NOVEL APPROACH FOR EFFLUENT TREATMENT OF 4-ADAPSA (DYE INTERMEDIATE) : USING SODIUM HYPOCHLORITE AS A REDUCING AGENT

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ABSTRACT

Dye wastes basically represent one of the most problem creating groups of pollutants and hazardous materials because they can be easily identified by the human eye and are not easily biodegradable. The purification of waste water from various industrial processes is a worldwide problem of increasing importance due to the restricted amounts of waste water suitable for direct use, the price of the purification and the necessity of utilizing the waste products. So it is require treating the dye waste water generated from the different dye manufacturing industries. In the present study the characteristics of the untreated wastewater generated from dye industrious was studied. Wastewaters of unit manufacturing (Industrial Chemical Works Naroda, Ahmedabad) 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 the Study also shows that the high amount of sludge was generated from the treatment of wastewater. By using of the Sodium Hypochlorite (NaOCl) (used in different amounts) as a reducing agent it is effectively used for the Reduction of COD of dye Effluent. The efficiency of the results presented are demonstrated by different dye manufacturing industries located in GIDC Naroda, 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.

Keyword: *Dye industries, COD, dyes wastes, pH, wastewater generated*

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1. INTRODUCTION

The chemical industry is of importance in terms of its impact on the environment. The wastewaters from this industry are generally strong and may contain toxic pollutants. Chemical industrial wastes usually contain organic and inorganic matter in varying degrees of concentration. It contains acids, bases, toxic materials, and matter high in biological oxygen demand, color, and low in suspended solids. Many materials in the chemical industry are toxic, mutagenic, carcinogenic or simply hardly biodegradable. Surfactants, emulsifiers and petroleum hydrocarbons that are being used in chemical industry reduce performance efficiency of many treatment unit operations The best strategy to clean highly contaminated and toxic industrial wastewater is in general to treat them at the source and sometimes by applying onsite treatment within the production lines with recycling of treated effluent. Since these wastes differ from domestic sewage in general characteristics, pretreatment is required to produce an equivalent effluent. In chemical industry, the high variability, stringent effluent permits, and extreme operating conditions define the practice of wastewater treatment proposed concept to select the appropriate treatment process for chemical industrialwastewater based on molecular size and biodegradability of the pollutants. Chemical industrial wastewater can be treated by some biological oxidation methods such as trickling filters, rotating biological contactor (RBC), activated sludge, or lagoons. Pollutants with a molecular size larger than 10,000-20,000, can be treated by coagulation followed by sedimentation or flotation. Waste minimization in the production process in chemical industry is the first and most important step to avoid waste formation during the production. Because of the fluctuation in the strength applied dynamic simulation to chemical-industry wastewater treatment to manage and control the treatment plant. The main objective of the present study was to evaluate the use of Alternative methods for the treatment of chemical industry wastewater. One component that everyone has everyday contact with regardless of geographical and cultural differences is dye. It can be estimated that 7 x 105 million tons of dye is available worldwide. Dyes are present in many essentials—fabrics for clothes and bags possess many textile dyes, while coloring dyes are used for food and beverages. However, from an environmental aspect, dye wastewater production from manufacturing and textile industries are problematic. The biggest problem that is prevalent in dye production is found in its high color and organic content. One can argue this point is due to the chemical characteristics of the dyes themselves. Many dyes consist of several aromatics such sulfo, nitro, amidocyanogen, chloro compounds. Another issue with dye production is because dye manufacturing processes produce various types of wastes, where the primary pollutants include volatile organic compounds, nitrogen oxides, HCl, and SOx. Additional properties of dye wastewater from the industrial industry involve high biochemical oxygen demand (BOD), chemical oxygen demand (COD), and suspended solids (SS). For example, vast dyes contain 25 kg/kg (or 25 mg/l where 1 kg/kg = 1 x 106 mg/L using the 2 density of water as 1 kg/L), 85 mg/l COD, while other dyes typically have a BOD of 6 mg/l, COD of 25 mg/l, and suspended solids of 6 mg/l. Without proper regulation and treatment, environmental and human health will experience various potential dangers. One of the reasons for the potential dangers involves the interactions between any discharged dyes and surrounding world. Expounding from the previous statistic, it can be stated that out of the 7 x 105 million tons available, only 2% of dyes are discharged as aqueous and 10% by means of coloration. The remaining 88% retain of discharged dyes retain their color due to sunlight, soils, bacteria, sweat, and degradation of microbes within the wastewater. An additional issue that is attributed to the environmental problems that some dyes have long half-lives, for example, Reactive Blue-19 has a half-life of 46 years. Because of some dyes have very long-half lives, their impacts can further linger. Some dyes can alter photosynthesis in plants, specifically in plants within water bodies because of the ceasing of light penetrating within receiving waters. Other impacts to the environment involve the health and vitality of stream, including undesired pollution, eutrophication, and toxicity.It is very evident that as dye production has become very significant within human society, the characteristics of dye wastewater are the resultant of many issues for public health and the environment. Some of the issues include the toxicity, color, and biodegradability issues, halogenated organic compounds, heavy metals and surfactants, and high BOD.While there is a plethora of literature that has attempted to individually describe the chemistry, classifications, legislation, and various tangible methods of dye treatment, the purpose of this text is to overlay all of these significant pieces for the purpose of truly highlighting the background for one to conclude there is a need for proper treatment of dye wastewater. However, this text does not serve is as an all-extensive guide to describe all of the contemporary methods of treating dye wastewater. Nevertheless, this text hopes to provide a starting point for those looking for background and resources that will lead them to discover more within this field of study. While there are many industries that used yes, the majority of focus will be primarily on what is being employedwithinthetextiledye industry.[1,2,3]

