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CHARACTERIZATION OF TEXTILE DYE EFFLUENT FROM KOMARAPALAYAM, NAMAKKAL DISTRICT, TAMILNADU, INDIA

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Abstract:-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. The results obtained from the physicochemical analysis of all the samples of effluent indicated high temperatures, alkaline pH, foul smell and were highly colored.TDS values in some samples were also very high. All the samples except one sample have high BOD values. The COD values of all the samples were very high indicating high degree of pollution. The results also showed elevated levels of inorganic ions. The concentrations of heavy metals namely Zn, Cd and Pb also very high. Almost all the above characteristics of textile dye effluent have greater variability compared with NEQS standard. Thus textile effluent is a major source of water pollution which will affect the flora and fauna existing in such environments. This study anchors on the need for treatment of textile effluent before discharged into the environment.

Keywords: Komarapalayam, Textile dye effluent, NEQS standard.

INTRODUCTION

Industrial pollution is one of the problems at present facing in the society and several efforts have been vigorously pursued to control it in various industries spanning length and breadth of the country to see that people live in a disease free environment. The textile mills actually represent a range of industries with operations and processes as diverse as its products (Nosheen et al., 2002). Color is imparted to textile effluent because of various dyes and pigments used. Many dyes are visible in water at concentrations as low as 1mgl- 1. Textile wastewaters, typically with dye content in the range of 10–200mg l- 1 are therefore highly colored. In addition to dyes, various salts and chemicals specially heavy metals are major sources in textile industry wastewater. Sediments, suspended and dissolved solids present in the textile effluent are important repositories for causing rapid depletion of dissolved oxygen leading to oxygen sag in the receiving water (Tamburlini et al., 2002; Chapman et al., 1982 and Ademoroti et al., 1992). The heavy metals and contaminants like dyes tend to persist indefinitely, circulating and eventually accumulating throughout the food chain (Macaskie and Dean 1984; Niu et al., 1993; Simmons et al., 1995). Various reports have mentioned the direct and indirect toxic effects of dyes and metals commonly used in textile industry in the form of tumors, cancers and allergies in human being besides these are also act as growth inhibitions on different trophic levels on bacteria, protozoans, algae, plants and different animals (Tamburlini et al., 2002; Specht and Platzek 1995; Sponza 2002; Bakshi and Sharma 2003; Moawad et al., 2003). In this study we examine the physicochemical properties and heavy metal levels of effluent discharged by textile industries, situated at Komarapalayam, an important textile city of Tamilnadu, India. The study may be helpful to carried out to monitor the efficiency of industry's treatment process.

MATERIAL AND METHODS

Dye effluent collection sites

The Textile town Komarapalayam is situated on the bank of Cauvery river (Ganga of South India) in Namakkal District, Tamilnadu, India. Komarapalayam lies between 11° 20" and 11° 30" northern latitude and between 77° 40" and 77° 50" eastern longitude. It is located about 405 km from Chennai, about 58 km from Salem, and about 14 km from Erode Central Bus Terminus and is on the Eastern bank of river Cauvery.

