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Environmental Degradation by Textile Industry; Performance of Chemical Coagulants and Activated Carbon for Removal of COD, BOD

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Abstract- Textile industry is responsible for generation of around one-fifth of industrial effluent pollution throughout the world; using more than 20,000 chemicals almost highly toxic, use to make clothes and ultimately discharge without proper treatment, into environment. It is largest consumer of freshwater than other industries. Textile industry wastewater has becomes threat for our environment. Textile sector plays very significant contributor for growth of economy, also engaged largest portion of population in jobs especially in rural areas. Meanwhile it is very polluting industry and prime responsible for the environmental degradation due to its highly polluted wastewater. Textile industry is consuming huge amount of fresh water during its production in different steps. In this study total thirty samples were taken from ten different sites/ industries of Karachi city, Pakistan. The samples were mixed in a composite sample and analysed for chemical oxygen demand and biological oxygen demand 1901 mg/L, 760 mg/L respectively. After treatment with different coagulants alum, ferric chloride and ferrous sulphate followed by activated carbon the pollution level decreased upto 97.47% and 97.23% for chemical oxygen demand and biological oxygen demand respectively.

Keywords- **:** Alum, Activated Carbon, BOD, Coagulation, COD.

I. INTRODUCTION

Industrialization is a source of employment to people but other side it is a major source of serious pollution and considered prime risk to environment. Industrial sector is second largest consumer of freshwater. The textile industrial sector is occupying a vital role in the economies throughout of the world but meanwhile it is also responsible for intensifying the environmental problems by generating the colored effluents. The textile industrial sector uses numerous chemicals as well as enormous quantity of freshwater throughout procedure.

Approximately two hundred litres of freshwater is required for production of only one kilogram of the product. The freshwater is mostly used for application of chemicals onto the fibres and rinsing of the final products. The wastewater generated throughout the contains large amount in form of dyes and other toxic contaminants also non-biodegradable, which may harm and affect the environment and human health if not treated properly [1]. Huge quantity of polluted material is discharged by this industry including different categories such as organic/inorganic compounds. The textile industries wastewater's characteristics vary and depend upon the type of textile final products and use of different chemicals in manufacturing. Effluent from textile industry comprises huge volumes of agents which may cause harm to the human health as well as environment, such as dissolved oxygen, turbidity, odor and color. Wastewater from the industry comprises different metals such as, Arsenic (As), Zinc (Zn) Chromium (Cr), and Copper (Cu). These metals may harm the environment [2]. Excess use of dyes in textile process causes of a bad color and may source of different diseases [3]. It can reduce the penetration of sunlight and affect photosynthesis process [4]. The concentration of suspended solids in the wastewater also a prime responsible in affecting the environment [4]. Due to presence of inorganic substances in the textile wastewater mark the water unfit because accumulation of extra concentration of soluble salts. These substances are very toxic to aquatic life even found in a lower quantity [5]. Few of the inorganic chemicals like hydrochloric acid, sodium hypochlorite, sodium hydroxide, sodium sulphide and reactive dyes are also toxic to aquatic life [5]. Metals, temperature and salt is also a great threat by this industry [6]. The organic components are found to undergo chemical and biological changes that outcome in the elimination of oxygen from water [5]. For the protection of our ecosystem, recycling of wastewater by textile industry is necessary, because treated wastewater can be used for agriculture purpose as well as within industry for different production processes [7]. The suspended solids, excessive quantities of oil and grease and gritty materials are removed in first step of textile wastewater treatment process [2]. Coagulation process has many cost effective applications in textile wastewater treatment. [8, 9]. The wastewater discharged by textile sector comprises of color, suspended solids, organic and inorganic pollution in huge quantity [10]. Activated carbon is very useful with highest percent removal of COD and BOD [11]. The activated carbon is widely used in different industries due to its structure, adsorbent quality and capacity, availability [12]. Among all physical treatment techniques adsorption process is tremendously effective for treatment of textile effluent. Activated carbon has proved an efficient adsorbent for exclusion of organic compounds from the textile effluent [13]. It is reported that around 280,000 tons of textile industrial waste is discharged per year worldwide [14]. It is known fact that untreated textile effluent into the water bodies, create environment and health issues due to comprise of carcinogenic substances and toxic metals [15].

The aim of present study is to determine environmental degradation and reduction of COD, BOD from textile industry by using different treatment techniques in the year of 2020.

