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PHYSICO-CHEMICAL ANALYSIS OF TEXTILE DYEING EFFLUENTS IN KARUR REGION OF TAMILNADU, INDIA

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ABSTRACT

Pollution is being one of the major problems that lead to a miserable condition in human and aquatic life. Among the many kinds of pollution, at present the most important one is the waste from textile industry which releases the wastewater containing dyes and processing chemicals. In the present investigation, our aim is to evaluate the suitability of the textile effluent samples collected from various textile units of Karur region, for discharge directly into aqueous bodies without treatment. The physicochemical analysis of the untreated textile effluent samples viz., pH, TDS, TSS, BOD5, COD, Total alkalinity, sodium, sulfate, phosphate, chloride and heavy metals concentration viz., chromium, cadmium, copper, iron, nickel, lead and zinc were carried out. It is concluded that the effluent is not be suitable for discharge directly into aqueous bodies without treatment.

KEYWORDS: pollution, dyes, heavy metals, physicochemical, textile effluents.

INTRODUCTION

Industrial effluents, especially textile effluents are creating severe pollution trouble to aquatic environment. 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.[1] The textile industries in Karur region of Tamilnadu state, India is as one of the well-developed industrial zone of the state and producing variety of textile products.[2] In these industries, the organic and inorganic chemicals are being used for bleaching, printing, dyeing, washing and finishing of the products. The water used for preparation of

dyes as well as for the processing, consequently, becomes highly complex in respect of pollution.[3] The wastewater drained to the River Cauvery is expected to act as one of the vital component to cause of the pollution of the River basin and finally marine ecosystem. The impact on the environment by textile industry has been recognized for same time, both in terms of the discharge of pollutants and of the consumption of water and energy. Major pollutants in textile waste waters are high suspended solid and other soluble substance.[4] This study assesses the chemical characteristics of waste waters and the average values of the analyzed parameters for the each collection point in textile wet processing mills of Karur, India.

MATERIALS AND METHODS

The determination of Physico-chemical parameters were carried out using conventional methods while that of heavy metals in the textile effluent sample were analyzed using an Atomic Absorption Spectrophotometer (AAS). A standard method was used for sampling (ISO 5667-01: 1996E). Textile waste water samples were collected in polyethylene bottle from the outlet of textile industries at the point of their discharge from five different textile mill Units. The physicochemical parameters like pH, TDS, TSS, BOD, COD, TA (Total Alkalinity) and ions such as sodium, sulfate, phosphate, chloride, cadmium, chromium, copper, iron, nickel, lead and zinc were analyzed according to Standard Methods (APHA, 1998).

Heavy Metal Analysis

A total of six metallic elements (Cr, Cu, Fe, Pb, Mn and Zn) were determined in the pre-treated samples of water using Atomic Absorption Spectrophotometer.

RESULTS AND DISCUSSION

The results pertaining to various physicochemical characteristics of raw textile effluents collected from different parts of Karur region (Units A, B, C, D and E) are shown in Table 1 where the sample E was collected from effluent storage tank and all other four samples were collected directly at the discharging point before reaching the effluent storage tank. Thus it can be noticed that the results displayed by the sample E is deviated from the trend displayed by the other samples.

Table 1: Physico-chemical characterization of effluent samples from various sites (All, except EC & pH in mg/L)

Sample	Turbidity	Electrical Conductivity	TDS	PH	Alkalinity	Total Hardness	Ammonia	Nitrite	Nitrate	Chloride	Fluoride	Sulphate	Phosphate	Tidys	BOD5	COD
A	20	26002	18202	4.5	4100	11200	0.00	0.692	297	6100	0.40	6.4	0.005	0.08	44	618
B	15	13431	9402	6.6	800	4600	0.00	0.591	160	4300	0.20	9.5	0.008	0.12	102	560
C	8	26801	18760	5.2	5200	11300	0.00	0.533	255	5220	0.20	40.8	0.007	0.2	26	1021
D	7	10867	7607	4.1	2200	4600	0.01	0.453	165	2100	0.50	59.6	0.015	0.36	58	896
E	4	4941	3459	3.8	490	1600	0.02	0.776	279	1250	0.40	135.0	0.010	0.72	84	342

The raw textile effluents were Red, Green, Black and Dark Blue in color and also have fishy and pungent odor. This odor of the effluent will cause nuisance to the public and decline the esthetic value of the environment and surroundings. Moreover, the colorless property of the natural water is an essential factor for the aquatic lives to survive. pH is one of the important biotic factor which serves as an index for the aquatic pollution. pH of the different effluent samples appeared to lie between 3.8 to 6.6 (Table 1). It is observed that only the sample B has pH within the permissible limit, while other samples have lower pH value including the sample E (pH=3.8) which is directly collected from the storage tank. Being acidic in nature, pH of effluents affects physicochemical properties of water which in turn adversely effects aquatic life, plants and humans.[5] The effluent has high levels of solids except in case E (3459 ppm) which was due to high dilution. The Total Dissolved Solids (TDS) were 18202, 9402, 18760, and 7607 mg/L for Sample A, B, C, and D respectively (Table 1).

