Pollutants of Wastewater Characteristics in Textile Industries

S.M. Imtiazuddin[1,*], Majid Mumtaz[1] and Khalil A. Mallick[2]

[1]*Department of Chemistry, University of Karachi, Pakistan*

[2]*Department of Geology, University of Karachi, Pakistan*

Abstract: Textile Industry is one of the most important and largest industrial sectors in Pakistan. It has a high importance in terms of its environment impact, since it consumes large quantity of textile industrial processed water and produces highly polluted discharge water. The textile industry uses high volume of water throughout its operation, from the washing of fibers to bleaching, mercerizing, dyeing, printing and washing of finished products. A process data collection was performed and integrated with a characterization of the process effluents in terms of treatability and reusability. In order to evaluate properly the wastewater loading, on analysis course was set. The samples were collected during four months period of time i.e. November, December, January and February 2009-2010 from the seven samples were collected from different textile mills and analyzed for various parameters such as Total Dissolved Solids(TDS), Chemical Oxygen Demand(COD), Biochemical Oxygen demand(BOD), pH, Electrical Conductivity(EC), and heavy metals like Cadmium(Cd), Chromium(Cr), Copper(Cu), Iron(Fe), Manganese(Mn), Nickel(Ni), Potassium(K), Phosphorous(P), Sodium(Na), Sulphur(S), Zinc(Zn) were found in within the limits. Concentrations of all these metal ions in the effluent were above the recommended NEQS. It was therefore concluded that textile effluents were highly polluted.

Keywords: Textile wastewater, pollutant, analysis.

INTRODUCTION

The textile industries of Karachi Pakistan region are considered as one of the well developed industrial zone of the country and produces varieties of products. For this purpose both the organic and inorganic chemical are being used for bleaching, coloring, designing and also for the 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 rivers, Layari, Malir and manmade channels on the beaches of Karachi without any treatment [1]. 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 components to cause of the pollution of the marine ecosystem and the marine biota. The polluted water flowing through the channels also pollute the ground water due to penetration effect in the rocks and the soil of the outlet streams.

It is the time of realization that the environmental pollution caused by textile wastes significantly effects of the health of flora and the general health of the residents of the area or the peoples using marine foods. The inorganic heavy metals, like Cd, Cu, Cr, Fe, Mn, Ni, Zn in ionic salts are directly absorbed by the marine and fresh water biota or are incorporated in ground water in both cases i.e. the polluted ground water and the marine foods which are being used extensively by human being may lead to the diseases like cancer, tumor, brain diseases, psychiatric diseases, sexual diseases etc. [2,12]. Like wise the toxic dyes and pigments of organic nature, such as C.I. Pigment Yellow-12 (3,3-dichloroBenzedine), C.I. Disperse Yellow-7 (P-Amino azobenzene), C.I. Direct Yellow-1 (Benzedine) etc. salt ,acid, alkalis', bleaching and finishing agent are also highly harmful and effect the health of biota to a great extent. The effects of the pollutants may not be quite evident immediately but with the passage of time their imperceptible effects are of fatal nature [3].

MATERIALS AND METHODS

Ten samples were collected from different textile mills at the point of their discharge. These samples were collected from different sections like desizing, bleaching, mercerizing, dyeing, printing and finishing [13]. The samples were analyzed for various physicochemical parameters like, TDS, pH, EC, BOD, COD and TSS [4].

A standard method was used for sampling (ISO 5667-02:1996 E). Textile wastewater samples were collected in polyethylene bottles at the outlet.

Standard analytical methods were used for the determination of 19 chemicals and physicochemical

*Address corresponding to this author at the Department of Chemistry, University of Karachi, Pakistan; E-mail: simtiazuddin@yahoo.com

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Table 1: Specific Pollutants from Textile Wet Processing

Process	Various Pyhsico-chemicals
Desizing	Enzymes, Starch, Waxes, CMC
Bleaching	H_2O_2, Sodium Silicate, Organic Stabilizer, Surfactant
Mercerizing	NaOH, Cotton Wax
Dyeing	Dyes, Salts, Surfactant, Urea, Soda Ash,
Printing	Urea, Dyes, Pigments, Binder, Soda Ash, Thickener
Finishing	Resins, Formaldehyde, PVA, Waxes, Hydrocarbon

variables. All reagents were analytical grade. The milli-Q system was used for purifying the water.

Textile effluent sample were preserved for analysis of heavy metals (Cd, Cr, Cu, Fe, N, Mn and Zn) by acidification with concentration HNO_3 (1.5ml HNO_3/l) of solution and then stored at 5^{o}C till analyzed.

