Assessment of Textile Industrial Effluent by Wastewater Quality Standards

Aijaz Panhwar[1]*, Khalida Faryal[2], Aftab Kandhro[3], Sofia Qaisar[1], Siraj ul Haqi[1], Zainulabdin Solangi[1], Mudasir Gorar[4]

[1]Pakistan Council for Scientific and Industrial Research, Karachi, Sindh, Pakistan
[2]Institute of Environmental Sciences, University of Sindh, Jamshoro, Pakistan
[3]M.A. Kazi Institute of Chemistry, University of Sindh, Jamshoro, Pakistan
[4] Government Degree College Mehar, Education Departments,, Sindh, Pakistan
Corresponding author email: aijazap@yahoo.com

ABSTRACT

The current study was initiated to examine the effects of highly polluted pollution by the textile industry in the textile industry of Karachi, Pakistan. During the study the focus was on physico-chemical parameters for example temperature, color, pH, total hardness, BOD, COD, TDS, TSS, turbidity, alkalinity, Cl, CO_3, HCO_3, Mg, Ca, Ma, K, NO_3, PO_4 and fats and oils. Thirty samples of wastewater were collected from ten different fabric mills and analyzed three times. Pollution was heavily polluted by high levels of COD, BOD, TDS, Cl, and TSS. The effects of fabric contamination were compared with NEQS & PEPA. The tested parameters exceed the permissible limits without pH. Samples were collected over a four-month period (November-February 2017-2018). The two old Karachi Lyari rivers and the River are heavily polluted by industrial effluent; the fabric contributes significantly to the pollution of the water and ultimately without the release of a cure in the Arabian Sea. It was concluded that the textile industry's pollution was significantly higher than the NEQS limits, It is advised that the contaminant should not be spilled directly into surface water without proper treatment.

Keywords: BOD, COD, Pollution, River, Wastewater.

INTRODUCTION

Fabric, after eating, is an important necessity of human life. The textile industry is comprises of three core groups: cellulose fibers (cotton), protein fibers and artificial fibers (polyester, nylon). The textile industry contributes an average of 8.5% to GDP, 60% of exports, 46 and 40% to manufacturing workers and industries respectively. The textile industry is a major consumer of industrial water, as well as a producer of wastewater. The growing demand for textile products ultimately increases the production of

wastewater, making the textile industry a major source of serious pollution problems worldwide [1, 2]. Approximately 2270 liters of water is needed to complete the production of fabrics less than 10 meters. The vast majority of water used is about 90% considered to be wastewater [3]. The process of adding color to fiber is known as dyeing which usually requires a large amount of freshwater during the complete different steps. The dyeing process uses of various chemicals around 8000 including surfactants, sulphide, heavy metals, and formaldehyde salts etc [4]. The sector is key accountable for polluting of resources water by dumping into surface water bodies where the species die at an alarming rate [5, 6]. The two old Karachi Lyari rivers and the River are heavily polluted by industrial effluent; the fabric contributes significantly to the pollution of the water and ultimately without the release of a cure in the Arabian Sea. Fabric stain is high in color and high in salt; they contain non-perishable compounds and are high in BOD & COD. Many researchers have suggested that the presence of certain metals and other dyes may suppress bacterial activity; and may interfere with other functions in the biological treatment process [7]. In fabric waste water solid solids and fiber residues are BOD binding [8]. Solid solids and fiber residues produce contaminated water with oils & oils and waxes, while the variants may include heavy metals Cr, Cu, Zn and Hg [9]. Wastewater produced by various industries is linked to the burden of congenital diseases (WHO, 2000 and 2002). Hydrogen sulfide is also formed under conditions of oxygen deficiency in the presence of organic matter and sulfur. This may be a possible cause of the high sulfide level measured in the treated wastewater. High BOD levels are indicators of wastewater pollution. It also indicates that there may be low levels of organic matter in polluted water where organisms are present. Higher levels of COD indicate toxicity and the presence of biologically resistant organisms [11].

Table 1. List of some of the waste materials generated at each level of cotton textile processing [12]

Process	**Wastewater Generation**
Fiber preparation	Little or no wastewater generated.
Yarn spinning	Little or no wastewater generated.
Slashing/sizing	BOD, COD, metals, cleaning waste.
Weaving	Little or no wastewater generated.
Tufting	Little or no wastewater generated.
Desizing	BOD from water sizes, synthetic size, etc.
Scouring	Insecticide residues; detergents, fats, oils; pectin, wax, knitting lubricants, solvents.
Bleaching	Sodium silicate, H2O2, organic stabilizer; high pH.
Singeing	Little or no wastewater generated.
Mercerizing	High pH, Sodium hydroxide.
Dyeing	Metals; salt; color; BOD; sulfide; acidity/alkalinity; spent solvents.
Printing	Suspended solids, urea, solvents, color, metals, heat, BOD, foam.

Finishing	BOD, COD, suspended solids, toxics, used up solvents.

