

Physico-Chemical Characteristics of Textile Dye Effluents Collected from Tirupur, Tamilnad, India and Their Impact on The Ecosystems



Zoology

KEYWORDS : Textile dye effluent, physico chemical, Tirupur city

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ABSTRACT

Textile industries are large industrial consumers of waters as well as producers of wastewater effluents. In this study the physico chemical parameters such as Colour, Odour, Temperature (TO), Total dissolved solids (TDS), Electrical conductivity (EC), pH, Biological oxygen dement (BOD), Chemical oxygen dement (COD), Phosphate, Nitrite, Iron, Silicate, Hydrogen sulphide, Residual Chlorine, Carbonate, Sulphate, Chromium, Lead and Cadmium of the untreated textile industry effluents randomly collected from Tirupur city of Tamilnadu were analyzed. The physicochemical analysis of the effluents of all the samples indicates that all the samples were highly polluted and having the values higher than the permissible limits. Remedial measures were recommended for the treatment of these effluents.

Introduction

Industrial effluents are possibly the most important single source of contaminates to aquatic environment [1]. Among the industrial effluents, the textile dye effluents have more impact on aquatic ecosystem. In India, the textile industry and its wastewaters have been increasing proportionally and creating severe pollution troubles [2]. The dyeing process of textiles normally necessitates large volumes of water. There are more than 8,000 chemical products associated with the dyeing process and over 100,000 commercially available dyes exist with over 7×10^5 metric tons of dyestuff produced per annum [3]. Generally, textile effluent is colored, varying in hydraulic flow rate, having high; pH, temperature, BOD, COD, TDS and TSS [4]. Uptake of textile effluents through food chain in aquatic organisms may cause various physiological effects like hypertension, sporadic fever, renal damage, cramps, tumor, cancers and allergies in human and acts as growth inhibitors on different trophic levels in aquatic ecosystem [5]. The textile wastewaters in the India are discharged mostly untreated over the land or in near by water bodies. The traditional physicochemical treatment methods used are in general inefficient, expensive and of limited applicable. Therefore, bioremediation of textile dye effluents is becoming important.

Materials and Methods

Textile dye effluent collection sites and collection of the sample

The samples were randomly collected from different area of Tirupur city (S_1, S_2, S_3, S_4, S_5 & S_6). The Tirupur city is located between 11.1075° N, 77.3398° E and covers the area of 27.19 km² (10.50 sq mi). The Noyyal river, a branch of Cauvery originates from Velliyanigiri hillocks on the Western Ghats flow through Tirupur city, in which the untreated textile dye effluents directly released. (Fig. 1)

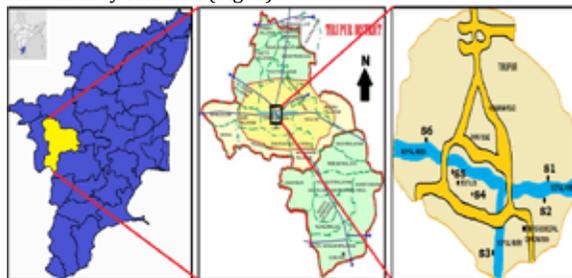


Fig-1 Map showing Tirupur location and textile dye effluent collection sites

The samples were collected in polyethylene 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 adopted by the method of APHA, 1998 [6].

Physico-Chemical characterization of textile dye effluents

COD was determined by the dichromate digestion method while BOD was determined by the dilution method [6]. Phosphate, nitrite, iron, silicate, hydrogen sulphide, residual chlorine, carbonate and sulphate 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 [6]. 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 effluents were collected from different parts of Tirupur city were Blue, Yellow, Black, Red, Green and Dark Blue 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 [7,8].

Table 1 depicted that the temperature of the effluent significantly ranged from 41.00°C to 48.00°C , which is higher than that of the NEQ standard. Higher temperature is harmful for aquatic life. If water temperatures vary too much, metabolic activities of aquatic life can malfunction. Temperature also affects the concentration of dissolved oxygen and can persuade the activity of bacteria in a water body [9]. pH value of all the six samples found to vary from 4.5 to 9.5 (Table 1). Six effluents had pH value higher than that of the NEQ standard (6 - 9). High pH lessens fish production [10] and also slows down the growth of aquatic macrophytes [11]. Again low pH can destroy the fish population accompanied by decrease in the variety of species in food chain [12]. EC found to ranging from 3.5 to 9.1 dsm^{-1} . Most of the textile effluents had higher EC values. Again TDS ranged from 1735 to 4751 mg l^{-1} . Two industry's effluents had TDS higher than the NEQ standard. Water having high EC and TDS values can cause osmotic stress at the root zone of plants which makes it more difficult

