Characterization of Textile Wastewater and Treatment by Chemical Coagulation

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Abstract— This study focused on the quality of textile dyeing effluent by analyze the physico-chemical parameters such as color, pH, total hardness, biological oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), total suspended solids (TSS), the effluent. The results of the analysis were correlated with the water quality standards of BIS (Bureau of Indian Standard) & National Environmental quality standard (NEQS).Also this paper included the case study of textile dyeing industry, Madurai district, Tamilnadu.

Keywords: biological oxygen demand (BOD), chemical oxygen demand (COD), Textile Wastewater and Treatment by Chemical Coagulation

I. Introduction

Clothing and textiles, after agriculture, is the basic requirement of human being. India has a large network of textile industries of varying competence. In terms of its production and employment, the textile industry is one of the largest industries in the world. India's second largest employment producing area is textile industry and about 35 million people both skilled and unskilled get direct employment as a result vast development in textiles. India's leading and oldest industrial sectors about 81% of total industries are located in Tamil Nadu, Gujarat, Punjab and Maharashtra and estimating about 20% of the total industrial production. In the year 2010-11 India furnished a large production of textile about 325 lakh bales. Ancient time's natural dyes are typically applied for dyeing process though these processes provided a limited range of colors on fabrics and it appears dull shade so these dyes are not much attractive by the people. The negative aspect of using natural dyes on fabric is easily faded when exposed to sunlight and washing as a result the synthetic dyes are successfully entered into the industrial market particularly textile industry. Synthetic dyes are complex substances most of them have produce an adverse effects on all forms of livings like soil, water, flora, fauna, livestock and human population. Approximately calculating that 80,000 tons of dyes used in various industries such as food processing industries, cosmetics, paper mills etc. but the textile division alone consumes about 60% of total dye production for coloring a variety of fabrics and about 10–15% of unspent dyes are let out into the clean water bodies which makes the water highly colored and polluted, typically with a concentration range 10–200Ppm. Large quantities of water are needed for textile processing, dyeing and printing. Among these various processes, dyeing process includes fixing dyes on fabrics, washing etc. requires more water and it consumes 16% of total water usage depending on the type of dyes used and this dyeing sector contributes to 15% - 20% of the total waste water flow. Particularly in India almost 70% of the water has become polluted due to the discharge of domestic sewage and industrial effluents into natural water source, such as rivers, streams as well as lakes. The color, concentration of trace metals, nature of dyes, and characteristics of effluent vary from industry to industry based on the water utilization and every day manufacturing goods. Major pollutants released from the textile industries are from the several of their wet processing operations like scouring, bleaching, mercerizing and dyeing since times immemorial, the three basic needs of mankind have been food, clothing and shelter. The units producing cloth by any mechanisms are called textile units. Textile industry is one of the oldest industries of the Tamilnadu. In recent years the textile industries has undergone modernization to a large extent with the latest development in textile technology. The textile process requires volumes of water of high purity and generates equally large volumes of water, which are complex and highly variable both in regard to quantity and characteristics. Color is imparted to textile effluent because of various dyes and pigments used. At some point in the manufacture of most textile goods chemical wet processing operations are necessary to properly prepare, purify, color or finish the product. In this study we examine the physicochemical properties and heavy metal levels of effluent discharged by textile industries.

II. Objectives

To study the performance of textile materials such as fibers, yarns, fabrics and characterization of textile industry with comparison of NEQS – National Environmental Quality Standards.

Testing the physico-chemical parameters (pH, Color, BOD, COD, TDS & TSS) of Textile effluents and Characterization of six industries

III. Sample Collection

Samples were randomly collected from different area of chinna kammai (S1, S2, S3, S4, S5 & S6). The samples were 1, 2, 3, 4, 5, 6 collected in polyethylene bottle previously washed with 8M HNO_3 and distilled water. so that no air space can be remained inside the bottles. Collected samples were shifted to the laboratory as soon as possible for the analysis of various physicochemical parameters

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Fig. 1: Dye effulent collection from the sites

IV. LITERATURE STUDY

Gomathi Elango.,et.at (2016)This study focused on the quality of textile dyeing effluent by analyze the physico-chemical parameters such as color, pH, total hardness, biological oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), total suspended solids (TSS), turbidity, chlorides, sulphides, silica, calcium, iron, oil and grease of the effluent. The results of the analysis were correlated with the water quality standards of BIS (Bureau of Indian Standard).

