STUDIES ON POLLUTION POTENTIAL DUE TO TEXTILE EFFLUENT IN SOLAPUR CITY

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ABSTRACT
The main goal of this study is characterization of textile effluent and find out pollution potential due to it. Field analysis has been carried out for the characterization of effluent from six textile industries I(1), I(2), I(3), I(4), I(5), I(6) for their pollution potential season wise. The major pollution indicator parameter are BOD, COD, TDS,Chloride, heavy metals, hydrogen sulphide,sulphate,hardness, alkalinity are analyzed by using standard procedure APHA(1995). The concentrations of solid are found to be 9060, 3608, 5828, 5740, 2048 mg/l for industry 1, 2,3,4,5 and 6 respectively. The COD and BOD values for I (1) were 1410 mg/l and 300 mg/l, I (2) 412 mg/l and 110 mg/l, I(3) 127mg/l and 44 mg/l, I(4) 982 mg/l and 270 mg/l, I(5) 396 mg/l and 120 mg/l, I(5) 554 mg/l and 160 mg/l respectively. Sulphate concentration for I(1) 880 mg/l,I(2) 410 mg/l , I(3) 620 mg/l,I(4) 914 mg/l,I(5) 920 mg/l ,I(6) 486 mg/l respectively season wise. The values pH for I(1), I(2), I(3), I(4), I(5) and I (6) are 8.21, 8.73, 8.78, 8.75, 7.91 and 9.41 respectively, this implies that the effluent were alkaline. The present investigations shows the textile effluents have pollution potential since the parameters measured have values above the tolerable limits compared to FEPA standards and WHO standards for effluent discharge. The high values obtained for parameters assessed, especially those of the concentrations of TDS, COD, BOD, so call for the pretreatment of effluent before it discharged into water body. Also, the high chloride content observed in textile effluent, thus suggesting that the chemical method of coagulation and flocculation may be an ideal treatment method.

KEY WORDS: Industrial pollution, Textile effluent, Water analysis

INTRODUCTION

Industrial pollution is one of the vital problem presently facing the India and all over the world. This is due to careless disposal of industrial effluents other wastes may contribute greatly to the poor quality of the water. Textile industries are one of the major sources of these effluents. (Government of India, Annual report 2005) due to the nature of operations which requires large volume of water, that eventually results in high waste water generation. The textile industry is distinguished by raw material used and this determines the volume of water required for their production as well as waste water generated.

The textile industry production includes raw cotton and raw wool based products in Solapur city. Six textile industries selected for are raw cotton based. During production, slashing, bleaching, mercerizing and dying are the major activities as well as waste water generation. The effluent coming from these industries contains acids used in desizing, dying base like caustic soda used in scouring mercerization. It also contains inorganic chlorine compounds and other oxidants like Hypochlorite of sodium.Organic compounds are also present e.g. dye stuff and optical bleachers, finishing chemicals, starch and related synthetic polymers for the sizing and thickening, surface active chemicals used as wetting and dispersing agents also metals are also present. All these chemicals are passed into an effluent tank and then drained into drainage system. The presence of dyes in surface and surface water makes them not only aesthetically objectionable but causes many water born diseases viz .nausea, hemorrhage, ulceration of skin and mucous membrane, dermatitis, perforation of nasel septum and severe irritation of respiratory tract. So proper analysis is needed to assess the pollution level for the protection of environment. In the present study the extent of pollution level is determined by studying various physico-chemical, anionic parameters and heavy metals in order to characterize the effluents of textile industries in Solapur city.

MATERIAL AND METHODS

Textile waste water was collected from six textile industries located specifically in east region of Solapur city. Composites samples of effluent are collected directly from outlet of those industries in plastic bottle of 1 liter capacity each manually over eight hours from 10.00am to 5.00pm. These coincide with working period of factory and sampling is most convenient during this period. Samples were preserved at refrigeration temperature to minimize biodegradation. Composite samples were collected from each industry season wise.