for a plant to absorb water for growth. Thus increased EC and TDS in irrigation water leads to lower crops production [13] and also serve as an indicator for water pollution [14]. BOD found to vary from 273 to 536 mg^l⁻¹. Six textile effluents had higher BOD than the NEQ standard. Excessive BOD is harmful to aquatic animals like fish and microorganisms. It also causes bad taste to the drinking water [15]. COD ranging from 1437 to 2873 mg^l⁻¹. Six textile effluents had COD higher than the NEQ standard. Edmund (1998) reported that higher COD concentration can cause a substantial damage to submersed plants [11]. Like BOD, higher COD is also harmful to all aquatic life [16]. Sulphate found to vary from 0.05 to 1.41 mg^l⁻¹. Six textile effluents had sulphate lower than the NEQ standard. According to WHO, the maximum allowable concentration of sulfate is 200 mg^l⁻¹ [17]. Phosphate ranging from 0.25 to 0.53 mg^l⁻¹ in all the samples. The over enrichment of phosphate can lead to algal blooms and also leads to eutrophication and depletion of oxygen in water bodies. The high phosphate content in water may lead to kidney damage and osteoporosis in human [18]. The ranges of nitrite in the textile effluents were found respectively 0.08 to 0.16 mg^l⁻¹. Nitrite contents of all

the six textile effluents were found within limit NEQ standard. Iron found to vary from 1.47 to 5.84 mg^l⁻¹. Five textile effluents had iron content above the NEQS standard and the remaining three industries had iron content within the NEQ standard. Water with high iron content has little effect on aquatic ecosystem [19] and also lead to staining of laundry and gives metallic taste to drinking water [20].

Chromium found to range from 23.12 to 6.05 mg^l⁻¹ above the NEQ standard. High concentration of Cr in water is harmful for plant growth and development, which may affect total dry matter production and yield [21]. Lead found to vary from 4.26 to 21.34 mg^l⁻¹. Effluents from six sites had lead content above the NEQ standard. The higher concentration of lead may be due to the use of lead nitrate as an oxidizing agent in textile industry. Elevated levels of lead in the water can cause reproductive damage in some aquatic life and cause blood and neurological defects in fish and other animals that live there[22]. Cadmium found to vary from 4.60 to 17.36 mg^l⁻¹ above the NEQ standard.

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

Sl. No	Parameters	Unit	collection sites						Average	P- values	*N.E.Q.S
			S1	S2	S3	S4	S5	S6			
1	Colour	-	Blue	yellow	Black	Red	green	Dark Blue	-	-	Colour less
2	Odour	-	Fishy	Pungent	Fishy	Fishy	Pungent	Pungent	-	-	No odour
3	T ^o	^o C	47	43	41	48	43	42	42.73	0.004	40
4	TDS	mg ^l ⁻¹	3843.00	2233.00	1735.00	2178.00	4751.00	4263.00	3167.16	0.002	3500
5	EC	dsm ⁻¹	7.4	5.7	3.5	9.1	4.8	8.2	6.45	0.001	-
6	pH	mg ^l ⁻¹	7.3	9.5	4.7	6.7	8.4	4.5	6.85	0.000	6 to 9
7	BOD	mg ^l ⁻¹	273.00	375.00	362.00	532.00	536.00	280.00	364.4	0.000	80-250
8	COD	mg ^l ⁻¹	2748.00	1463.00	1562.00	1725.00	2873.00	1437.00	1968	0.009	150-400
9	Phosphate	mg ^l ⁻¹	0.36	0.30	0.25	0.53	0.44	0.45	0.38	0.000	-
10	Nitrite	mg ^l ⁻¹	0.16	0.08	0.26	0.32	0.30	0.51	0.27	0.006	-
11	Iron	mg ^l ⁻¹	2.32	4.72	3.52	4.73	5.84	1.47	3.76	0.003	2
12	Silicate	mg ^l ⁻¹	1.42	0.28	1.53	0.24	1.46	1.02	0.99	0.009	-
13	Hydrogen Sulphide	mg ^l ⁻¹	6.5	7.3	5.8	4.4	11.2	4.5	6.61	0.001	-
14	Residual Chlorine	mg ^l ⁻¹	6.42	3.64	2.87	5.76	7.23	3.34	4.87	0.001	-
15	Carbonates	mg ^l ⁻¹	0.2	1.4	5.7	4.3	6.2	0.5	3.05	0.038	-
16	Sulphates	mg ^l ⁻¹	0.84	0.32	1.12	0.05	1.41	0.53	0.71	0.019	-
17	Lead	mg ^l ⁻¹	4.26	12.43	18.43	11.35	21.34	7.23	17.04	0.005	0.05
18	Cromium	mg ^l ⁻¹	15.74	20.50	11.37	15.35	23.12	16.21	12.50	0.004	1
19	Cadmium	mg ^l ⁻¹	16.48	4.62	8.32	4.60	17.36	12.15	10.58	0.006	0.1
20	Bacterial count	CFU/ml	28×10 ⁵	14×10 ⁵	31×10 ⁵	18×10 ⁵	33×10 ⁵	29×10 ⁵	25.5×10 ⁵	0.000	-

*NEQS – National Environmental Quality Standard (2000).

Conclusion

This study clearly indicates that the effluents from Tirupur textile industries was exceedingly polluted. Hence there is urgent need to follow the affordable Ecofriendly treatment methods before their discharge into the environment for reducing their potential environmental hazards. Strict environmental laws should be enacted by government to restrain this pressure.

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