Shuchismita Dey., et.at (2015) study the textile and apparel industries in Bangladesh are playing an utmost important role offering tremendous opportunities for the economy of Bangladesh. But, hasty and unplanned clustered growth of industries leads to adverse environmental consequence in an alarming way. This work is aimed at giving emphasis on the present pollution scenario in Bangladesh due to textile effluent.

Kamal A.K.I.,et.at (2015)The present study has been undertaken in a laboratory scale to characterize and investigate pollution potential of textile effluents from DEPZ area in Dhaka, Bangladesh. Collected effluent samples from five different industries were analyzed for physico-chemical parameters using field kits and Standard Methods, and for metals using Flame Atomic Absorption Spectrophotometer (FAAS). The average physico-chemical parameters such as temperature, color, pH, DO, EC, BOD, COD, TS, total alkalinity and total hardness were found 52.4 ºC, 2646 PCU, 9.788, 1.492 mg/L, 7473.2 µs/cm, 157 mg/L, 508.8 mg/L, 9140.8 mg/L, 761.2 mg/L and 189.6 mg/L, respectively.

RajaGanesh K.,et.at (2014) Investigated Effluents from textile industries contain different types of dyes, which consists of high molecular weight and complex chemical structures, low level of biodegradability. Hence, direct deposition of these effluents into the environment cause pollution particularly in aquatic ecosystem. In this investigation, the physicochemical characteristics of the effluent samples were evaluated to ascertain the efficiency of industry's waste water treatment process. Conventional methods were employed for analysis of physicochemical parameters, while heavy metals in the effluent samples were analyzed using atomic absorption spectrophotometer.

V. STUDY AREA

The textile dyeing effluent is collected from the chinna kammai textile industry (Madurai) in the modernized world, industrialization is indispensable and considered to be a key role for the development of nation's wealth in terms of domestic employment and legal relationship between the countries by exchange of material goods. But the drawback of industrialization is pollution where the untreated effluents by all possible sources such as textile dyeing, leather tanning, paper and pulp processing, sugar manufacturing, etc. The 3rd largest city in the Tamilnadu 25th most populated city in India located on the banks of River vaigai. Today Madurai is one of the leading cotton knitwear manufacturing swarm in South India both for overseas market and the domestic market and almost 40 per cent of India's cotton knitwear exports happening from Madurai. According to TNPCB the total dissolved solids (TDS) in the water discharged into the river should not be more than 1,100 parts per million (ppm) but the TDS level of water in the vaigai dam area is above 5,000 ppm. During summer the level of TDS is high and also local groundwater is becoming brackish and significantly harder due to more water evaporation for the past two decades. In detail, higher concentrations of pollutants mainly organic matter in river water cause an increase in biological oxygen demand, chemical oxygen demand, total dissolved solids, total suspended solids as a result the water is unfit for drinking, irrigation or any other purposes and the people in vaigai river basin are very much frustrated due to large consumption of contaminated waste water.

VI. SAMPLE COLLECTION

Parameters	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6	NEQS Standards	BIS standards
pH	9.7	9.8	10.1	9.6	10.7	9.5	(6-9)	(5.5-9)
BOD (mg/l)	1100	300	1200	3000	900	1600	(80-250)	(100)
COD (mg/l)	350	420	320	640	570	620	(156-400)	(250)
TDS (mg/l)	435	1059	317	2032	1243	577	(3500)	(2100)
TSS (mg/l)	210	504	157	1010	314	467	(100)	(100)
COLOR	Dark Red	Black	Crimson Red	Yellow	Ruby Red	Blue	Colorless	Colorless