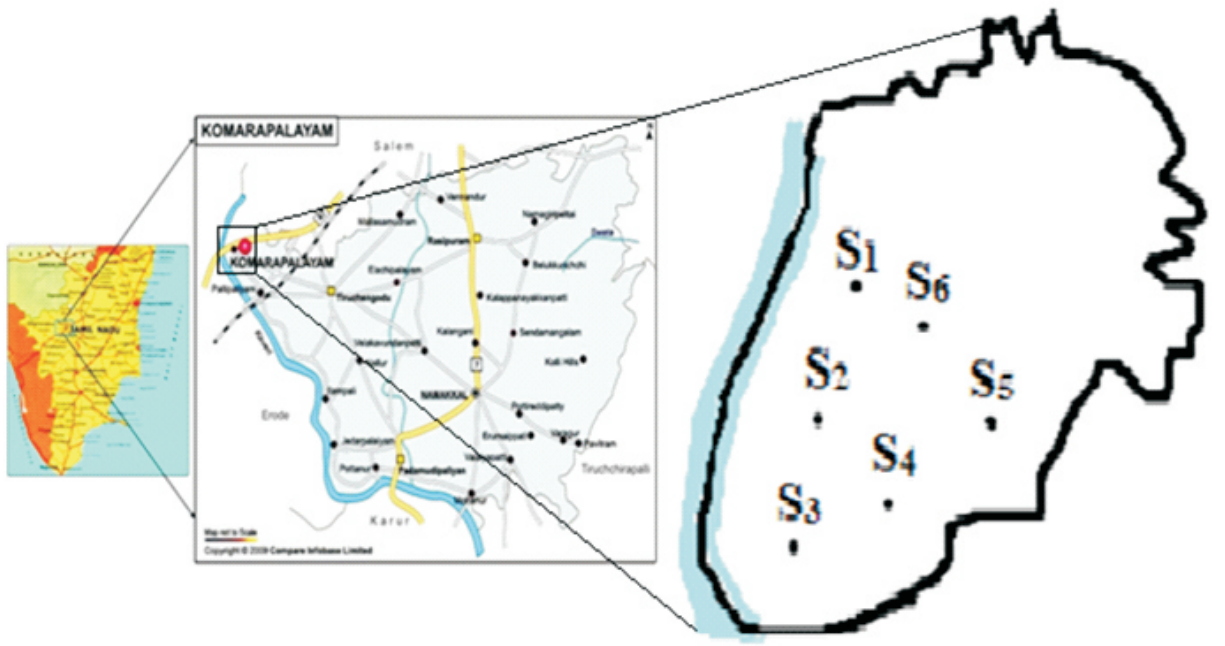

Fig-1 Map showing Komarapalayam location and textile dye effluent collection sites

The town is situated on plain fertile lands sloping from east to west to wares Cauvery River. The temperature here is moderate through out of the year except during summer. The prevailing south-west and north-east monsoon winds bring less rains and heavy rains during the month of July and November respectively. (Fig. 1)

A Panoramic view of Cauvery river

Textile dyeing procedure at collection site

Cmmon used dyes in Komarapalayam Boiling of dyes

Fig-2 Textile dye effluent collection site and dyeing procedure

Sample Collection

Samples were randomly collected from different area of Komarapalayam (S_1, S_2, S_3, S_4, S_5 & S_6). The samples were collected in polyethylene bottle previously washed with 8M HNO3 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 and pH were analyzed at the sampling spot. The collected samples were preserved for further analysis (APHA, 1992; De 2000; Manivasakam 2000). (Fig. 2 & 3)