II. Material and Methods

2.1. Chemical Reagents and Glasswares:

All chemicals were obtained from E. Merck of analytical grade. Distilled water was used throughout the study. Concentrated nitric acid and hydrogen peroxide were used for the digestion of samples. Working standard solutions were prepared immediately from stock standard solution. All solutions were stored at 4°C until needed for analysis. Plastic and glasswares were cleaned by soaking in 2M of HNO3 solution for overnight. Different sizes of beakers & flasks (volumetric & conical) pipettes, burettes, cylinders were used etc.

Equipments Used:

UV Visible spectrophotometer thermo scientific model No. evolution 300 was used for the analysis of Chemical Oxygen Demand (COD). Cooled Incubator model Muve (Turkey) UL#121, was used for the analysis of Biological Oxygen Demand (BOD).

2.2. Sampling and its Preparation:

The wastewater samples were taken in pre cleaned plastic bottles from the discharge point of the industry for physico- chemical parameters analysis by using standard procedures. As per moral obligation and commitment with the management of the textile industries, the details of the owners are not mentioned in the paper. During sampling all SOPs were followed [16]. Thirty samples were collected from ten different textile industries units in triplicate and then mixed together to make the composite sample. The composite sample was used for treatment evaluation. The collected samples and composite sample was stored in clean plastic bottles at the temperature of 4 °C without any chemical addition so that chemical characteristics were not changed.

2.3. Experimental Method:

1000 ml sample were prepared in a capacity of 2 liter beaker. Different coagulants such as alum, ferric chloride and ferrous sulphate were added in quantity of 100, 200 and 400 mg each, to the samples. Stirring was done by using magnetic stirrer followed by sedimentation and filtered after settling, using Whatman 42 filter paper [17].

Measurement of Physico-chemical Parameters:

The Physicochemical Parameters such as chemical oxygen demand and biological oxygen demand were determined by using standard methods for the examination of water & wastewater [18].

2.4. Chemical Coagulation:

The coagulation process with alum as the only coagulant, which can achieve substantial organic elimination [19]. Treatment of textile effluent was initiated to assessment the efficiency of the different selected coagulants and treating with different doses in samples by a range of different coagulants in concentrations of 100 mg/l, 200 mg/l and 400 mg/l. The coagulation process was performed by mixing one liter of textile wastewater. Later the adding of coagulants (alum, ferric chloride and ferrous sulphate) the wastewater was stirred rapidly at 200 rpm for five minute, 150 rpm for twenty five minutes and then slowly stirred at 80 rpm for more 30 minutes. Then effluent was allowed to settle for 60 minutes and then filtered with whatsman 42 paper. After proper filtration, the treated samples were analysed. The finest results were accomplished by using dose of 200 mg/l. [17].

2.5. Column Experiment:

After process of chemical coagulation, the samples were further treated by activated carbon using 5 g. Experiments were carried out in glass column having 75 cm length and 2.75 diameters [17]. Adsorbent was filled in the column and at the top and bottom glass beds were filled for the supporting purpose, at flow rate 1000 ml/60minutes [11].

III. Experimental Section

3.1. Coagulation

The selection of chemical coagulants is very important step for chemical treatment of textile effluent. It's also depending upon the type and concentration of the chemical coagulants for effective use prior to adsorption process in treatment of wastewater. It is essential to confirm the safety, efficacy, quality of the chemical coagulations to be used for treatment of wastewater. In chemical coagulation the initial step is to add chemicals in industrial wastewater; where the rapid mixing after adding of chemicals in order to make sure that the chemicals are consistently and evenly dispersed in the wastewater, in a second step. In third step, the chemical is mixed again in slow mixing, to reassure the development of insoluble solid precipitates. The final step is the removal of the coagulated particles by filtration [20]. This process is known as "coagulation."

3.2. Mixing:

After adding of different coagulants the mixing is another key step. To get required results, the uniformity in mixing of all coagulants is very essential in the wastewater treatment process. If any gap including overdose in mixing step rises, the result will be in woeful performance.

3.3.Adsorption Process:

Alum followed by activated carbon proved very effective with good results.

3.4. Coagulation with Aluminum Salts:

Aluminum Sulphate mostly called alum is very common and economical salt. It is easily available and broadly used as a coagulant in industrial wastewater treatment [18].

