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Treatability Study of Color Reduction from Textile Waste Water Effluent Sample by Coagulation-flocculation Method using different Coagulants and Dosing Compositions

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Abstract—*A textile is the major source of water consumption and waste water pollution, there are various treatment techniques to remove color and waste water textile pollution. Coagulation flocculation is the widely used method to remove pollution from textile due to suspended particles .in this research the two coagulant were selected that is Alum and ferric chloride in order to select the suitable ones with optimum removal effiency in terms of color. the research shown that When the PH is varied it has been seen that improved color removal were obtained by reducing the PH to 5.0 also it has been observed that at PH 5.0 the incremental increase of PH is 78% and lowest value was at 48% in case of Alum and in the case of Fecl3 the maximum percentage removal for color removal was 79-80%.Color is the main attraction of any fabric no matter how excellent its constitution, if unsuitably colored it is bound to be a failure as a commercial product. Sustainability of the environment has become a focus; hence the need for improvement and monitoring of textile waste water discharges, for which major concern is color. Color in textile dyeing and finishing effluents is as a result of large amounts of dye stuffs left during the dyeing stages and inefficient dyeing processes often resulting in unfixed forms.*

Keywords*: Textiles; Dyes; Textile Wastewaters; Primary Treatment;*

1. INTRODUCTION

The word textile means to weave which was adopted from the Latin word '*texere*'. Textiles can be woven by both hand and machines. The raw materials for textiles are natural and synthetic fibers [1]. The sources of natural fibers are minerals, animals and plants. With the advancement of technology, fibers can now be extracted from chemicals. However, plant sources yield a large amount of fibers than those obtained from animal and mineral sources. Most of the textiles produced are as a result of spinning of fibers from the yarns [2, 3].

The importance of Textile industries in the manufacture of clothes and clothing materials cannot be over emphasized. But as good as they are, their existence also signifies a very crucial environmental issue, bothering on waste water discharges. According to [4], the textile industry is very important because its materials are used in varying ways including clothes for wearing. Products are however affected by the styles in clothing wears, changes with the season and the trends in fashion. Dyes and colors are known to have a long history and constitute an important component in our daily lives. Natural plants and insect sources were initially used by the dye industry and then rapidly turned to synthetic manufacturing processes. The Synthetic dyes are considered a major part of our lives. [5, 6].

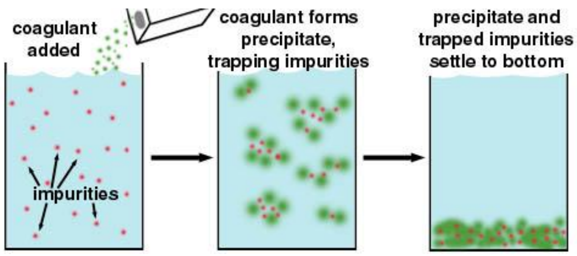
Textile and Clothing (T&C) is one of the largest and oldest industries present globally [7]. The T&C industry provides jobs with no required special skills, which in turn plays a major role in providing employment in poor countries like Bangladesh, Vietnam, Sri Lanka and Mauritius. Therefore, it plays a vital role in the increase of Gross Domestic Product (GDP) value of these countries [7].

The textile industry is classified into three main categories: cellulose fibres (cotton, rayon, linen, ramie, hemp and lyocell), protein fibres (wool, angora, mohair, cashmere and silk) and synthetic fibres (polyester, nylon, spandex, acetate, acrylic, ingeo and polypropylene). The type of dyes and chemicals used in the textile industry are found to differ depending on the fabrics manufactured.

Dyes are substances that possess high coloration degree and are employed in the Textile, pharmaceutical cosmetics, plastics, photographic, paper and food industry (Zollinger H., 1991). In contrast to pigments, dyes are applied to various substrates (textile materials, leather, paper, hair, etc.) from a liquid, in which they are completely, or at least partly, soluble. Therefore, dyes must posses a specific affinity to the substrate for which they are used (Zollinger H., 1991).

2. COAGULATION FLOCCULATION MECHANISM

Coagulation is the destabilization of colloids by addition of chemicals that neutralize the negative charges the chemicals are known as coagulants, usually higher valence cationic salts (Al^{3+}, Fe^{3+} etc.), Coagulation is essentially a chemical process.