MATERIAL AND METHODS

Experimental Instrumentations

Table 2. Methodology of the study using standard procedures [19]

Parameters	Results	Instruments
pH	1-14	pH Meter
Total Dissolve Solids (TDS)	ppm	Gravitational Method
Total Suspended Solids (TSS)		Standard method
Dissolve Oxygen	ppm	D.O. Meter, Hanna, U.K,
Electrical Conductivity	(µs/cm)	Conductivity meter WTW LF 330/SE
Chemical Oxygen Demand	ppm	Hach digestion device (Model: DRB200: Digital Reactor Block) and Hach spectrophotometer (Model: DR 3900 Benchtop spectrophotometer)
Biological Oxygen Demand	ppm	BOD5 Track Method
Chlorides	ppm	Standard Titration Method
Nitrate	ppm	UV/Visible spectrophotometer, Perkin Elmer Lambda 2
Phosphate	ppm	UV/Visible spectrophotometer, Perkin Elmer Lambda 2

Reagents and glasswares

Pure water was obtained by the Milli purifier system and was used throughout the study. All chemicals used in the analytical reagent range are E. Merck. Samples are composed of Concentrated HNO_3 and H_2O_2. Standard operating solutions were adjusted quickly from stock levels; and stored at -4 ° C until needed to be analyzed. Plastic and glass were cleaned by immersing in 2M HNO_3 solution overnight.

Sample and its preparation

Disposal samples are collected in plastic bottles cleaned from their source and placed under physico-chemical boundaries using standard procedures [13, 14]. As a moral obligation, the names and addresses of the mill are hidden in this article. Samples are collected from the air in solid plastic sample bottles and placed in an ice box to preserve the natural characteristics of the waste disposal. All common protocols and procedures are used for the collection, transport, storage and chemical analysis of samples [13, 14].

Measurement of Physico-chemical parameters

The purpose of this study was to measure various physical parameters such as pH, turbidity, temperature, color, odor, EC, TDS, TSS, COD, BOD, DO, Cl, SO_4, NO_3 and oils & grease, by standard methods [15].

Software used:

MS office Excel software used for results.

RESULTS & DISCUSSION

Table 3. Results of the physicochemical parameters of textile wastewater

Parameters	Units	T-1	T-2	T-3	T-4	T-5	T-6	T-7	T-8	T-9	T-10
COD	mg /l	4056	3968	3874	1002	3860	3790	1800	2200	3811	3701
BOD	mg /l	1876	1745	1702	388	1910	1880	850	980	1882	177
pH	1-14	8.1	7.6	7.3	6.2	7.9	7.8	9.0	9.8	7.9	8.0
TDS	mg /l	4198	3972	3792	1140	4080	4170	5600	6800	4120	4099
TSS	mg /l	188	173	156	120	180	170	900	1100	210	182
EC	µS/cm	9140	8780	7056	2640	8870	9054	11200	13600	8330	8901
Alkalinity	mg /l	245	196	120	20	243	194	373.1	590.4	260	240
Hardness	mg /l	259	203	137.8	233.5	229.8	174	144	123.5	241	232
Ca	mg /l	74	58	42	4.9	64	48	18	12	70	68
Mg	mg /l	18	14	8	2.7	17	13	28	18	16	15
Chloride	mg /l	8650	7890	7430	260	8550	7790	1525	1632	7651	8150
Na	mg /l	340	260	220	180	330	250	885	110	315	352
K	mg /l	1.5	1.2	1.1	2.5	1.4	1.1	11	13	02	04
HCO_3	mg /l	299	239	146	24	289	229	455	720	290	280
CO_3	mg /l	ND	ND	ND	ND	ND	ND	120	120	ND	ND
Oil & grease	mg /l	22	16	14	ND	21	15	ND	ND	20	20
Nitrate	mg /l	3.86	4.39	3.88	8.70	12.10	16.90	19.31	19.61	9.21	2.25
Phosphate	mg /l	10.9	9.15	65.5	14.4	35.1	82.1	101.0	27.5	87.0	30.31

The physico-chemical parameters of the contaminated textile material are presented in table 3. Estimated pH values 6.2 to 9.80. All impurities were naturally alkaline and within the limits of the NEQS except sample -8. TSS was the highest of all samples at 1100 mg / l, in sample number 8, while TDS was highest at 6800 mg / l, BOD level was up to 1910 mg / l, all samples were above limits. COD levels in various mills were up to 4056 mg / l, much higher than the permissible limit. The chloride concentration was above the NEQS limits in contaminated water at 8650 mg / l. Contaminated water samples had oil and oil levels between 14 mg / l to 22 mg / l compared to the NEQS limit of 10mg / l, while Ec was between

2640 mg / l to 13600 mg / l is very high compared to the NEQS limits. The maximum concentration observed at alkalinity 20 mg / l mg / l up to 590 mg / l, no alkaline limit is defined in the NEQS. The strength was 123 mg / l to 259 mg / l. Ca readings were 4.9 mg / l to 74 mg / l, Mg results were 2.7 mg / l to 18 mg / l, Na readings were marked 110 mg / l to 885 mg / l, Potassium results were 1.1 mg / l to 13 mg / l, results of CO_3 sample were 24 mg / l to 720 mg / l, Carbonate was 120 mg / l, Nitrate effects were 3.86 mg / l to 19.61 mg / l, Nitrite detection was observed 2.40 to 35.90, PO4 readings were 9.15 mg / l to 87 mg / l.