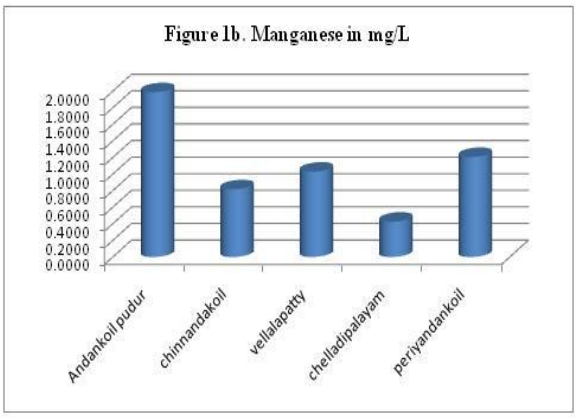
The concentration of COD and BOD5 in the effluents were 618 and 44 mg/L for (Unit A), 560 and 102 mg/L for (Unit B), 1021 and 26 mg/L (Unit C), 896 and 58 mg/L (Unit D) and 342 and 84 mg/L for (Unit E), respectively (Table 1). This indicates that these effluents are hardly degradable and may not undergo more than 50% substrate biodegradation, as it is known that only when COD:BOD5 ratio lies between 2 and 3.5, the organic matter undergoes 50-90% substrate biodegradation.[5] The total alkalinity (TA) of water is the capacity to neutralize acidic nature and the presence of carbonates, bicarbonates and hydroxides are the main cause of alkalinity in the water. The alkalinity values were found to vary from 490 to 5200 mg/L. The concentration of sulfate (SO_4^{2-}) ion in textile effluents were 6.4, 9.5, 40.8, 59.6 and 135.0 mg/L for Sample A B, C, D and E, respectively (Table 1). It is obvious that majority of the samples have permissible limits of sulfate ion. The concentration of phosphate (PO_4^{3-}) ion in textile effluents were 0.005, 0.008, 0.007, 0.015 and 0.010 mg/L for Sample A

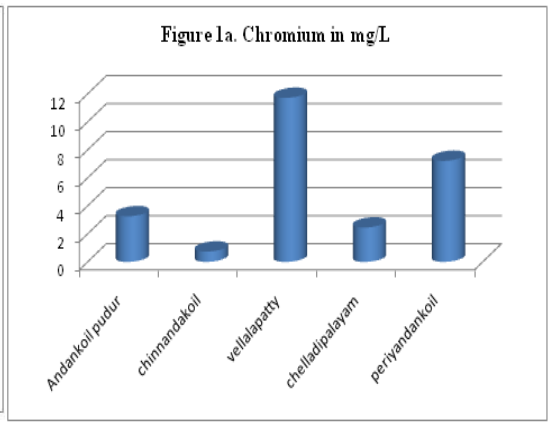
B, C, D and E respectively (Table 1). Phosphate was thus found to be very low. The values of chloride (Cl^{-}) ion in textile effluents were 3100, 4300, 5220, 2100 and 1250 mg/L for Sample A B, C, D and E respectively (Table 1). All the textile Mills effluents have alarmingly high values of chloride contents. High chloride contents are detrimental for aquatic life including micro-organisms and thus not suitable for irrigation purposes.[6]

Table 2: Heavy Metal ion (mg/L) present in effluent at various sites (in mg/L).