Table 1: CHARACTERIZATION OF TEXTILE WASTEWATER

Samples were randomly collected from different area of chinna kammai (S1, S2, S3, S4, S5 & S6). The samples were 1, 2, 3, 4, 5, 6 collected in polyethylene bottle previously washed with 8M HNO_3 and distilled water. The total volume of the bottle was filled completely and a cap was locked enough, so that no air space can be remained inside the bottles. Collected samples were shifted to the laboratory as soon as possible for the analysis of various physicochemical parameters. Some parameters namely temperature, Color, and PH were analyzed at the sampling spot. The collected samples were preserved for further analysis.

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Fig. 2: SIX DIFFERENT INDUSTRIES PHYSICO-CHEMICAL PARAMETERS

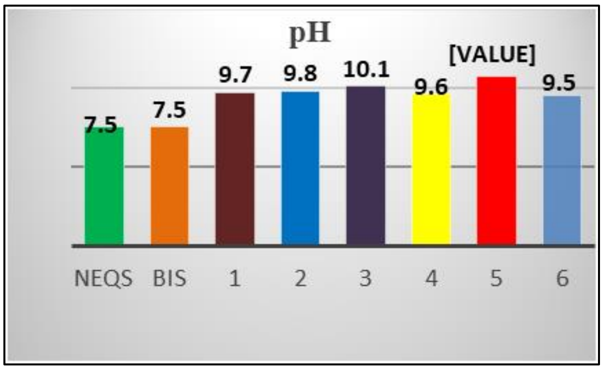

Fig. 3: PH VALUES OF SIX SAMPLES

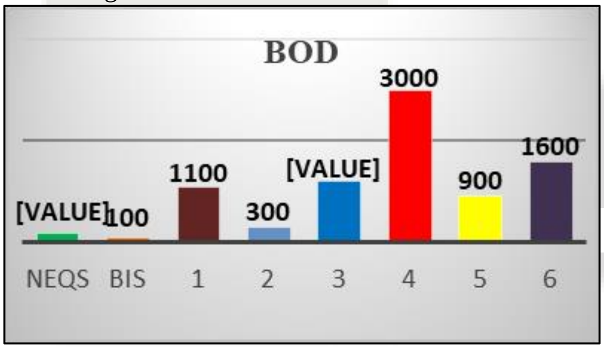

Fig. 4: BOD VALUES OF SIX SAMPLES

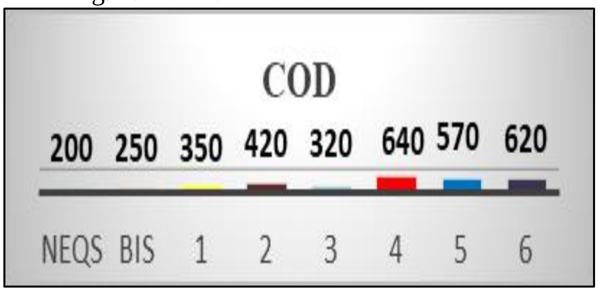

Fig. 5: COD VALUES OF SIX SAMPLES

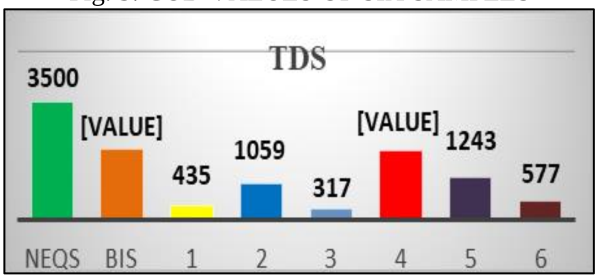

Fig. 6: TDS VALUES OF SIX SAMPLES

Parameters	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
PH	8.5	9.2	8.6	8.5	9.4	8.7
BOD (mg/l)	700	200	800	2400	650	1200
COD (mg/l)	200	320	228	424	376	516
TDS (mg/l)	370	820	240	1420	820	474
TSS (mg/l)	170	312	112	996	210	368
COLOR	Lite Red	Rose	Lite Yellow	Red	Colorless	Colorless