Source: Wikipedia

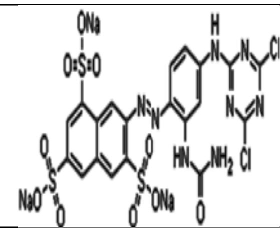
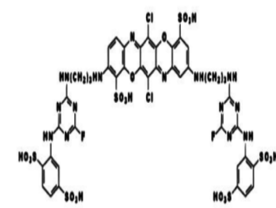
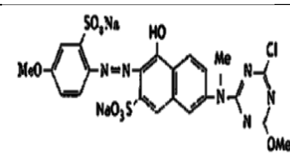
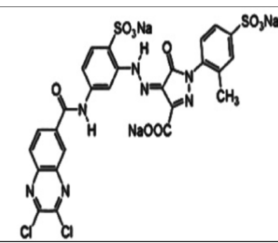
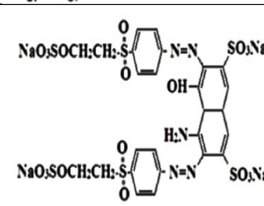
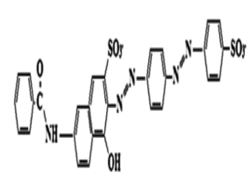
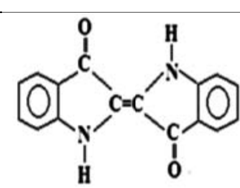
2.2 Flocculation: is the agglomeration of destabilized particles into large size particles known as flocs which can be effectively removed by sedimentation or flotation.

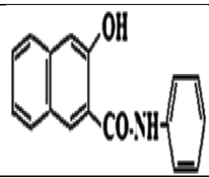
3. DYES USED IN THE TEXTILE MANUFACTURING PROCESS

Dyes and colors are known to have a long history and constitute an important component in our daily lives. Natural plants and insect sources were initially used by the dye industry and then rapidly turned to synthetic manufacturing processes. The Synthetic dyes are considered a major part of our lives, several of the synthetic dyes, especially azo dyes, were found to be toxic, carcinogenic and mutagenic and are thus banned throughout the world, [8, 9]. Their use and manufacture have however continued until today because of their low cost, ease of synthesis and other desirable properties [10, 11].Azo dyes are considered the largest group of dyes and or industrial colorants which currently represents 60-70% share in the worlds dye market [12,14]. The bonds are resistant to breakdown, hence, they exhibit the potential for persistence and accumulation in the environment. Dyes can be classified into different types depending on their chemical compositions and properties. Therefore, the usage of dyes varies from industry to industry depending on the fabrics they manufacture. Cellulose is made up of repeating glucose units. The most commonly used dye for cellulose textiles is reactive dyes. The other types of dyes used are direct dyes, vat dyes, sulphur dyes, indigo dyes and napthol dyes. The structures of these dyes are presented in **Table 1.**

Color is the main attraction of any fabric. No matter how excellent its constitution, if unsuitably colored it is bound to be a failure as a commercial product. Fabric was earlier being dyed with natural dyes. These however gave a limited and a dull range of colors. Besides, they showed low color fastness when exposed to washing and sunlight. As a result they needed a mordant to form a dye complex to fix the fiber and dye together thus making the dyers' work tedious. The discovery of synthetic dyes by W. H. Perkins in 1856 has provided a wide range of dyes that are color fast and come in a wider color range and brighter shades [16]. As a result "dye application" has become a massive industry today.

Table 1: Structures of reactive dyes [15].

Dyes	Structure
Procion MX	
Cibacron F	
Sabracron F	
Drimarene K	
Remazol	
Direct Dyes (Direct red 81)	
Indigo Dyes (Dark blue)	

Napthol Dyes (Napthol AS)	

4. MATERIAL AND METHODOLOGY

For the purpose of this research work, the field survey and laboratory analysis was carry out, the waste water effluent samples were collected from different sampling sites in an around Jodhpur, which is assumed to undergo the pre-treatments. The optimization of color reduction was done by coagulation flocculation process by the means of jar test using the range of different coagulants as well as different PH ranges.

4.4. Coagulation-flocculation study

The study was performed with varying concentration of alum and ferric chloride in the range of different coagulants using a Jar test apparatus. Firstly, 500 ml each of wastewater sample was taken to six numbers of beakers and added with stock alum and ferric chloride solution to make the final concentration and dosages of both the alum and ferric chlorides.

- **Coagulation with Alum**

Effluent sample were dosed with alum doses of 200,400,600,800 and 1000mg/l. All samples were PH corrected before addition of alum such that after addition the PH was approximately 7.Once the optimum dosage had been established at PH 7 the same dosage was used at PH 5, 6, 8 to establish the influence of PH on color removal.