Location	Chromium	Zinc	Copper	Lead	Iron	Manganese
A	3	1.02	20.1	0.3	17.8	1.9879
B	1	4.74	7.5	0.1	15.0	0.8165
C	12	2.152	29.74	0.3	9.3	1.0295
D	2	13.03	8.8	0.1	6.4	0.4260
E	7	0.168	23.8	0.2	10.1	1.2069

The mean concentrations of heavy metals in textile effluents samples for Sample A B, C, D and E were 3, 1, 12, 7, and 2 mg/L for Cr; 1.02, 4.74, 2.152, 0.168 and 13.03, mg/L for Zn; 20.1, 7.5, 29.74, 23.8 and 8.8, mg/L for Cu; 0.3, 0.1, 0.3, 0.2 and 0.1 mg/L for Pb; 17.8, 15.0, 9.3, 10.1and 6.4 mg/L for Fe; 1.987, 0.816, 1.029,1.206 and 0.426 mg/L for Mn; (Table 2). Chromium was found to range from 1.00 to 12.00 mg/L (Table 2). Four textile effluents had chromium content above the standard. High concentration of Cr in water is harmful for plant growth includes alterations in the germination process as well as in the growth of roots, stems and leaves.[6] Copper is a common environmental metal it was found to range from 7.5 to 29.74 mg/L (Table 2). Copper is an essential substance to human life, however, in high concentrations, it can cause anemia, liver and kidney damage, stomach and intentional irritation.[7] Iron was found to vary from 6.4 to 17.8 mg/L (Table 2). Five textile mills effluent had Iron content above the NEQS. Water with high Iron content has little effect on aquatic life and irrigation.[8]





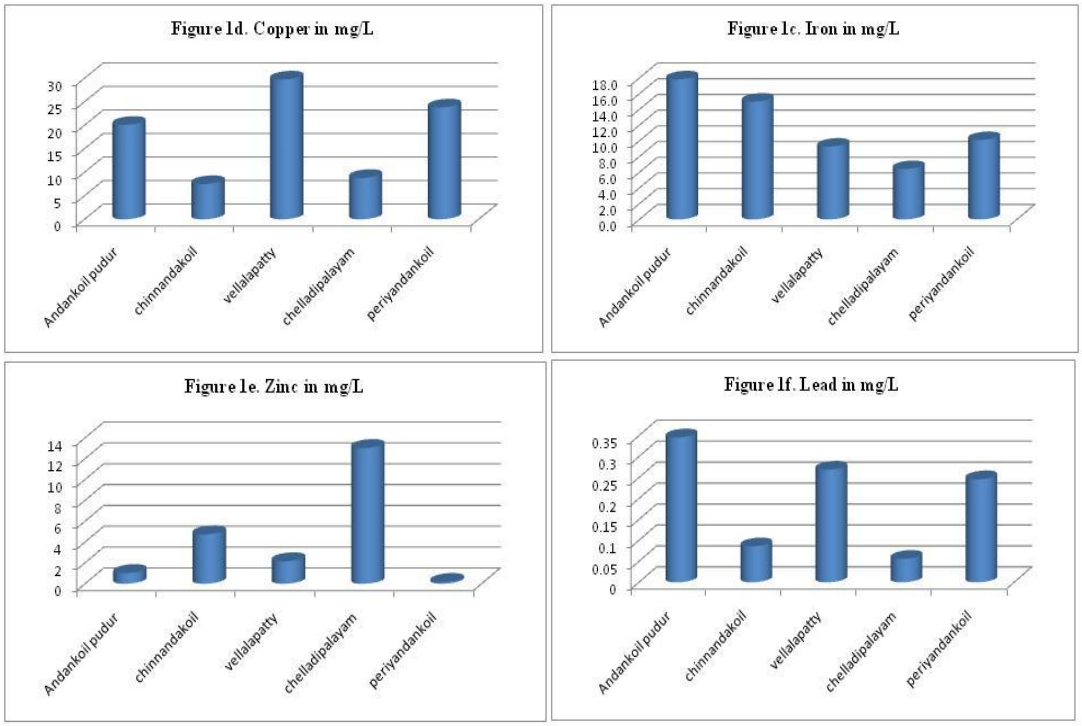


Figure 1: Selected heavy metals present in dyeing effluent.

Lead was found to range from 0.1 to 0.2 mg/L (Table 2). Five textile mills effluent had Lead content above the NEQS. 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.[9] Zinc was found to range from 0.168 to 13.03 mg/L (Table 2). All five textile effluent samples have the zinc content under the NEQS. High concentration of zinc in water is most harmful to aquatic life during early life stages.[10]

CONCLUSION

The effluents from the study area are with high degree of alkalinity, COD, and BOD5. Heavy metal concentration and TDS are considerably higher than the standards stipulated by the governmental authorities and set by the National Environment Quality Standard (NEQS). Based on these observations, it is concluded that the effluents are not suitable for discharge directly into aqueous bodies without treatment. It is consequently recommended that the effluents from the textile industry should be treated before being disposed into the water bodies. Further investigation is required on treatment of textile effluents. Moreover, analysis of the wastewater and its impacts on human livestock has to be studied in detail after the treatment.

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