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 .[4]

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.[5]

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.[6]

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. [7]

2. AIMS AND OBJECTIVES

Now a days wastewater treatment is not an easy task. For treatment of waste water is too necessary. The dye waste water has high amount of organic matter so without treatment pull down in water stream is not ethical. Objectives of my study are treatment of dye waste water using Sodium hypochlorite as a reducing agent. The scope is to first characterize the dye waste water, then these studies by using treatment methods of waste water. Waste Gujarat region has various industrial zones developed by Gujarat Industrial Development Corporation (GIDC). Industrial Chemical Works Naroda area is one of them. Naroda GIDC has various dyes and dye Intermediates manufacturing Units, Now a days , In india many Industrial Zones have installed CETPs for the Treatment of waste water generated from various manufacturing units but some CETPs not working properly so that’s why taking one of the dyes manufacturing industry (Industrial Chemical Works Naroda) for the using treatment methods to treat the dye waste water treatment

3. MATERIAL AND METHODS

STEPWISE PROCEDURE FOR ALL FUNCTIONS (INCLUDED ALL DATA)

STEP - 1

- After complete the process in Isolation vessel the semi solid 4 – ADAPSA is sent to the Nutsche filter & its color is sky blue, when all the materials sent to the Nutsche filter which separate the finish good from an effluent it contains 20000-22000 COD.
- In this Step the effluent from Nutsche filter which contain 20000 - 22000 COD, it is the final stage that the product 4 – ADAPSA is filtering on Nutsche filter.
- The PH is 2.0.

- As shown in figure the finally 4 – ADAPSA is taken out in Nutsche filter and remaining effluent is discharged which contains 20000 COD. After filtering the 4 – ADAPSA is sent for the drying and blending process.

  - Nutsche Features

  The arrangement for the glass Nutsche includes the following components:

- QVF Borosilicate glass filter body
- QVF Borosilicate glass reactor cover with nozzles for agitation, vent valve and feed dip pipe.
- QVF Borosilicate glass bottom cover with drain / vacuum outlet
- Virgin PTFE filter support plate
- Manual vessel lifting/lowering/swivel for access to cake and filter media
- Support structure constructed in stainless steel pipe and PTFE-coated Kee-Klamps
- The mesh size of Nutsche cloth is 500 per inch.

- Nutsche Advantages
- All process wetted parts are non-metallic, such as borosilicate glass and PTFE, thereby providing superior corrosion resistance, product purity and process visibility.