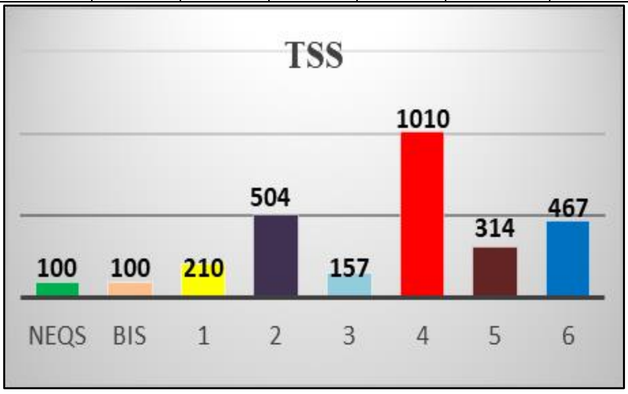

Fig. 7: TSS VALUES OF SIX SAMPLES

From the Fig (3.1, 3.2, 3.3, 3.4, 3.5). We are classified into three categories of the industries (Red, Orange, Green) Red, Orange, Green type of industries are indicates the highly pollutant, moderate pollutant, less pollutant respectively. In the sample 4 & 5 are the Red type of industry 1,2,3,6 industries are orange categories.

Fig. 8: RESULT FOR COAGULATION PROCESS WITHOUT AERATION:

Fig. 9: COAGULATION PROCESS WITH AERATION

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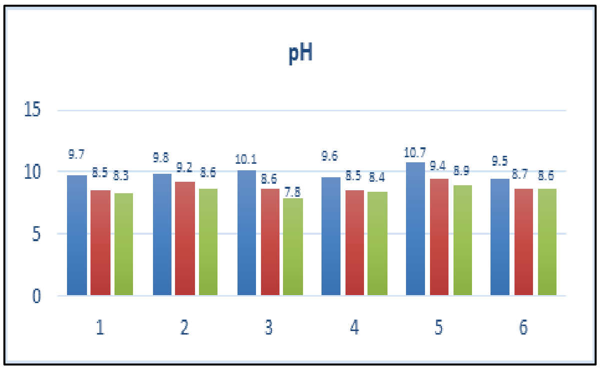

Fig. 10: COMPARISON OF PH VALUES FOR COLLECTED SAMPLES, COAGULATION PROCESS WITHOUT AERATION &

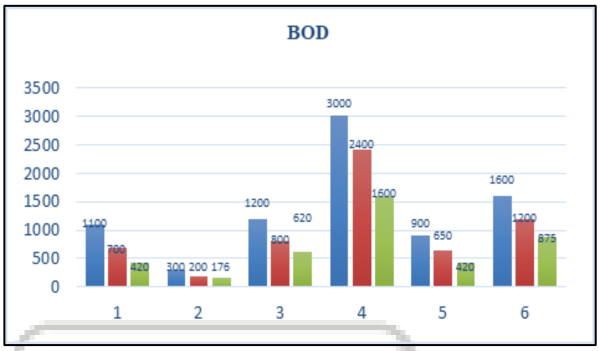

Fig. 11: COMPARISON OF BOD VALUES FOR COLLECTED SAMPLES, COAGULATION PROCESS WITHOUT AERATION & COAGULATION WITH AERATION PROCESS.