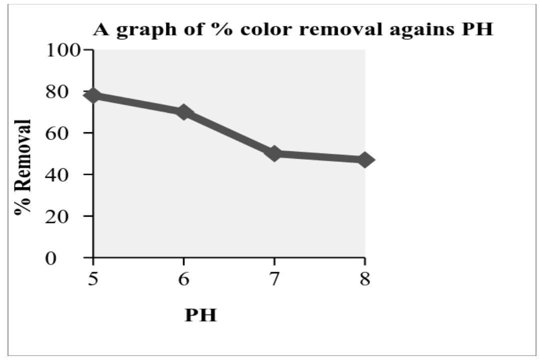
- **Coagulation with Ferric chloride**

Effluent sample were dosed with Fecl3 doses of 200,400,600,800 and 1000mg/l. All samples were PH corrected before addition of Fecl3 such that after addition the PH was approximately5.o see fig 3.0 once the optimum dosage had been established at PH 5. The same dosage was used at PH 5, 6, 8 to establish the influence of PH on color. See fig 3.1 below.

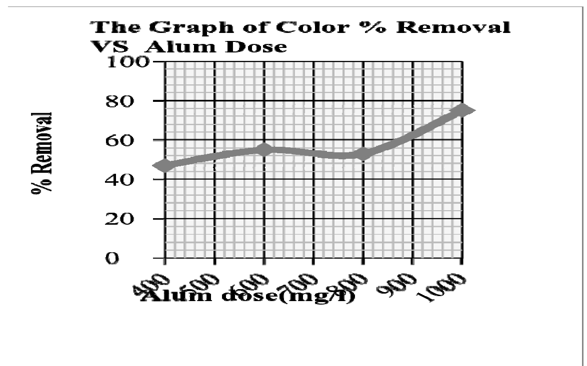
5. RESULTS AND DISCUSSION

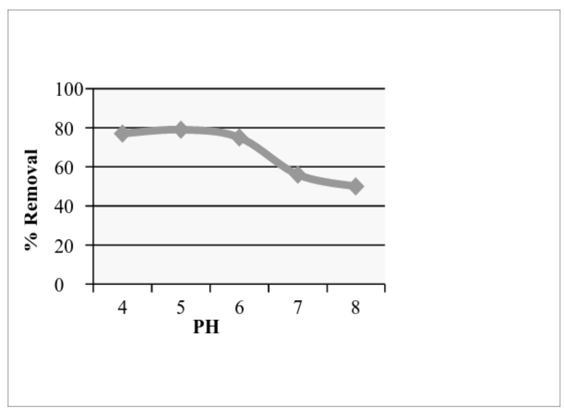
The initial experiment at PH 7 showed that coagulation was achieved at alum doses of 400ml and higher. Color removal increased with the alum doses from 46% at 400mg/l to 76% at 1000mg/l as shown in fig 1.0. The correlation coefficient for color removal was found to be 0.89, at constant PH and varying dosage

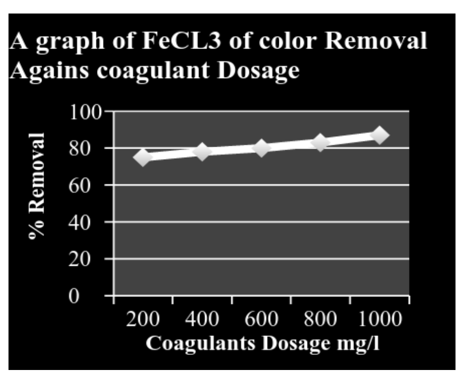
When the PH is varied it has been seen that improved color removal were obtained by reducing the PH to 5.0 Also it has been observed that at PH 5.0 the incremental increase of PH is 78% and lowest value was at 47% as shown in the fig 2.0 below.



From the above **figure 2.0** it was clearly shown that optimal color removal from textile effluent were obtained when an alum dose of 400mg/l was applied at PH 5.0.







It is obvious from the graph that color and pH removal are optimized at **pH 5**. The ferric chloride coagulation experiments showed that in order to produce a good floc at pH 5 a dose of 400mg/l was required. It was however possible to produce a poorer quality floc at a dose of 200mg/l.

6. CONCLUSIONS

From the above experiments it can be concluded that while both alum and ferric chloride produce a good floc at a dose of 400mg/1 at pH 5, ferric chloride was able to produce a somewhat poorer quality floc at a dose of only 200mg/l with only a very small decrease in color removal. From the above figure 2.0 it was clearly shown that optimal color from textile effluent were obtained when an alum dose of 400mg/l was applied at PH 5.

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