International Journal of Textile and Fashion Technology (IJTFT)
ISSN 2250-2378
Vol. 3, Issue 2, Jun 2013, 47-52

TREATMENT AND CHARACTERIZATION OF WASTEWATER FROM VARIOUS DYEING INDUSTRIES USING DIFFERENT ADSORBENTS

RAVI S. TANK[1], PANKAJ M. AKBARI[2], RAJAT D. UNADKAT[3], VINEETKUMAR R. GUPTA[4] & KARTIK D. LADVA[5]

[1,2,3,4]Department of Industrial Chemistry, Shree Manibhai Virani & Smt. Navalben Virani Science College, Saurashtra University, Gujarat, India

[5]Department of Chemistry, Shree Manibhai Virani & Smt. Navalben Virani Science College, Saurashtra University, Gujarat, India

ABSTRACT

Industrial based research project using different types of adsorbents for the treatment of liquid waste generated from various dyeing industries. The effluents generated from dyeing industries impart high pollution problems. The research is based on the treatment and characterization of effluent wastewater collected from dying industries of Saurashtra region using different adsorbent like High Adsorbent Silica (HAS) and Activate Carbon (AC). As the effluent generated by dyeing industries contains considerable amount of chloride, acidity, BOD, TDS, DO and many other undesirable parameters. These pollutants are found to have carcinogenic, mutagenic effects on human beings. It will also cause growth problems in fresh water animals. This will lead to severe environmental pollution problems. The study focuses on use and comparative effectiveness of two adsorbent HDS and AC to reduce and arrest the severity of pollutants present in the dyeing effluent.

KEYWORDS: Industrial Effluent, Dyeing Industries, Activated Carbon, Pollutant, High Adsorbent Silica, Adsorbent

INTRODUCTION

Many of the South Asian countries including India are experiencing severe environmental problems due to their rapid industrialization. This phenomenon is very common where the water polluting industries like dye manufacturing, textile dyeing, leather tanning, paper and pulp processing, sugar manufacturing, etc. thrive as clusters.

The coloured effluent discharged by these industries leads to the serious pollution of surface waters, ground waters and soils. Among the above mentioned industries, dye manufacturing industries and textile industries are the largest source of dye containing effluent that on discharge generates serious environmental threats.

Generally, such industrial units are functioning in small scale or medium scale with high employment generation and foreign exchange potential. But the pollution control mechanisms among these units are extremely weak [1]. Rajkot is located in the South- West region of Gujarat. The district headquarter is Rajkot city, the largest city in Saurashtra and fourth largest in Gujarat.

Rajkot has 14 talukas like Rajkot, Morbi, Jetpur, Wankaner etc. Rajkot city is considered the economic, industrial and educational hub of the Saurashtra region. Textiles and Apparels are the emerging sectors of Rajkot region. Manufacturing activities are concentrated in two main industrial estates i.e. Aji and Bhaktinagar. Rajkot is mainly depends on cloth mills [2].

EFFLUENTS FROM DYING INDUSTRIES

Table 1: The Following are Some of the Parameters as Per the Standards of Central Pollution Control Board (CPCB) India, for the Requirements of Maximum Value to Discharge the Effluent Directly to the Water.[3]

Parameter	Maximum Value	Parameter	Maximum Value
pH	5-9	Suspended Solids	100
BOD	30	Total Alkalinity	125-200
TSS	50	TH	50
TDS	50	Suspended Solids	100

Note: The Values are in Mg/Litre, Except pH

The textile industry consumes large amounts of energy and water and generates large volumes of waste. The water consumption and wastewater generation from a textile industry depends upon the processing operations employed during the conversion of fiber to textile fabric. In textile industry desizing, scouring, bleaching, mercerizing, dyeing, printing, and packing are the main processing stages that consume approximately 2400 to 2700 m^3/day of raw water. The used water is flown from the industry as colored effluent and its characteristics depend upon the processing stages. In general, the wastewater from a typical cotton textile industry is characterized by high values of BOD, COD, colour, and pH.