Sample analysis

The physico-chemical parameters were analyzed by using standard methods for the examination of water and waste water (APHA: 1995) and Trivedy and Goel (1986).
1) PH was determined by digital pH meter.(Elico model no.)
2) Concentration of sulphate was determined by using DR/ 2010 HACH potable data logging spectrophotometer.
3) Total dissolved solid was determined gravimetrically.

4) Ca and Mg were determined by using complex metric titration.
5) Fe and Copper by atomic absorption spectrophotometer.
6) Hydrogen sulphide by using titrimetric method.
7) DO by using Winkler method.
8) COD by using dichromate digestion method.
9) BOD by using dilution method.
10) Total hardness and alkalinity was determined by titrimatrically.

RESULTS AND DISCUSSION

The quality of the effluent generated from six textile industries was characterized using pollution indicator parameter shown in the following tables 1-7. A highly colored liquid effluent with pungent odor was observed under studied area. The PH variation is primarily caused by different kinds of dye stuff used in dying process in six different industries. Higher pH approaches in effluents owing to the waste composition of textile mills such as, NaOCl, NaOH, Na_2SiO_3, surfactants, sodium phosphate. Water pH influences the other properties of water body, activity of organism and potency of toxic substances present in the aquatic environment.

Concentration of organic pollutant indicator

1) Biochemical oxygen demand

All the six textile industries under studied area releases lot of biochemical oxygen demanding wastes .The studied BOD Values are listed in Table 1.It is observed that the BOD values varied from 44 to 360 mg\l and average value is 177 mg\l and it is 3 to 4 times higher than the literature value. Biochemical oxygen demanding wastes consumes the dissolved oxygen from water. Excessive BOD value is harmful to aquatic animal.

Table 1: BOD values of textile waste water for selected six industries.

Industries/ Parameter	BOD (Rainy)	BOD (Winter)	BOD Summer)
Industry-1	105	110	240
Industry -2	360	300	310
Industry -3	90	44	72
Industry -4	190	270	136
Industry -5	170	120	124
Industry -6	220	160	180

2) Chemical oxygen demand

Chemical oxygen demand is the amount of specified oxidant that reacts with the sample under controlled condition. This is one of the important parameter for assessing the quality of chemically oxidizing matter in water. The values are listed in Table 2. Perusal of table revels that the values are ranging from 127 to 4290 mg\l and average value was 664 mg\l which is 8-9 times higher than literature value.

Table 2: COD values of textile effluents.

Industries/ parameter	COD (Rainy)	COD (Winter)	COD (Summer)
Industry-1	444	1410	1325
Industry-2	4290	412	985
Industry-3	400	127	337
Industry-4	709	982	540
Industry-5	576	396	195
Industry-6	790	554	499

3) Total dissolved solid

TDS in water consists of ammonia, nitrite, nitrate, phosphate, alkalis, some acids, sulphates, metallic ions etc.The total dissolved solid values of the effluent coming from six textile industries are given in Table 3. These values lied between 1560 mg\l to 9060 mg\l and average value is 4572 mg\l.It is found that most of them sample contains TDS concentration 3 to 5 times higher than FEPA standards of effluent discharge. The high TDS value of effluent is not desirable because high concentration of TDS elevates the density of water, influences osmoregulation of fresh water organism, and reduces solubility of gases.

Table 3. The values of TDS of studied textile effluents.

Industries/ parameter	TDS (Rainy)	TDS (winter)	TDS (summer)
Industry-1	9060	4496	4370
Industry-2	6954	2808	4490
Industry-3	3340	3608	3472
Industry-4	5424	5828	8650
Industry-5	3350	5740	5240
Industry-6	7914	2148	2530

4) Hydrogen sulphide

Hydrogen sulphide can be determined by precipitating sample with cadmium sulphide. In acidic medium, with excess of iodine, the precipitate gets dissolved and sulphide is oxidized to sulphur. The remaining iodine can be titrated against $Na_2 S_2O_3$ using starch as indicator. Hydrogen sulphide is formed because of decomposition of organic matter and mostly from bacterial reduction of sulphate under condition of deficient oxygen. In present investigation it is found to be in the range of 14 to 70 mg\l and average value is 35.8mg\l as shown in Table 4.It is found that it is about 31 to 34 times higher than FMENV limit. Hydrogen sulphide is very toxic and attacks the metals directly and indirectly causing serious corrosion of concrete sewers.