- Nutsche Specifications
- Pressures from full vacuum to 14.5 psig (1.0 bar g)
- Temperatures from -4°F (-20ºC) to 250°F (120ºC)
- Filter Body Volume: 20 liters (5.3 Gallons)
- Agitator Motor: XP, 230/460V, 1/2 Hp, 1200 rpm
- Gear Reducer: 0 –100 RPM, Manual.

STEP - 2

- By using the filter clarifier the COD is reduced from 20000 to 19000 mg/l Clarifiers are settling tanks built with mechanical means for continuous removal of solids being deposited by sedimentation. A clarifier is generally used to remove solid particles or suspended solids from liquid for clarification and (or) thickening. Concentrated impurities, discharged from the bottom of the tank are known as sludge, while the particles that float to the surface of the liquid are called scum.
- Filter clarifier which filter the Organic compound salt and reduces COD.
- **Applications of Filter Clarifier**

  Pretreatment

  Potable Water treatment.

  Waste water Treatment

  Mining.
- From above seeing the all readings in the table and graph by using of the filter clarifier in all stages (readings 1 to 11) the COD is reduced from 20000 to 19000 mg/l that can be clearly seen in the graph which generally remove solid particles from the dye effluent (4 ADAPSA) from the graph in all stages it will give the straight line from reading 1 to 11.

STEP - 3

- Use of various dyes in order to color the products is a common practise in dye industry. The presence of these dyes in water even at low concentration is highly visible and undesirable.
- The most widely used adsorbent is commercially available activated carbon remains an expensive material.
- Activated carbon is prepared from orange peel. Experiments were conducted to treat dye effluent using activated carbon prepared from agriculture waste.
- So the First off all to prepare a set of test dye solution of 50 mg/l, 100 mg/l, 150 mg/l, 200 mg/l, 250 mg/l (50 to 250 mg/l) after it was prepared from effluent solution and this solution is taken in to the reagent bottles, varying doses of adsorbents is added to study the feasibility of color removal.
- A number of such reagent bottles containing the test mixture depending upon the requirements were employed

- Then the reagent bottles containing test mixture was placed in an orbital shaker operating at 90 RPM, to facillate the effective mixing and precipitates formation. Then the reagent bottles containing reaction mixture were kept under undistributed for 1 hour for the settlement of precipitation formed.
- The settled precipitates are seperated from the mixture by filtration with the help of a filter paper. The filtrate is analyzed for percentage color removal by using the calibration curve prepared. the procedure is repeated.

Effect of time on % Color Removal

- Variation of color removal with time at optimum RPM of 90 for dye effluent is given in table and graph. Maximum Color removal of 60.00 % occurs at optimum time 100 min

Table -1 Time vs % Color Removal

Time	% Color Removal
20	47.11
40	34.11
60	36.54
80	49.00
100	60.00
120	39.63
140	45.12