A common approach to textile mill effluent treatment consists of screening, flow equalization, and settling to remove suspended solids, followed by biological treatment. Physical-chemical treatment is also practiced: careful control of pH, followed by the addition of a coagulant such as alum before settling, can achieve good primary treatment. Further treatment to reduce BOD, if required, can be carried out using oxidation ponds (if space permits) or another aerobic process; up to 95% removal of BOD can be achieved [1].

ADVERSE EFFECTS OF EFFLUENTS

According to WHO, about 80% of all the diseases of human beings are caused by water, since these diseases are directly related with human health, it is necessary to bring awareness among the present and future generation about the consequences of water pollution [4]. Presence of very high concentrations of these dyes can be highly aesthetically unacceptable but also the discharge of these effluents can be carcinogenic, mutagenic and generally very harmful to the environment [5], [6], [7]**.**

The incidence of high fluoride and arsenic in river water near Textile industries in Rajkot causes the problem of fluorosis. Waste-water treatment plants use low levels of chlorine to disinfect drinking water, but chlorine that enters the waste-water or groundwater can mix with other chemicals and reciprocate into drinking water, which can produce hazardous effects to human and animal health in addition to the environment [4].

Because of the high BOD, the untreated dyeing and textile wastewater can cause rapid depletion of dissolved oxygen, if it is directly discharged into the surface water sources. The effluents with high levels of COD are toxic to biological life.

The high alkalinity and traces of chromium (employed in dyes) adversely affect the aquatic life and also interfere with the biological treatment process.

The high colour renders the water unfit for use at the downstream of the disposal point.

The high percentage of DO will lead to the development of mosquito larva and proliferation of soil bacteria [1].

A study investigated the effects of textile dye waste water on the health of the freshwater fish, Gambusiaaffine, more commonly known as the mosquito fish. The researchers measured the toxic effects of untreated waste water on the shape and size of the fishes' red blood cells, or RBCs, and compared them to the same parameters in fish that inhabited areas with treated waste water. The study found that there were significant differences in both the shape and size of RBCs caused by the untreated effluent and recommended that these parameters be included in future monitoring of toxic effects on all fish species [8]

EFFLUENT CHARACTERISATION

The samples of the effluents were collected from nearby dyeing industry of Rajkot for the study. The samples were analysed using Biological as well as Physcio-chemical tests before and after the treatment.

Total Dissolved Solids [9],[11],[12]

50 ml of the raw effluent sample is taken and heated up to 103-105°C overnight and cooled in desiccators and dried it. The total dissolved solids were found to be 14860 mg/lit which is high.

Dissolved Oxygen [9],[10],[11]

To 200 ml of the sample add 1 ml of $MnSO_4$ and 2 ml alkali iodide azide reagent. After adding 1 ml sulphuric acid and 2 ml 2% starch solution titrate it with $Na_2S_2O_3$ and DO found to be 8.1mg/litre of DO.

Biological Oxygen Demand [9],[10],[11],[13]

BOD was measured by adding 1 ml of Phosphate Buffer, $MgSO_4$, $CaCl_2$, and FeCl2 each to the sample. The sample taken were diluted in the ratio of 1:100, 1:50, 1:33 and blank sample taken for 5 day incubation at 20°C and calculated that sample is having very high BOD of 362.03 mg/litre.

Total Hardness [9],[13],[14],[15]

50 ml sample after dilution was added 2 ml of Buffer of pH 10 with two to three drops of Eriochrome Black-T as an indicator with 0.01M EDTA and the total hardness found to be 166 mg/litre, which is quite high amount of hardness in the sample.

Total Alkalinity [9],[13]

20 ml sample was titrated with 0.02N H_2SO_4 in presence of phenolphthalein indicator to make it up to 8.4 pH and then again titrated with 0.02N H_2SO_4 in presence of methyl orange as an indicator. The total alkalinity of sample found to be on highly alkaline side of 70 mg/litre.

pH Estimation [16],[17]

The pH of the Sample was measured by using pH meter of type and model is CL 54^{+}. The sample is highly acidic in nature and it shows the reading of 5.20 pH.

TREATMENT OF EFFLUENT WITH VARIOUS ADSORBENTS AND CHARACTERISATION

After the analysis of raw sample of the waste water from dye industry, it was observed that the raw sample contains considerable amount of pollutants quite above its safe tolerant value, which is not acceptable from clean environment point of view.