Table 4: Sulphide values of textile effluents.

Industries/ parameter	Sulphide (Rainy)	Sulphide (winter)	Sulphide (summer)
Industry-1	24	32	14
Industry-2	24	16	15
Industry-3	28	32	16
Industry-4	44	48	18
Industry-5	70	80	50
Industry-6	30	76	28

Concentration of anion in effluent

1) **Chloride ion**

The chloride ion concentration can be determined using mhos titration by using potassium chromate indicator. The chloride ion concentrations of the effluents studied are given in Table 5.It is varied from 760 to 3350 mg/L and average value was found to be 1641 mg/L. It is found that sample contains chloride ion concentration around double than DoE standard10. These different types of effluent contain bleaching liquor which is quite toxic due to the presence of chloride ion. In present investigations high values of chloride concentration was observed and it is responsible for increase in hardness of water.Therefore suggesting the chemical method of coagulation and flocculation may be an ideal treatment method.

Table 5. Chloride ions for different industrial effluents.

Industries/ parameter	Chloride (Rainy)	Chloride (winter)	Chloride (summer)
Industry-1	1800	2150	1010
Industry-2	3350	760	1239
Industry-3	1350	940	1022
Industry-4	2150	2175	1336
Industry-5	1200	2150	1651
Industry-6	3350	1050	850

2) Sulphate

Sulphate concentration was determined by spectrophotometrically by running the standard curve of sulphate solution. Sulphate is an important anion imparting hardness of water. It may undergo transformation to sulphur or hydrogen sulphide depending largely upon the redox potential of water. In all the effluents sulphate ion concentration varied from 410 to 914 mg/L as shown in Table 6.The average value was found to be 700 mg/L and it is found that it is 16 times higher than the DoE standard10.

Table 6. sulphate values of studied effluents.

Industries/ parameter	Sulphate (Rainy)	Sulphate (winter)	Sulphate (summer)
Industry-1	560	880	450
Industry-2	600	410	550
Industry-3	580	620	410
Industry-4	910	914	885
Industry-5	740	920	780
Industry-6	780	486	575

Concentration of metal

The values of magnesium and calcium studied are listed in Table 7. This values also higher than FEPA (1988) and WHO (1971) due to wide use of various chemicals in textile processing units particularly dyeing (Mahtusa et al, 2009)

Table 7. Values of Mg and Ca studied textile effluents.

Industrial parameter	*Magnesium (Rainy)*	Magnesium (Winter)	Magnesium (Summer)	*Calcium (Rainy)*	Calcium (Winter)	Calcium (Summer)
Industry-1	54	83	55	136	228	270
Industry-2	83	93	65	188	131	180
Industry-3	85	66	75	216	188	390
Industry-4	76	71	57	256	248	160
Industry-5	61	219	72	276	433	290
Industry-6	102	51	79	108	124	264

CONCLUSION

The results obtained from this study showed that the effluents of the textile processing waste water are alkaline with high salt concentrations. It also showed the concentration of TDS, BOD, COD are significantly higher than the standards given by the FEPA and WHO. Based on this study, it revels that these effluents can be treated by chemical method like coagulation and flocculation.

REFERENCES

APHA (1995). Standard Methods for Examination of Water and Waste Water 19th Edition, American Public Health Association, Washington DC.

FEPA (1988). Effluent discharge standard, Federal Environmental Protection Agency, Lagos.

Mahfuza sultana S., Islam S.M. Ratnajit Suha and Al.M Ansur M.A. (2009). Impact of the effluents of Textile Dyeing Industries on the surface water quality inside D.N.D. Embankment, Narayanganj. *Bangla. J. Sci. Ind. Res.* **44** (1):65-80.

Textile Ministry, Government of India (2004). Annual report. **1:**1-17.

Trivedy R.K. and Goel P.K. (1986). Chemical and Biological Methods for water Pollution studies, Env.Pub. Karad, India.

WHO (1971). International Standards for Drinking Water. 3rd ed., Geneva.