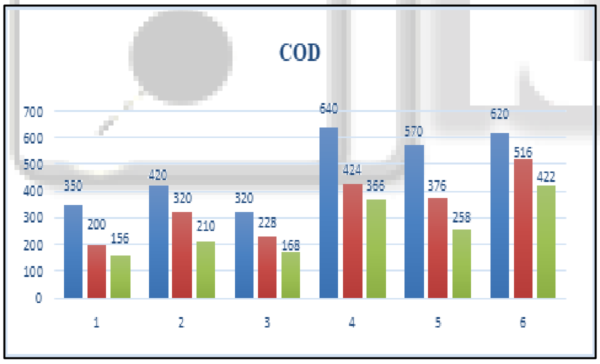

Fig. 12: COMPARISON OF COD VALUES FOR COLLECTED SAMPLES, COAGULATION PROCESS WITHOUT AERATION &

Parameters	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	Sample 6
PH	8.3	8.6	7.4	8.4	8.9	8.6
BOD (mg/l)	420	176	620	1600	420	875
COD (mg/l)	156	210	168	366	258	422
TDS (mg/l)	220	610	168	840	560	254
TSS (mg/l)	120	268	67	670	158	218
COLOR	Lite Red	Rose	Lite Yellow	Red	Colorless	Colorless

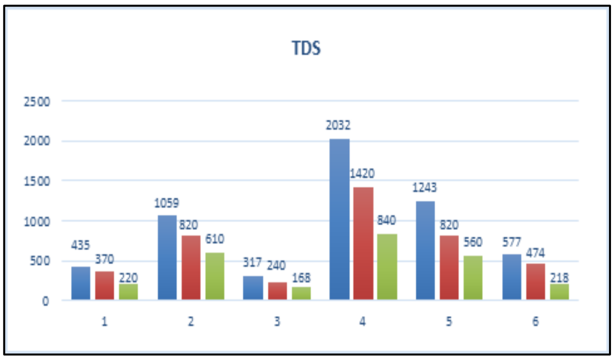

Fig. 13: COMPARISON OF TDS VALUES FOR COLLECTED SAMPLES, COAGULATION PROCESS WITHOUT AERATION & COAGULATION WITH AERATION PROCESS

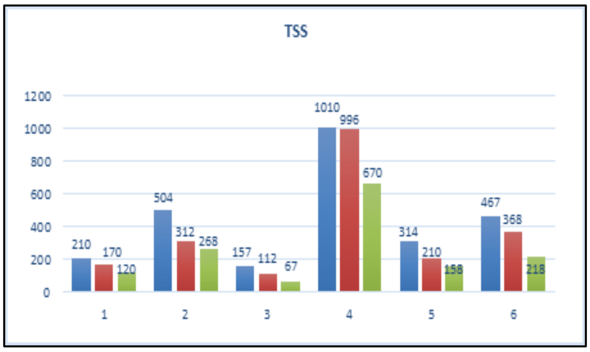

Fig. 14: COMPARISON OF TSS VALUES FOR COLLECTED SAMPLES, COAGULATION PROCESS WITHOUT AERATION & COAGULATION WITH AERATION PROCESS.

From the fig 4.1, 4.2, 4.3, 4.4, 4.5 show that comparison of pH, BOD, COD, TDS, TSS values for collected samples, coagulation process without aeration & coagulation with aeration process. These physico- chemical parameters values will be decreases with the compare to the collected samples & coagulation without aeration process. But Color changes will not be obtained. In this process result will be get effective and removal efficiency also increased. In coagulation process was the more effective result will be given and aeration with coagulation process was enhanced results.

VII. CONCLUSION

It can be concluded that the Physico-chemical parameters analysis of textile dye effluent collected from chinna kammai indicates high pollution levels compared with National Environmental Quality Standards (NEQS, 2000) & Bureau of Indian Standards (BIS). In the reference of TNPCB Red, Orange, Green type of industries are indicates the highly pollutant, moderate pollutant, less pollutant respectively. In this study sample 4 & 5 are the Red type of industry 1,2,3,6 industries are orange categories. In the coagulation process we are added 2mg/l of alum, 20 grams/l of cow dung and aeration for 24 hours in each samples. After the coagulation and aeration process we are tested the samples for pH, COD, BOD, TSS, TDS. These physico-chemical parameters values will be again decreases with the compare to the collected samples & coagulation without aeration process. The color gets slightly changed and BOD, COD, TSS, TDS parameters gets maximum removal efficiency attained. But the samples 4 & 5 gets minimum removal efficiency obtained. From this study coagulation process was the best treatment process for the textile dyeing effluents.

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