So, in order to reduce and arrest the presence of harmful substances well under the permissible range and to check effect of different types of adsorbents namely, HAS and AC, various tests were performed on the effluent wastewater of the dyeing industries.

For HAS treatment of effluent, first 10 g of HAS heated at 250oC for 2 hours in electric oven (Model :MSI-5, Make : Metalab), then cool it in desiccator for about 30 minutes.

Add the prepared adsorbent to 500ml of the diluted (1:150) sample and heat it at 50oC for 1 Hour.

For AC treatment of effluent, first 10 g of AC heated at 250oC for 2 hours in electric oven (Model : MSI-5, Make : Metalab), then cool it in desiccator for about 30 minutes.

Add the prepared adsorbent to 500ml of the diluted (1:150) sample and heat it at 50oC for 1 Hour.

After the treatment of waste water effluent with HAS and AC adsorbent the measurement and analysis various parameters showed interesting results as follows.

Total Dissolved Solids

14860 mg/lit of hardness in raw effluent is very high. To reduce the total dissolved solids sample treated with HAS and it was found to contain 12800 mg/lit.

Another sample was given treatment with AC and the total dissolved solids were found to be 7000 mg/lit., which is far better than the value of raw effluent.

Dissolved Oxygen

The DO of the sample treated with HAS found to contain 7.3 mg/lit and the sample treated with AC found to contain 6.5 mg/lit, which is far better than the value of raw effluent.

Biological Oxygen Demand

The BOD of the sample treated with HAS found to be 287.3 mg/lit which is still high and the BOD of the sample treated with AC found to be 143.6 mg/lit.

Total Hardness

The total hardness of the sample treated with HAS found to be 176 mg/lit whereas the sample treated with AC is 148 mg/lit.

Total Alkalinity

The total alkalinity to the sample treated with HAS found to be 25 mg/lit whereas the total alkalinity of the sample treated with AC found to be 50 mg/lit.

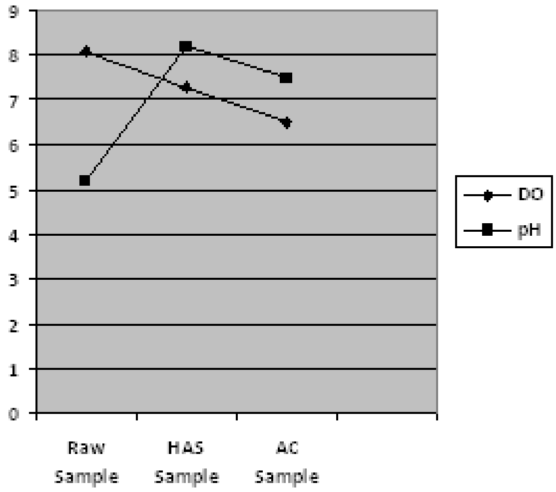
pH Estimation

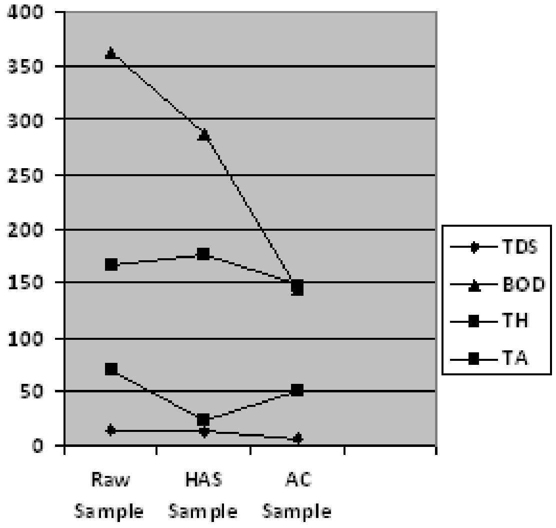
Using electrode type of pH metre we have measure the pH of the sample with HAS found to be 8.21 and the pH of the sample treated with AC is found to be 7.5.

COMPARISION OF POTENTIAL OF HAS & AC

The data recorded before and after the treatment of effluent generated from dyeing industry and its treatment using HAS and AC adsorbent was critically analysed and the results obtained were very interesting.