Metal Analysis

All the seven metals were analyzed by Solar Unicam atomic absorption spectrophotometer using Air-Acetylene flame, as recommended by [5]. The detectable limits for the various metals were 0.05mg/l (Cu), 0.01mg/l (Cd), 0.04mg/l (Cr), 0.25mg/l (Fe), 0.13mg/l (Mn), 0.3mg/l (Ni), 0.004mg/ (Zn). Sodium (Na), Potassium (k), Sulphur(S), Phosphorous (P), were analyzed using a flam photometer.

Physicochemical Analysis

Electrical conductivity (EC), Total Dissolved Solids (TDS), temperature, pH, Chemical Oxygen Demand (COD), Biochemical Oxygen (BOD) [6]. Total Suspended Solids (TSS), were carried out according to standardized methods [7].

RESULTS AND DISCUSSION

The effluents characteristics need to be properly monitored for better environmental protection. All the textile mills had their effluents having temperatures between 36.0^{o}C to 49.2^{o}C given by Table **2** which are higher then the set limit by the NEQS [8]. National Environmental Quality Standards the pH value 7.5 to 11.55 the effluents were alkaline in nature [9]. Total Suspended Solids (TSS) were extremely high upto 934mg/l at Mill number 2 and 4, whereas Total Dissolved Solid (TDS) were high at Mill number 3 and 5, Biochemical Oxygen Demand (BOD) levels at various mills were 85.35mg/l to 653.75mg/l. Chemical Oxygen Demand (COD) levels at various mills were 115.66mg/l to 705.25mg/l [10,11]. Heavy metals concentrations were higher than the NEQS limits in the textile effluents shown in Table **3**. Effluents sample had copper levels range between 0.07-5.14mg/l as against NEQS less than 1.0mg/l limit. While chromium was range between 0.42mg/l to 1.86mg/l, Mill number 2, 3 and 5 has high concentration of 1.86mg/l, 1.66mg/l and 1.05mg/l, NEQS limits is 1.0mg/l. In seven of the textile effluents similarly Mangnese (Mn), Iron (Fe), Zinc (Zn) and Cadmium (Cd), concentration are within the NEQS limits except Mill 5 and 7.

Table 2: Physico-Chemical Characterization of Textile Mills Effluents

Parameters	NEQS	Mill-1	Mill-2	Mill-3	Mill-4	Mill-5	Mill-6	Mill-7
pH Value	6 - 9	7.5	8.6	9.5	10.4	11.5	10.6	11.3
Temperature	Upto 40^o C	36	36.6	39.7	38.3	49.2	45.0	42.5
TSS	Upto 200 mg/l	934	1875	1619	1236	954	1159	1050
TDS	Upto 3500 mg/l	2469	5408	6481	4868	7295	4025	3687
EC	400 mS/cm	295.3	282.4	175.7	196.3	345.0	320.1	256.5
BOD	Upto 80 mg/l	125.55	185.35	653.75	156.50	312.61	262.54	220.30
COD	Upto 150 mg/l	115.66	612.16	431.61	251.25	705.25	342.21	342.24

Table 3: Heavy Metals Concentrations in Textile Mills Effluents

Metals	NEQS	Mill-1	Mill-2	Mill-3	Mill-4	Mill-5	Mill-6	Mill-7
Cd	0.1 mg/l	0.001	0.001	N.D	0.05	0.18	0.08	0.15
Cr	1.0 mg/l	1.53	1.86	1.66	1.20	1.05	1.12	1.32
Cu	1.0 mg/l	0.07	1.37	5.14	2.66	4.51	3.33	1.96
Fe	2.0 mg/l	1.08	1.16	1.86	2.00	2.61	1.88	3.11
Ni	1.0 mg/l	0.75	0.96	1.00	0.66	1.21	0.82	1.53
Mn	1.5 mg/l	1.31	1.10	0.95	0.88	1.85	1.16	1.65
Zn	5.0 mg/l	2.36	3.21	4.65	4.55	6.03	4.95	5.85

CONCLUSION

The results can be used as starting points in order to design the sewage network and to ensure its protection in case of the joint effect of some toxic and corrosive pollutant agents. Certain pollutants in textile wastewater are more important to target for pollution prevention. The large volumes of wastewater generated also contain a wide variety of chemicals used throughout processing. These can cause damage if not properly treated before discharge to the environment. The aquatic toxicity of textile industry wastewater varies considerably among production facilities. The sources of aquatic toxicity can include salt, surfactants, ionic metals and their metal complexes, toxic organic chemicals, biocides and toxic anionic. Most textile dyes have low aquatic toxicity. Wastewater in bleaching, mercerizing, dying, printing and finishing sectors required separate treatment which can decrease the concentration of polluting agents.

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