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Characterization and Treatment of Untreated Wastewater Generated from Dyes and Dye Intermediates Manufacturing Industries of Vatva Industrial Area, Gujarat, India

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ABSTRACT -In the present study the characteristics of the untreated wastewater generated from dye industrious was studied. Wastewaters of 3 unit manufacturing different types of dyes were used for this study. Dye Wastewater is well known to contain strong color, high pH, temperature, Chemical Oxygen Demand (COD) and biodegradable materials. Wastewater was analyzed for pH, Chemical Oxygen Demand (COD), Biological Oxygen Demand (BOD), Total Dissolved Solids (TDS), Suspended Solids (SS), Chloride, Sodium, Amine, Aniline Oil, Oil and Grease & Phenonic Compounds. The Study shows that the treated wastewater does not match the discharge norms provided by the GPCB, Gujarat, India. The Study also shows that the high amount of sludge was generated from the treatment of wastewater. The efficiency of the results presented are demonstrated by different dye manufacturing industries located in GIDC Vatva, Ahmedabad, Gujarat (India). The Study also correlated manufacturing process with wastewater characteristics and shows that the wastewater is a mixture of wastewater generated from various stages of manufacturing process.

Index Terms: Dye industries, COD, BOD, Total Dissolved Solids, pH, wastewater generated.

1. INTRODUCTION

In India almost 70 per cent of its surface water resources and a growing percentage of groundwater reserves were contaminated by biological, toxic, organic, and inorganic pollutants which show water scarcity for both human use and for the ecosystem & ecology (environment).[1] Wastewater derived from the production of dyes is highly variable in composition, and contains a large number of different compounds such as raw materials(anilines), intermediate products, and even the dye itself As with many other industrial sectors, growing concern about environmental issues has prompted the dye manufacture industry and textile industry to investigate more appropriate and environmentally friendly treatment technologies to meet the discharge restraints that are becoming stricter every day. Dyes production, textile preparation, dyeing and finishing plants are currently being forced to treat their effluents at least partially prior to discharge to publicly owned treatment works because of the high organic load, strong and resistant colour as well as high dissolved solids content of the Discharged wastewater .[2]

Primary treatment involves operations like screening and sedimentation to suspended particles and organic materials partially from the wastewater. Pre-aeration, addition of flocculating agents along with necessary mechanical agitation are used to improve efficiency of primary treatment. The secondary treatment transforms the organic material into various cell tissues and gases with the help of micro-organism specifically bacteria. Secondary treatment is usually done by attached growth processes like trickling filtration, rotating biological contactors or suspended growth process like activated sludge process. The primary and secondary treatments together bring down the level of BOD and COD significantly. Tertiary treatment is used improve the treated water quality to comply with the regulatory norms. Tertiary treatment removes substantial quantities of heavy metals, biodegradable substances, nitrogen, phosphorus, bacteria, viruses etc. Reverse osmosis and Ion exchange are also commonly used for removal of specific ions or reduction of dissolved solids. Some of these treatment techniques are expensive and consume a huge quantity of chemicals and costly land area. The treatment cost of water is expected to increase further, due to stringent discharge norms prescribed by regulatory authorities. This has motivated the industries to identify suitable technologies to minimize water consumption and waste water generation. This has also helped in development of innovative,

effective and economical methodologies for the treatment of wastewater and optimum use of these resources. Hence, it is necessary to propose a simple optimization strategy to select suitable technology from the available alternatives.[3]
Water resource development has taken place all over the world. There is a tremendous amount of pressure in protecting the water resources available in the country. Protecting the surface water resources from wastewater pollution plays a vital role for the development. The disposal of wastewater into the surface water bodies leads to serious problems and affects thePeople in health aspects. Especially in the urban areas, the pollution of domestic effluent discharges into the nearby surface water bodies created problems for the public. There are many ways of safe disposal of wastewater. But improper management of wastewater generation in the urban areas find its own way of getting into the surface water. Hence, the effluent discharge affects the surface water bodies. The water quality changes in the surface water bodies created many health problems to the public.[4]

It was decided to Consider COD as the measure of organic Solutes in the waste water samples. The Color of the Wastewater was also measured. These parameters (COD and color) reflect the practical aspects of wastewater treatment on the Industrial Scale. Thus such a study should be of much relevance to the industry in selecting cost effective wastewater treatment technique to comply with the statutory regulation. [5]

2. MATERIAL AND METHODS

2.1 Source of wastewater

Dye wastewater was collected three times after interval of one month during November 2016 to January 2017 from collection tank of ETP of 3 Industries located in Vatva industrial area, Gujarat, India. After collection of sample of dye wastewater preparing the three different sets of collected samples.

2.2 Preparation of combined dye wastewater

To prepare representative combined dye wastewater sample, fractional ratio in total dye waste water quantity for each industry was analysed and identified and waste water were in ratio of waste water load to preparing 9 L wastewater. Then this wastewater was equalized by means of stir in a tank of 12 liter capacity for 10 minutes.