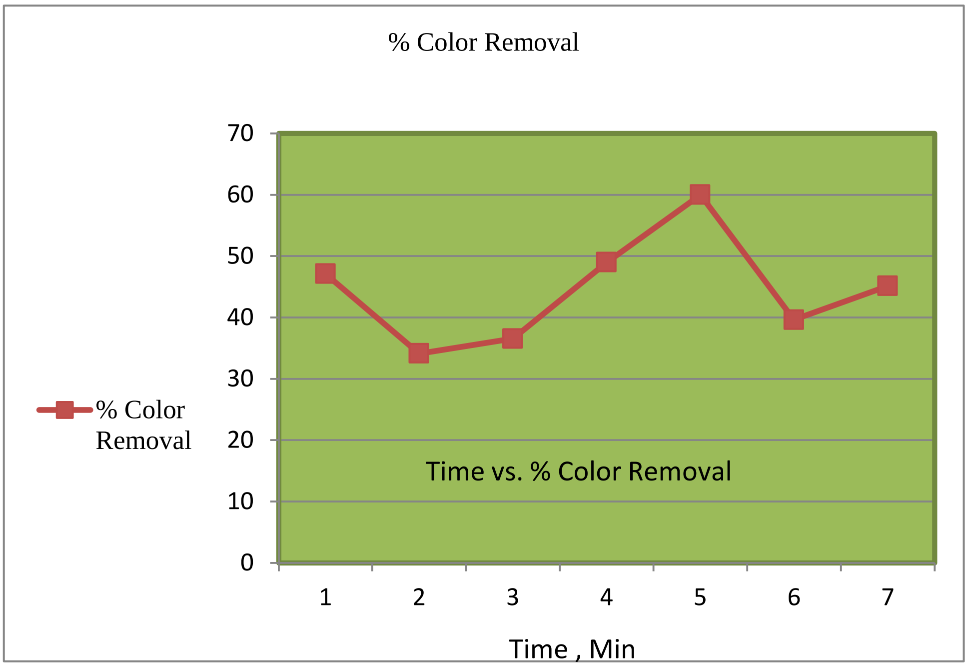

Chart -1 Time vs. % Color Removal

- Here by adding a Activated Carbon 2 % Vol ml means starting with the reading of 0.4 % To 2 % at the difference of 0.4, means of that starting with Activated Carbon 0.4 % means of that by dissolving at the amount of 0.4 % Activated carbon in for the set of 50 mg/l to 250 mg/l till the value come at 2.0%, At 2.0 % of Activated Carbon % removal Efficiency is more as compare to other previous percentage.

Table -2 Activated Carbon (Percentage ratio) vs % Color Removal

Sr. No	Activated Carbon (In Percentage Ration) in %	% Color Removal
1	0.4	53.22
2	0.8	62.14

3	1.2	79.33
4	1.6	89.22
5	2	99.44

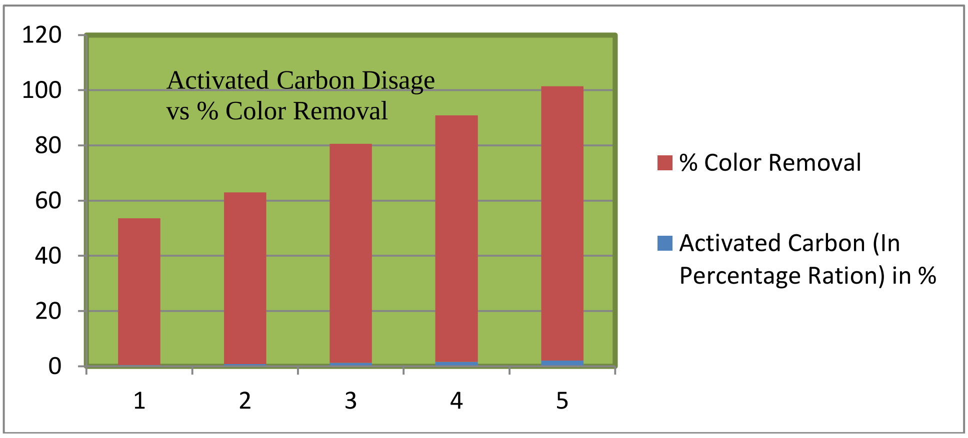

Chart -2 Activated Carbon Dosage vs. % Color Removal

- As above as per the graph showing at the different different dosages of activated carbon with different sets of reading as we can see above tables, reading basically starts from 0.4 % to at the end is 2.0%. So finally it is
- proved that at the 5 t h reading of dosage of activated carbon with 2.0% fixing, we got the very good color removing efficiency 99.44%. Almost solution becomes colorless.

STEP - 4

- Now by adding of Sodium Hypochlorite (At the interval of 50 gm that means taking 50 gm to 1100 gm) the COD is reduced from 17000 to 5015mg/l By using Sodium Hypochlorite & PH become neutral 7.0 by adding Sodium Hypochlorite.
- By adding Sodium Hypochlorite reductions take place.
- Temperature is 85-90 C.
- To add Sodium Hypochlorite till PH will become 7.0

STEP - 5

- This stage is called polymer adding stage. In this stage it is required to adding a poly Aluminium Chloride after the stage no 4 process completed, when stage no. 4 process is completed poly aluminium chloride is added to keep the process smoothing.
- Poly Aluminium Chloride is used as process smoothing.
- As the Poly Aluminium Chloride is added at every stages from 1 to 11, this polymer react with that effluent (After step 4) which contain organic as well as inorganic effluent in which break the bond of that of both of the effluent and processes become smoothing, COD also reduces in Step 5 and after it becomes large lumps, as the large lumps are formed it is very easy in pulverising and drying process.

