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Full Length Research Paper

Physico-Chemical Analysis and Heavy Metals Concentration in Textile Effluent in Karachi Region of Pakistan

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Pollution is an important problem in human and aquatic life that leads to a miserable condition. There are many kinds of pollution but textile industry is mainly by the release of wastewater containing dyes and chemicals, coming out from wet processing like de-sizing, scouring, bleaching, mercerizing, dyeing, printing and finishing. In present investigation, the physico-chemical analysis and heavy metals concentration are pH, TDS, TSS, BOD_5, COD, Total alkalinity, sodium, sulfate, phosphate, chloride, chromium, cadmium, copper, iron, nickel, lead and zinc were found within the permissible limits. Concentrations of all these metal ions in the effluent were above the recommended NEQS. The effluent samples were evaluated to ascertain the efficiency of industries wastewater treatment process. Conventional methods were employed for determination of physico-chemical parameters while; heavy metals in the textile effluent sample were analyzed using an Atomic Absorption Spectrophotometer (AAS).

Keywords: Pollution, physicochemical, textile effluents, analysis.

INTRODUCTION

The textile industries in Karachi region of Pakistan considered as one of the well developed industrial zone of the country and produced varieties of product. For this purpose both the organic and inorganic chemical are being used for bleaching, printing, dyeing, washing and finishing of the products. In this connection the use of water is quite extensive both for preparation of dyes of organic and inorganic nature and washing of the products. Consequently the waste water becomes highly complex in respect of pollution of both organic and inorganic nature and is being drained through river of Lyari, Malir and manmade channel on the beaches of Karachi, Pakistan, without any treatment (S.M.Imtiazuddin et al., 2012). The drain water and solid effluents are ultimately added into the beaches ecosystem of Karachi, Pakistan. The pollutant to the beaches, in addition to other sources and are expected to act as one of the vital component to cause of the pollution of the marine ecosystem and the marine biota.

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 (Lacasse and Baummann, 2006).

Major pollutants in textile waste waters are high suspended solid and other soluble substance (Venceslau et al., 1994, world Bank, 2007).

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 Karachi, Pakistan.

MATERIALS AND METHODS

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. All reagents used were of analytical grade. The Milli-Q Integral Water Purification System was used for purification of water.

Twenty samples were collected from five different textile mills at the point of their discharge. The samples

Table 1: Physico-chemical characterization of effluent samples from various sites.

Sites	pH	TDS (mg/L)	TSS (mg/L)	COD (mg/L)	BOD_5 (mg/L)	TA (mg/L)
Mill-1	11.87±0.603	2896±299.2	2592±907.04	1072±294.53	1189±206.73	1096±127.07
Mill-2	10.23±0.404	2365±267.1	1843±218.22	805±85.52	1060±66.56	1199±166.33
Mill-3	9.00±0.624	1593±246.8	1340±335.63	657±71.80	859±111.92	1155±116.21
Mill-4	10.10±0.361	2149±145.9	1581±160.17	710±93.40	1031±82.73	1323±241.86
Mill-5	9.97±0.651	2534±803.6	2599±542.48	731±109.51	1052±131.78	1292±129.80

Table 2: Inorganic elements present in effluent at various sites**.**

Sites	Sodium (mg/L)	Sulfate (mg/L)	Phosphate (mg/L)	Chloride (mg/L)
Mill-1	20.67±2.79	18.38±1.88	2.161±0.21	1460±86.45
Mill-2	27.70±1.99	15.03±1.28	2.590±0.904	1818±228.5
Mill-3	18.01±1.46	8.82±1.41	1.790±0.38	1169±64.33
Mill-4	12.66±4.64	13.51±1.70	1.834±0.58	1916±148.5
Mill-5	18.19±0.55	10.58±0.63	1.100±0.06	1359±179.0

were also collected from different department like bleaching, dyeing, printing, washing finishing. 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).

Metal Analysis

A total of seven metallic elements (Cd, Cr, Cu, Fe, Ni, Pb and Zn) were determined in the pre-treated samples of water using Atomic Absorption Spectrophotometry as described by (Gregg, 1989).

RESULTS AND DISCUSSION

The results pertaining to various physicochemical characteristics of textile effluents are shown in Table 1. pH of different effluent samples appeared to lie between 9 to 11.87. It is obvious that only bleaching and mercerizing samples have pH within the permissible limit, while other samples have higher pH values especially in mixed effluents. These results are in accordance with the result of (Junkins, 1982) who reported that the textile wastes are highly alkaline. Effluents of other textile dyes industry showed similar pH trend, as seen in the present study, being alkaline in nature, pH of effluents effects physicochemical properties of water which in turn adversely effects aquatic life, plants and humans (Gupta et al., 1992, Gowrisankar et al., 1997).

The effluent has high levels of solid. The Total Dissolved Solids (TDS) and Total Suspended Solids (TSS) were 2896, 2365, 1593, 2149 and 2534 mg/L for (Mill-1), (Mill-2), (Mill-3), (Mill-4) and (Mill-5) and 2592, 1843, 1340, 1581 and 2599 mg/L for (Mill-I), (Mill-2), (Mill-3), (Mill-4) and (Mill-5), respectively (Table 1). The higher values of TDS and TSS are one of the major sources of domestic activities going on at that point.

