 1mm filter paper is used. The effect of polyelectrolyte on effectiveness colour removal, and maximum sludge sedimentation in short time period was analysed by using of very low amount of closing chemicals.

All these tests were performed at temperature (250C±2) because temperature is one of the effective parameters on density, viscosity and therefore retained volume of coagulant used.

The present work was experimental analysis used to different chemical coagulants are:

(A).Lime (10% sol) + ferrous sulphate (5% sol) + poly-electrolyte (0.1% sol).

(B).Lime (10% sol) + aluminium chloride (5% sol) +poly – electrolyte (0.1% sol).

(C).Caustic (10% sol) + ferric chloride (5% sol) + poly- electrolyte (0.1% sol).

(D).Lime (10% sol) + alum (5% sol) + poly-electrolyte (0.1% sol).

Analytical Technique:-

COD (FAS titration), TDS (Electro Conductivity), Total hardness, Calcium Hardness, Magnesium Hardness (EDTA titration) and Chloride ($AgNO_3$ titration) measurements were performed according to standard methods (APHA (American Health Association), 1998. Standard Method for Examination). The pH were determined using digital pH meter calibrated using buffer solutions of pH 4.0 and 7.0.

RESULTS AND DISCUSSION

Table1. Textile waste water sample analysis before and after treatment (mg/l)

Parameter	Untreated water	Treated water			
		Composition-A	Composition-B	Composition-C	Composition-D
COD	560	224	280	243	280
Total Hardness	485	124	73	58	73
Ca^{+2}	270	69	55	42	55
Mg^{+2}	215	55	18	16	18
Chloride	895	490	580	560	540
TDS	1680	2464	2390	1974	2586

Table2. Textile waste water sample after treatment percentage reduction.(%)

Parameter	Composition-A	Composition-B	Composition-C	Composition-D
COD	60%	50%	56%	50%
Total hardness	25%	15%	12%	15%
Ca^{+2}	25%	20%	15%	20%
Mg^{+2}	25%	8%	7%	8%
Chloride	45%	35%	37%	39%
TDS	46%	42%	17%	53%

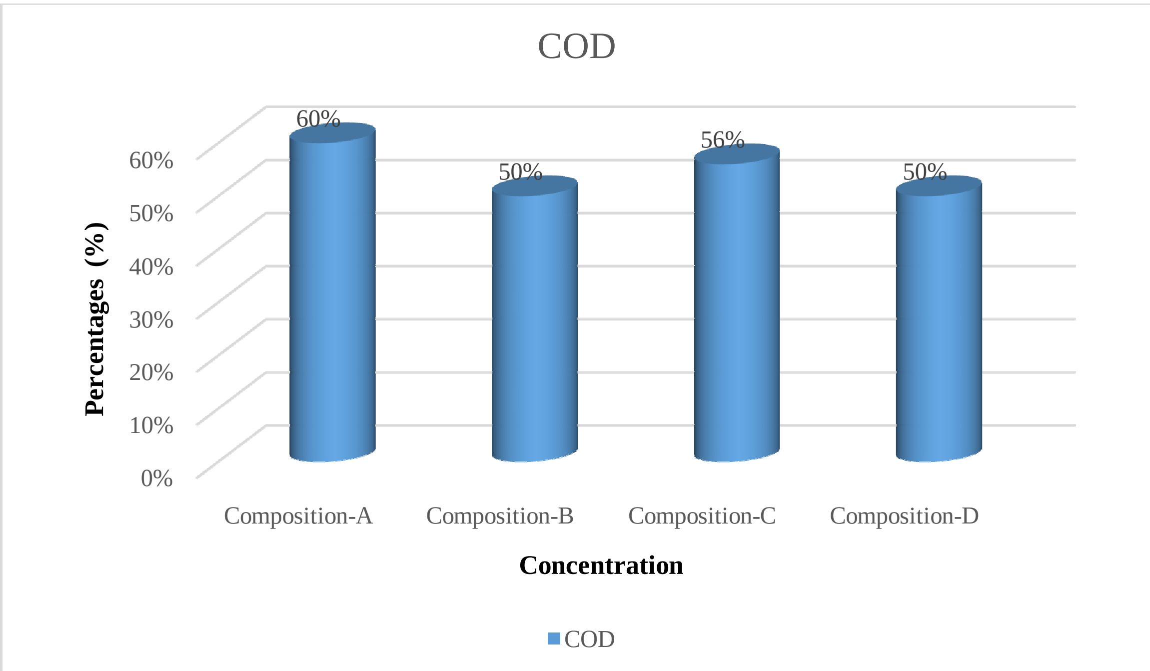

Figure2. % Reduction of Chemical Oxygen Demand (COD)