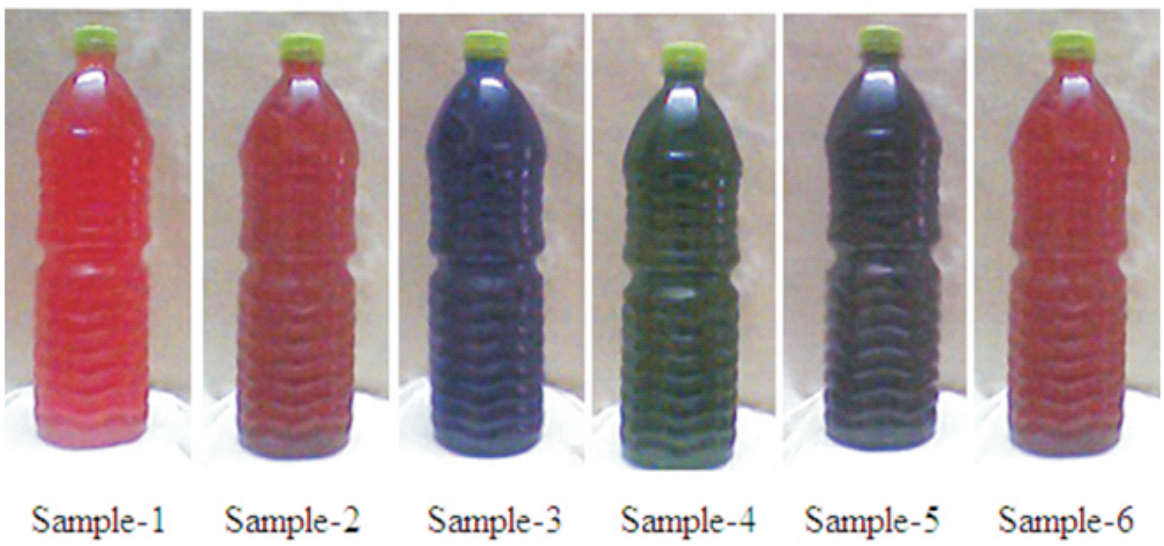

Fig-3 Collected textile dye effluent from different locations of Komarapalayam

PHYSICO-CHEMICAL ANALYSIS OF DYE EFFLUENT

Temperature, pH, colour and smell of the samples were recorded on the spot from where the samples were collected. Temperature was measured using mercury thermometer graduated from 0º to 100°C. pH was determined using portable pH meter. Chemical oxygen demand (COD) was determined by the dichromate digestion method while biochemical oxygen demand (BOD) was determined by the dilution method (APHA, 1998). Total alkalinity, calcium, magnesium and chloride were estimated by titration method. Analyses of different metal ions in the effluent samples were analyzed by Atomic Absorption Spectrophotometer (Mac: SL 176-Double beam Spectrophotometer) as per the standard method recommended by APHA, 1998. The results obtained were evaluated in accordance with the norms prescribed by National Environmental Quality Standards (NEQS, 2000).

Statistical analysis

Data was statistically analyzed at 0.05 by one-way ANOVA using Microsoft excel.

RESULTS AND DISCUSSION

The physico-chemical parameters analysis of textile dye effluent collected from Komarapalayam indicates high pollution levels compared with National Environmental Quality Standards (NEQS, 2000). The results obtained from this study provide a giant stride compliment to previous work in this area (Robinson *et al*., 2002). Apparently, the effluent sample collected from different parts of Komarapalayam town during dyeing and washing conditions were Orange, Red, Blue, Dark green, Dark black and red in colour and also have fishy and pungent odour (Table 1). This odour of the effluent will cause nuisance to the public and decline the esthetic value of the environment and surroundings. The result indicates the high levels of the pH particularly in sample 3 and 5. The higher pH value in the effluent indicating the alkalinity conditions and this will have an adverse effect on the water permeability. The values of TDS are ranging from 1213.00-3849.67 respectively and exceed the permissible limits as well indicates pollution of the water. The value of BOD ranging from 270-1842 and COD from 725-2080. These values are beyond the permissible limits and indicate high level of pollution. This can deplete dissolved oxygen from streams, lakes and oceans may cause death of aerobic organisms and increases the anaerobic properties of water (Irina-Isabella Savin and Romen Butnaru 2008). The above undesirable changes in the physic-chemical properties of textile dye effluent may have negative effects on the quality of freshwater and subsequently cause harm to aquatic life especially fish (Morrison *et a*l., 2001). The high levels of COD in analysed sample indicates the toxicity of the effluent and the presence of large amounts of biologically resistant organic substances (Yusuff and Sonibar 2004; Geetha *et al*., 2008).The concentration of Zn in the collected samples were ranging from 13.03-36.13 mgl^{-1}, Cd was 8.25-24.51 mgl^{-1}, and Pb was 11.12-32.10 mgl^{-1} in water samples. This indicates the high level of pollution in the water discharged from textile industries into the environment (Table 1). The presence of heavy metals in the current samples was found to be high which is of the same order of magnitude reported in another textile dye effluent sample (Naeem Ali *et al*., 2009). A high value of heavy metal ions in the effluent severely affects the soil fertility (Kumar 1989). High concentrations of zinc in water is most harmful to aquatic life during early life stages under conditions of low pH, low dissolved oxygen and elevated temperatures (Eisler 1993). The elevated level of Zn-content in the aquatic ecosystem is toxic to plants, birds and animals (Furness and Raibow 2005). Elevated levels of lead in the water can cause reproductive damage in some aquatic life and cause blood and neurological changes in fish and other animals that live there (XTR Research Lab, 2011). The presence of relatively high Pb-content in the environmental water has become a major threat to plant, animal and human life due to its bioaccumulation tendency and toxicity (Oancea *et al*., 2007).The levels Zn, Cd, and Pb in all the samples were above the standard limits. It have been reported that the major problem associated with textile processing effluents is presence of heavy metal ions, which arise from materials used in the dyeing process or in a considerably high amount, from metal containing dye. (Robinson *et al*., 2002).