The comparison of the effectiveness of the two adsorbent in reducing and arresting the harmful substances is given as below:





CONCLUSIONS

The effluent sample collected from dyeing industry taken for this project contained very high values of BOD, DO, TDS, TH, pH, Total Alkanity and so on which is very dangerous for the health as well as environmental pollution aspects.

So we tried to reduce and arrest these substances in considerable amount as compared to the raw sample with the help of different adsorbent namely HAS and AC.

For the reduction of total dissolved solids AC is found more effective than HAS. It reduced the total dissolved solids by a factor of more than two of a raw sample.

For the reduction of DO AC is found to be more effective than HAS.

For the reduction of BOD AC is found to be more effective than HAS. It reduced the BOD by a factor more than two of a raw sample.

For the reduction of Total Hardness AC is found to be more effective than HAS. It was observed that the total hardness of the sample treated with HAS increased while AC reduced the total hardness of the sample by considerable amount.

For the reduction of total alkalinity HAS is found to be more effective than AC. It reduced the total alkalinity by a factor of three of a raw sample.

For the control of pH, it was observed that HAS makes treated sample more alkaline than the AC sample.

So, from the above study we can conclude that if the effluents generated from dyeing industries are treated with a HAS and AC adsorbent, which are available abundantly and easily.

With the application of such materials the load of environment pollution can be lessened by considerable amount.

ACKNOWLEDGMENTS

We are unequivocally thankful the P.P. Tyagvallabh Swamiji and Dr. A.U. Patel for providing access such a world class infrastructure and state of art laboratory facilities and we do acknowledge the support extended by the staff member of Industrial Chemistry Department of Shree M. & N. Virani Science College, Yogidham Gurukul, Rajkot , Gujarat (India) .

REFERENCES

1. Ambasana, Chetan C., 2006, "Microbial Degradation of Recalcitrant compound", thesis PhD, Saurashtra University.
2. http://www.vibrantgujarat.com/dist-profile-rajkot.htm
3. Pollution prevention and abatement handbook, World Bank Group, July- 1998.
4. "Physcio chemical characteristics of ground and surface water in Gophar sub-division of Sonitpur district- Assam India", Pranab Sabhapandit*+, J. Envir. Sci & Engg., Vol.53, No. 1, p.89-96, Jan 2011
5. S.Papic, N. Koprivanac, A. L. Bozi. A. Metes, "A removal of some reactive dyes from synthetic wastewater by combined Al (III) coagulation/carbon adsorption". Dye Pigments, Vol. 62, 2004, pp. 293-300
6. S. Asad, M. A. Amoozegar, A. A Pourbabaee, M. N. Sarbolouki, S. M. M. Dastgheib, "Decolourization of the textile azo dyes by newly isolated halophilic and halotolerant bacteria". Biores. Technoll., Vol. 98, 2007, pp. 2082-2088.
7. K. K. Mukesh and A. Saroj, "Mutagenic assessment of effluents from Journal of Chinese Clinical Medicine., Vol. 5 (11), 2010, pp. 93-97.
8. Journal of Environmental Biology,"A comparative study on the toxic effects of the textile dyeing industries". October 2006
9. Standard methods for the examination of water and wastewater, APHA, AWWA, and WEF 21st edition, 2005.
10. Chemistry for environmental engineering, 4th edition, Clair N. Sawyer, Perrg Z. Caty, Gener F. Parkin.
11. GPCB guide manual, Water and Wastewater Analysis.
12. Howard, C. S(1933) Determination of total dissolved solids in water analysis, Ind. Engg. Chem. Anal. Edition, 54.
13. CPCB documents stating the guideline values for various water bodies, Rationalization and Optimization of Water Quality Monitoring Network, CPCB, MINARS, IS-2001-2001.
14. Goetz C. A and R C. Smith (1959), Evolution of various Methods and Reagents for total Hardness and Calcium Hardness in Water lowa state J. Sci. pp 34-81.
15. Schwarzenbach, Grand H. Flaschika (1969), Complexometeric Titration, 2nd edition, Barnes and Noble, Inc., New York.
16. Whqlibdo.who.int/publication/1979/9241541504- eng-p77-142.htm
17. SCP Science, Water Analysis Handbook Vol. 2 pp 9
18. www.wikipedia/spectrometry basic principle.htm