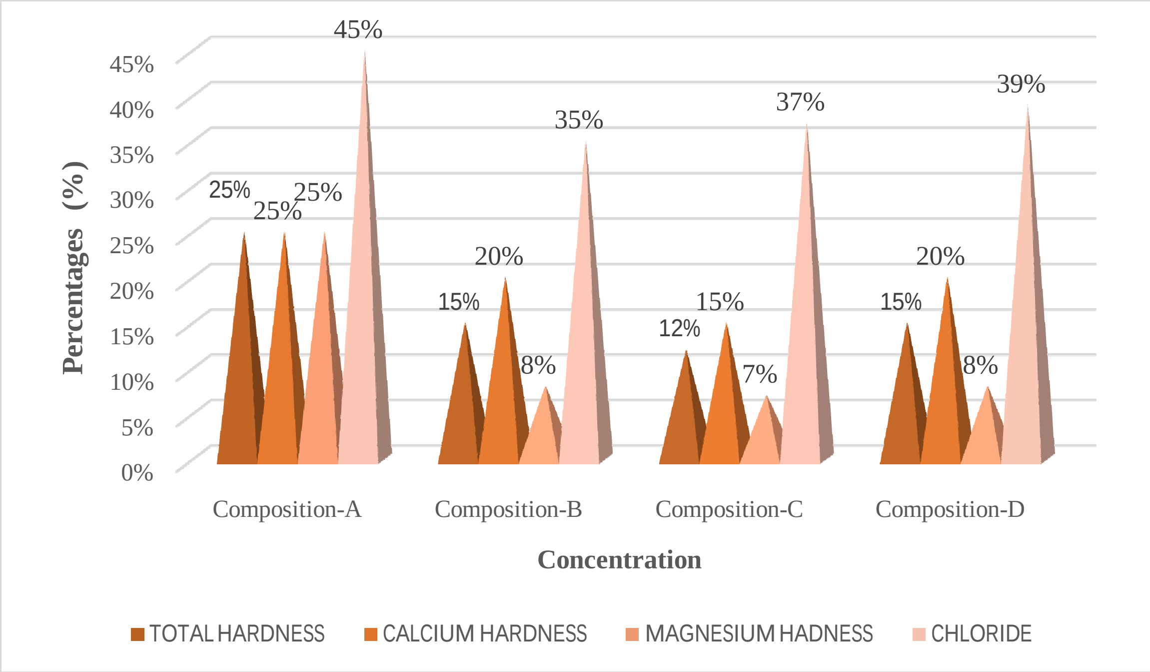

Figure 3. % Reduction of Total Hardness, Calcium Hardness, Magnesium Hardness and Chloride.

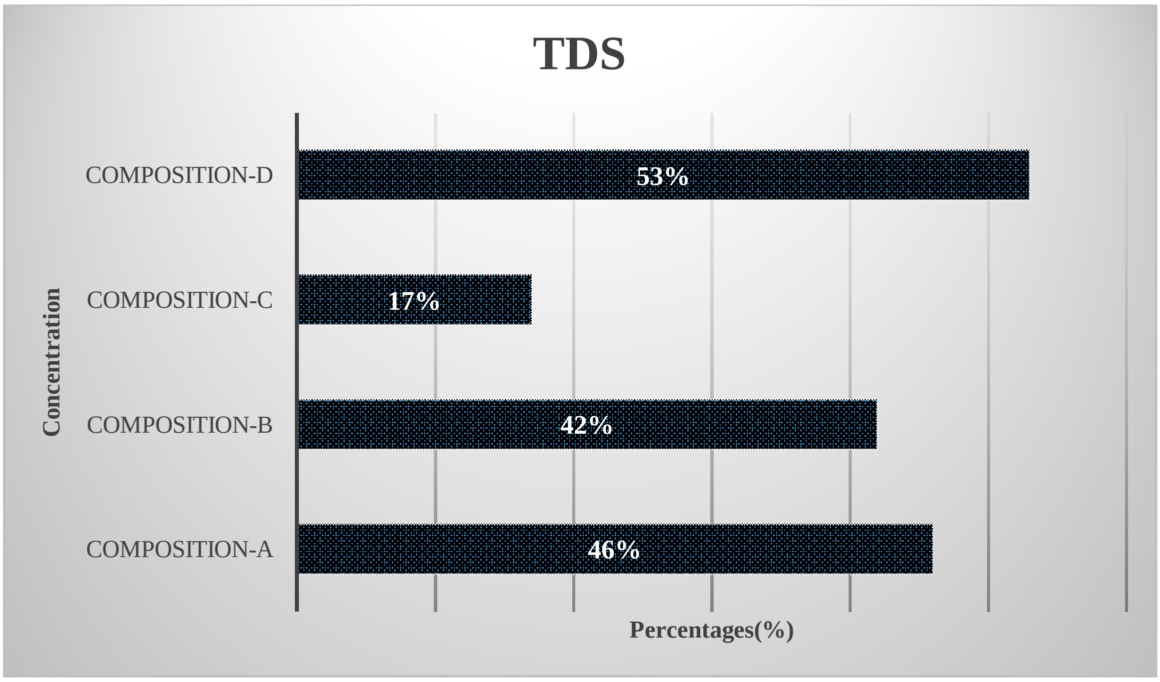

Figure4. % Reduction of TDS

From the above figures and table it is quite evident that composition-A (lime (10% sol) + ferrous sulphate (5% sol) + poly-electrolyte (0.1% sol) gave the best results. It was also observed that composition-A formed maximum flocks between pH 10 to 11. These flocks settled in quick time when dosed with polyelectrolyte which is a highly viscous solution. On reducing pH below 10 results in decrease flocks size which did not settle sludge effectively. It is also observed that COD, hardness, Ca^{+2}, Mg^{+2} and chloride decrease wax maximum is composition-A (figure1, 2). However TDS increases (figure3). This may be due to addition of lime which makes light weight floating flocks, whose specific gravity is very low, so they float at water surface and will not settle properly. The flock produced by iron salt with lime is heavier and can remove more percentage of suspended solids than alum.

CONCLUSION

From the analysis of textile effluent it can be concluded that composition A[lime(10% sol)+ Ferrous sulphate(5% sol)+poly-electrolyte(0.1% sol)]. Gives the best result compared to another composition. From this composition COD will decrease 560-224(60%). From the composition C [caustic (10% sol) + Ferric chloride (5% sol)+ poly-electrolyte(0.1% sol)] COD will decrease 560-243(56%).

Textile effluent can be reused by the giving different chemical dosing treatment to the water due to the chemical dosing COD can be reduced and the water will be reused. For the various purposes like some industrial purpose and gardening.

The Naroda Enviro projects ltd. (NEPL) is used the textile industry effluent as a dilution to decrease COD.

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