CONCLUSION

India is a developing country where small scale industrial units mainly in textile industry form a major part of the Nation's economy. But most of small scale textile industrial units directly released its effluents without treatment into the environment because the cost of waste water treatment through traditional methods is high. The characterization of textile dye effluent collected from Komarapalayam indicates that the effluents make the water unsuitable for cultivation purpose. Now we need proper management to save our environment from pollution caused by textile dye effluent. For this we need to take proper steps to develop affordable eco-friendly technology for the treatment of textile dye effluents before released in to the environment.

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Table 1: Physico-chemical characterization of textile dye effluent (P < 0.05).

Parameters	collection sites						*NEQS Standard values	P- values
	S_1	S_2	S_3	S_4	S_5	S_6		
Colour (mgl^{-1})	orange	Red	blue	Dark green	Dark black	Red	Colour less	-
Odour	Pungent	Fishy	Pungent	Fishy	Fishy	Pungent	Odour less	-
Temperature	37.20	52.00	47.25	33.40	27.00	41.30	40	0.000
TDS (mgl^{-1})	1213.00	3849.67	3286.00	2457.00	1836.00	2341.54	3500	0.001
PH (mgl^{-1})	7.00	4.8	9.3	6.2	7.9	6.4	6-9	0.000
BOD (mgl^{-1})	243.00	1842.00	553.00	480.00	270.00	652	80-250	0.039
COD (mgl^{-1})	1088.00	2080.00	1728.00	1532.00	873.00	725.00	156-400	0.002
Phosphate (mgl^{-1})	0.36	0.40	0.22	0.71	0.52	0.63	15	0.001
Nitrite (mgl^{-1})	0.06	0.18	0.29	0.24	0.27	0.11	-	0.004
Iron (mgl^{-1})	4.20	6.80	7.00	5.62	6.32	4.56	2	0.000
Silicate (mgl^{-1})	0.17	1.14	0.12	1.18	0.30	0.42	-	0.037
Hydrogen Sulphide (mgl^{-1})	7.8	8.5	8.7	9.4	10.1	6.8	-	0.000
Residual Chlorine (mgl^{-1})	4.44	6.21	7.79	7.75	2.43	5.23	-	0.001
Carbonates (mgl^{-1})	1.2	0.9	2.4	3.6	5.1	4.23	-	0.008
Sulphates (mgl^{-1})	0.24	1.28	1.02	1.13	0.41	3.12	1000	0.035
Zinc (mgl^{-1})	17.45	36.13	22.41	20.23	13.03	15.32	5	0.002
Lead (mgl^{-1})	11.12	23.41	18.22	14.55	32.10	27.22	0.5	0.001
Cadmium (mgl^{-1})	24.51	8.25	23.14	32.68	9.12	23.45	0.1	0.004

*NEQS – National Environmental Quality Standard (2000).

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