The concentration of COD and BOD_5 in the effluents were 1072 and 1189 mg/L for (Mill-1), 805 and 1060 mg/L for (Mill-2), 657 and 859 mg/L (Mill-3), 710 and 1031 mg/L for (Mill-4) and 1052 and 1292 mg/L (Mill-5), respectively (Table 1). This indicates that these effluents are high in recalcitrant and hardly degradable components and may not undergo more than 50% substrate biodegradation, as it is known that organic matter with 50-90% substrate biodegradation has a COD:BOD_5 ratio between 2 and 3.5 (Quano et al., 1978).

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 are found to vary from1096 to 1323 mg/L.

The concentration of sodium ion in textile effluents were 20.67, 27.70, 18.01, 12.66 and 18.19 mg/L for (Mill-1), (Mill-2), (Mill-3), (Mill-4) and (Mill-5), respectively (Table 2). The results have permissible limits of sodium ions.

The concentration of sulfate (SO_4^{2-}) ion in textile effluents were 18.38, 15.03, 8.82, 13.51 and 10.58 mg/L for (Mill-1), (Mill-2), (Mill-3), (Mill-4) and (Mill-5), respectively (Table 2). 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 2.161, 2.590, 1.790, 1.834 and 1.160 mg/L for (Mill-1), (Mill-2), (Mill-3), (Mill-4) and (Mill-5), respectively (Table 2). Phosphate was found to be

Table 3: Heavy Metal ion (mg/L) present in effluent at various sites

Sites	Cd	Cr	Cu	Fe	Ni	Pb	Zn
Mill-1	0.089±0.014	0.175±0.073	0.249±0.065	0.256±0.090	0.274±0.094	0.137±0.053	0.125±0.023
Mill-2	0.074±0.014	0.927±0.179	0.795±0.609	0.159±0.025	0.241±0.099	0.131±0.038	0.101±0.029
Mill-3	0.129±0.040	0.873±0.040	0.063±0.029	0.162±0.032	0.162±0.024	0.175±0.091	0.146±0.054
Mill-4	0.045±0.0183	0.165±0.033	0.247±0.047	0.296±0.078	0.134±0.047	0.147±0.034	0.077±0.016
Mill-5	0.123±0.080	0.123±0.080	0.308±0.021	0.438±0.021	0.133±0.035	0.121±0.027	0.121±0.022

positively correlated with effluent.

The values of chloride (Cl^-) ion in textile effluents were 1460, 1818, 1169, 1485 and 1359 mg/L for (Mill-1), (Mill-2), (Mill-3), (Mill-4) and (Mill-5), respectively (Table 2). All the textile Mills effluents had alarmingly high values of chloride contents. High chloride contents are harmful for metallic pipes as well as for agricultural crop if such wastes containing high chlorides are used for irrigation purposes. Moreover, high chloride content also kills some micro-organisms which are important in food chain of aquatic life (Kumar, 1989).

The mean concentrations of heavy metals in textile effluents samples for (Mill-1), (Mill-2), (Mill-3), (Mill-4) and (Mill-5) were 0.089, 0.074, 0.129, 0.045 and 0.123 mg/L for Cd; 0.175, 0.927, 0.873, 0.165 and 0.123 mg/L for Cr; 0.249, 0.795, 0.063, 0.247 and 0.308 mg/L for Cu; 0.256, 0.159, 0.162, 0.296 and 0.438 mg/L for Fe; 0.274, 0.241, 0.162, 0.134 and 0.133 mg/L for Ni; 0.137, 0.131, 0.175, 0.147 and 0.124 mg/L for Pb; 0.125, 0.101, 0.146, 0.077 and 0.121 mg/L Zn.

Cadmium was found to range from 0.045 to 0.129 mg/L (Table 3). Cadmium content was found to be above the NEQS from all the textile effluent analyzed. Cd has a range of negative physiological effects on organism, such as decreased growth rate and negative effects on embryonic development (Newman and Melntosh, 1991).

Chromium was found to range from 0.123 to 0.927 mg/L (Table 3). Five textile mills effluent had chromium content above the NEQS. 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 (Arun K., et al. 2005).

Copper is a common environmental metal it was found to range from 0.063 to 0.795 mg/L (Table 3). Five textile mills effluent had copper is an essential substance to human life, however, in high concentrations, it can cause anaemia, liver and kidney damage, stomach and intentional irritation (Turnland, 1988).

Iron was found to vary from 0.159 to 0.438 mg/L (Table 3). Five textile mills effluent had Iron content above the NEQS. Water with high Iron content has little effect on aquatic life and irrigation (Oram, 2011).

Nickel was found to vary from 0.133 to 0.274 mg/L (Table 3). Five textile mills effluent had nickel content above the NEQS. Nickel were spatially and temporary high in the water samples. Nickel limiting levels were exceeded could be said to be contaminated by nickel. Long term exposure can cause decreased body weight, heart and liver damage and skin irritation.

Lead was found to range from 0.121 to 0.175 mg/L (Table 3). 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 (Oancea S. et al., 2007).

Zinc was found to range from 0.077 to 0.146 mg/L (Table 3). All five textile mills effluents among the zinc content under the NEQS. High concentration of zinc in water is most harmful to aquatic life during early life stages. Again water with relatively high zinc content is non toxic to plants birds and animals (Eisler R. 1993)

CONCLUSION

The current study has shown that textile industries of Karachi region discharges effluents with high degree of alkalinity, COD, and BOD_5, heavy metal concentration, TDS, TSS. Most of the textile industries effluents were found to be quite higher than the recommended values set by the National Environment Quality Standard (NEQS). It is therefore recommended that the effluent from the textile industry should be treated before being disposed into the water bodies. Further investigation is required on the quality of textile effluent and its impacts on human livestock and agricultural health where it is used.

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