3.5. Coagulations with Iron Salts:

Iron salts mostly are used ferric sulfate, ferric chloride and ferrous sulfate. These salts are generally corrosive in nature and may present difficulties in dissolving, and their use may result in high soluble iron concentration in process effluents. Good results may be get even in too acidic condition [21].

3.6. Statistical Analysis:

All experimental data were examined in triplicate and calculations (mean+std) were done by Excel 2013.

III. Results and Discussion

Different doses of alum 100, 200, 400 mg/L were used and best results were achieved 229, 86 mg by using 200 mg/L for COD and BOD respectively. (Table-1). Different doses of ferric chloride 100, 200, 400 mg/L were used for obtaining of good results and best results were achieved on 200 mg/L (Table-2), 242 mg/L, and 82 mg/L for COD & BOD respectively. Different doses of ferrous sulphate 100, 200, 400 mg/L were used for obtaining of good results and best results were achieved on 200 mg/L (Table-3), 251 mg/L, and 113 mg/L for COD & BOD respectively. The coagulation with alum samples were further treated using 05 g of activated carbon and attained significant effects; 48 and 21 mg/l for COD and BOD respectively (Table-4). While ferric chloride proved good results but less than alum; 101 and 38 mg/l for COD and BOD respectively (Table-5). The results of ferrous sulphate coagulation were marginally higher than alum and ferric chloride, 104 and 43 mg/l for COD and BOD respectively (Table-6).

Table 1: Treatment of sugar mill effluent with different doses of alum

Parameter	NEQS	Before Treatment	Alum (100mg)	Alum (200mg)	Alum (400mg)
COD	150	1901	452	229	231
BOD	80	760	224	86	83

Table 2: Treatment of sugar mill effluent with different doses ferric chloride

Parameter	NEQS	Before Treatment	FeCl3 (100mg)	FeCl3 (200mg)	FeCl3 (400mg)
COD	150	1901	493	242	240
BOD	80	760	230	82	80

Table 3: Treatment of sugar mill effluent with different doses ferrous sulphate

Parameter	NEQS	Before treatment	FeSO4 (100mg)	FeSO4 (200mg)	FeSO4 (400mg)
COD	150	1901	496	251	249
BOD	80	760	242	113	108

Table 4: Treatment of sugar wastewater with alum and adsorption

Parameters	NEQS	Before treatment	Alum (200mg)	Activated Charcoal (5g)
COD	150	1901	229	48
BOD	80	760	86	21

Table 5: Treatment of Sugar wastewater with FeCl3 and adsorption.

Parameters	NEQS	Before Treatment	Ferric Chloride (200mg)	Activated Charcoal (5g)
COD	150	1901	242	101
BOD	80	760	82	38

Table 6: Treatment of Sugar wastewater with FeSO4 and adsorption

Parameters	NEQS	Before Treatment	Ferrous Sulphate (200mg)	Activated Charcoal (5g)
COD	150	1901	251	104
BOD	80	760	113	43

V. CONCLUSION

The heavy load of toxic chemicals discharge by textile industry is the main environmental threat. Huge use of freshwater in different processes production, processing this industry is associated with water pollution. The major pollutants in industrial wastewater are considered as BOD, COD. The textile industries are responsible for intensifying the environmental problems by generating the highly toxic effluents. Industrial effluent has becomes a great threat to our environment especially very precious resource water. It is a prime responsibility of environmental scientist and engineers for efforts and makes reusable the industrial wastewater for agriculture purpose. The aim of this study was to remove pollution from textile industry's wastewater and protection of the environment. For this purpose different techniques were employed in which chemical coagulation with alum, ferric chloride and ferrous sulphate followed with combination of activated carbon. Among all coagulants used, the alum is easily available everywhere and cheapest than others, and showed more impressive results. Treatment of the wastewater by alum dose of 200 mg/L with activated carbon 5g dose attained good results upto 97.31% and 96.31 % for COD and BOD respectively. While 94.68%, 95% using ferric chloride and 94.52 and 94.34 % using ferrous sulphate for COD and BOD respectively and meet the requirements of National Environmental Quality Standards (NEQS) and International Standards for treated industrial wastewater reuse in agriculture purpose. It is proved from the study, that by using this technique the industrial wastewater can be treated very effectively with time saving and cost effective and the treated water can be used in agriculture.

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