2.3 Treatment of dye wastewater and characterization

The untreated combined and equalized dye wastewater was analyzed using Standard methods.[6] 3 L of this combined and equalized dye wastewater was given primary treatment. For this treatment 10 % solution of hydrated lime and 5 % solution of ferrous sulphate were used as coagulants.[7] pH of waste water was raised to 10.88 to 11.1 with the lime solution and neutralized to 7 - 8 pH value with ferrous sulphate solution. This treatment generated chemical sludge which was filtered by a filter cloth and kept in oven for drying at 80 ^{0}C. for 24 hours. After drying this sludge was collected and weighted. The treated dye wastewater was analyzed for the same parameters of untreated dye waste water. The consumption of treatment of chemicals, quantity of sludge generated and characteristics of treated dye wastewater are provided in below tables respectively.

3. RESULTS AND DISCUSSION

3.1 Quality of untreated combined and equalized dye wastewater

The Quality of untreated combined and equalized dye wastewater is shown in Table 1. The results show that the combined dye wastewater pH is within the range of 1.02 to 1.84, which means that the combined dye wastewater is highly acidic in nature. The dye wastewater was treated with lime and ferrous Sulphate solutions. The amount of treatment chemical consumed is shown in Table 2. Sludge was generated during the treatment, which was filtered and dried. Table 3 Shows that the quantity of the sludge generated from the treatment. And the filtrate was characterised. The results are shown in table 4.

From the above study, it is found that after the primary treatment very large amount of sludge is generated whih is in the range of 387 gm/L to 782 gm/L. The treated dye wastewater having very high COD and very high TDS value therefore this wastewater will create more complicated during the secondary treatments.

Table 1: Quality of untreated combined and equalized dye wastewater

Sr. No	**Parameters**	**Dye effluent sample 1 (A.D. Chem Industry, Vatva)**	**Dye effluent sample 2 (G.D. Chem Industry, Vatva)**	**Dye effluent sample 3 (A.D. Chem phase 2 Industry, Vatva)**
1	pH	1.84	1.02	1.33
2	Chemical Oxygen Demand (COD)	55625	80500	78477
3	Biological Oxygen Demand (BOD)	26547	22255	33455
4	Total Dissolved Solids (TDS)	188625	198652	139000
5	Suspended Solids (SS)	10625	9877	7899
6	Chloride (cl-)	66899	48777	35222
7	Sodium	1.01	1.04	1.03
8	Amine	2.1	2.2	2.8
9	Aniline oil	6.2	5.8	4.2
10	Oil and Grease	98	78	88
11	Phenonic Compounds	42.1	32.2	27.2

All values except pH are expressed in mg/L.

Table 2: Treatment chemicals consumed

Sr. No.	**Treatment Chemicals**	**Dye effluent sample 1 (A.D. Chem Industry, Vatva)**	**Dye effluent sample 2 (G.D. Chem Industry, Vatva)**	**Dye effluent sample 3 (A.D. Chem phase 2 Industry, Vatva)**
1	10.00 % Lime Solution	3 L (PH raised to 11.1)	3 L (PH raised to 10.63)	3 L (PH raised to 10.88)
2	5 % Ferrous Sulphate Solution	3 L (PH brought to 7.15)	3 L (PH brought to 7.01)	3 L (PH brought to 7.51)

Table 3: Quality of Sludge Generated From The Primary Treatment

Sr. No	**Sludge generation**	**Dye effluent sample 1 (A.D. Chem Industry, Vatva)**	**Dye effluent sample 2 (G.D. Chem Industry, Vatva)**	**Dye effluent sample 3 (A.D. Chem phase 2 Industry, Vatva)**
1	Sludge quantity (After drying at 80 ^{0}C)	782gm/L	752gm/L	387 gm/L

Table 4: Quality of treated combined and equalized wastewater

Sr. No	**Parameters**	**Dye effluent sample 1 (A.D. Chem Industry, Vatva)**	**Dye effluent sample 2 (G.D. Chem Industry, Vatva)**	**Dye effluent sample 3 (A.D. Chem phase 2 Industry, Vatva)**
1	pH	7.10	7.05	7.31
2	Chemical Oxygen Demand (COD)	35625	42500	32477
3	Biological Oxygen Demand (BOD)	9625	8745	7455
4	Total Dissolved Solids (TDS)	100625	108652	109000
5	Suspended Solids (SS)	870	621	621
6	Chloride (cl-)	10566	9222	8777
7	Sodium	0.020	0.019	0.014
8	Amine	0.052	0.026	0.019
9	Aniline oil	0.17	0.20	0.45
10	Oil and Grease	15	12	10
11	Phenonic Compounds	10.1	9.2	11.2

All values except pH are expressed in mg/L

4. CONCLUSION

The Study shows that the Dye wastewater collected from equalization tank of the industries is a mixture of dye wastewater generated during various stages including dye wastewater generated from utilities like boiler, chillers, cold water, floor washing etc.. It is recommended that a study should be carried out on the products manufactured by each of the industries on regular basis based on the market demand. Although water treatment is a common practise for supplying good quality of water from a source, maintaining an adequate water quality. The output of above study will help to segrate dye wastewater of similar nature. This will helpful the authorities to judge the collection and treatment system at different industry level and CETP level. This is very important because the dye wastewater, form all scale industries, is going to to CETP for centralised dye wastewater treatment.

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