Table- 3 COD reduction by using sodium hypochlorite (NaOCl)

Sr. no	Reagent Used	Month	Quantity Used (Trial Run) (GM)	Effect On PH	Chemical Oxygen Demand (COD) (mg/l)
1	Sodium Hypochlorite	2 - Dec	50	2.43	19000
2	Sodium Hypochlorite	5 - Dec	100	3.01	18050
3	Sodium	8 - Dec	150	3.21	17100

	Hypochlorite				
4	Sodium Hypochlorite	11 - Dec	200	3.77	16000
5	Sodium Hypochlorite	14 - Dec	250	3.90	15250
6	Sodium Hypochlorite	17 - Dec	300	3.99	14750
7	Sodium Hypochlorite	20 - Dec	350	4.35	13900
8	Sodium Hypochlorite	23 - Dec	400	4.88	13100
9	Sodium Hypochlorite	26 - Dec	450	5.00	12000
10	Sodium Hypochlorite	29 - Dec	500	5.52	11200
11	Sodium Hypochlorite	1 – Jan	550	6.77	10500
12	Sodium Hypochlorite	4 - Jan	600	7.01	8000
13	Sodium Hypochlorite	7 - Jan	650	7.05	7500
14	Sodium Hypochlorite	10 - Jan	700	7.12	7000
15	Sodium Hypochlorite	13 - Jan	750	7.17	6500
16	Sodium Hypochlorite	16 - Jan	800	7.21	6300
17	Sodium Hypochlorite	19 - Jan	850	7.26	6020
18	Sodium Hypochlorite	22 - Jan	900	7.29	5800
19	Sodium Hypochlorite	25 - Jan	950	7.36	5652
20	Sodium Hypochlorite	28 - Jan	1000	7.40	5400
21	Sodium Hypochlorite	31 - Jan	1050	7.45	5241
22	Sodium Hypochlorite	02- Feb	1100	7.50	5015

4. RESULTS

After Performing the experiment of finding COD by taking trial run (initial reading) 50 gm of Sodium Hypochlorite, the COD is reduced from 20000-20000 (mg/l) to 19000 mg/l. So by taking different sets of trail run of Sodium Hypochlorite taking 100 gm, 150 gm, 200 gm, 250 gm, 300 gm, 350 gm, 400 gm, 450 gm, 500 gm, 550 gm, 600 gm, 650 gm, 700 gm, 750 gm, 800 gm 850 gm, 900 gm, 950 gm, 1000 gm, 1050 gm, 1100 gm COD is reduced respectively 18050 mg/l, 17100 mg/l, 16000 mg/l, 15250 mg/l, 14750 mg/l, 13900 mg/l, 13100 mg/l, 12000 mg/l ,11200 mg/l, 10500 mg/l, 8000 mg/l, 7500 mg/l, 7000 mg/l, 6500 mg/l, 6300 mg/l, 6020 mg/l, 5800 mg/l, 5652 mg/l, 5400 mg/l, 5241 mg/l, 5015 mg/l. COD is gradually decreased while taking the reading started with 600 gm to 1100 gm. Work has been done for reading 11 (Taking 11 reading).

5. 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.COD and color were reduced significantly by using Sodium Hypochlorite and activated Carbon with 2 % Volume ml. The performance of color removal was significantly removed by above mentioned techniques. The treated water can be reused for effective Drying Process.

6. ACKNOWLEDGEMENT

The Authors are thankful to CETP, Naroda and Industrial Chemical works Pvt. Ltd., Ahmedabad, Gujarat, India for providing laboratory facilities.

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