CONCLUSION

From this study, it concludes that the physicochemical parameters studied such as pH, TDS, Ec, TSS, COD, BOD, SO_4, Cl, the effects of the findings were significantly higher than the NEQS limits. Textile wastewater results indicate that it is responsible for depletion of DO. Higher COD, BOD, TDS, TSS, Chloride levels, are threat to environment and need to be carefully monitored to better protect the environment. Also should be focus and priority on the use of environmentally friendly chemicals and processes that require a small amount of clean water. Strict monitoring for pollution reduction should be implemented to protect the environment.

REFERENCES

[1] Asia I.O., Oladoja N.A. and Bamuza-pemu E.E. (2006). Treatment of Textile Sludge using anaerobic technology, African Journal of Biotechnology, 18:5, 1678–1683.

[2] Andre dos B.S., Francisco J.C. and Jules van B.L. (2007). Review paper on current Technologies for decolourisation of textile wastewaters: Perspectives for anaerobic Biotechnology, Bioresource Technology, 98, 2369–2385.

[3] Islam, M., Mahmud, K., Faruk, O., and M. S., & Billah, M. (2011). Textile Dyeing Industries in Bangladesh for Sustainable Development, International Journal of Environmental Science and Development, 2:6, 428-436.

[3] Khataee A.R. and Kasiri M.B. (2010). Photocatalytic degradation of organic dyes in the presence of nanostructured titanium dioxide: Influence of the chemical structure of dyes, Journal of Molecular Catalysis (A: Chemical) 328, 8-26.

[4] Hanif, M.A., R. Nadeem, U. Rashid and M.N. Zafar (2005). Assessing pollution level in effluents of industries in city zone of Faisalabad, Pakistan. Journal of Applied Sciences, 5, 1713–1717. DOI:

10.3923/JAS.2005.1713-1717.

[5] Nese T., Nuket S., İsmail T. (2007). Pollutants of Textile Industry Wastewater and Assessment of its Discharge Limits by Water Quality Standards, Turkish Journal of Fisheries and Aquatic Sciences 7, 97-103.

[6] Wynne, G Maharaj, D. and Buckley, C. (2001). Cleaner Production in the Textile Industry- Lessons from the Danish Experience, School of Chemical Engineering, University of Natal, Durban, South Africa, 3, 17-22.

[7] Environmental Protection Authority (1998). Environmental Guidelines for the Textile dyeing and Finishing Industry, State Government of Victoria, Melbourne, Victoria, Australia.

[9] Pakistan Environmental Protection Agency (PEPA, 2000). National Environmental Quality Standards, Registered No. M-302, L-7646, Part-II, Annex-I, 1291-92.

[10] WHO, (2002). Water Pollutants: Biological Agents Dissolved Chemicals, Non-dissolved Chemicals, Sediments, Heat, WHO CEHA, Amman, Jordan.

[11] P. Manikandan1, P. N. Palanisamy, R. Baskar, P. Sivakumar and P. Sakthi sharmila (2015). Physico Chemical Analysis of Textile Industrial Effluents from Tirupur City, Tn, India. International Journal of Advance Research in Science and Engineering, 4:2.

[12] Babu B. R., Parande A. K., Raghu S. and Kumar T. P. (2007). Cotton textile processing: waste generation and effluent treatment. The Journal of Cotton Science, 11, 141-153.

[13] Aftab K., Ali D., Aijaz P., Beena N., Gulzar HJ., Sheikh K., Sofia Q., Tahir A. (2011). Determination of different trace and essential element in lemon grass samples by x-ray fluorescence spectroscopy technique International Food Research Journal, 18: 265-270.

[14] Aftab Kandhro, Razia Begam, Aijaz Panhwar, Tooba Haq, Niaz Memon and Alia Bano (2013). Determination of Physicochemical Parameter and Treatment of Sugar Mill Effluents. Pakistan Journal of Scientific and Industrial Research (Series A: Physical Science), 56:3 176-179.

[15] American Public Health Association, NY. Washington DC. pp 2-172. APHA, (1995). Standard Methods for the Examination of Water and Wastewater.

[16] ASTM International, Annual Book of ASTM Standards (2003). Water and Environmental Technology, v. 11.01, West Conshohocken, Pennsylvania.

[17] National Environmental Quality Standards 2001.

[18] Talarposhti A.M., Donnelly.T and Anderson G.K. (2001). Colour removal from a simulated dye wastewater using a two- phase anerobic packed bed reactor, Water Research, 35, 425-432.

[19] Aijaz Panhwar, Aftab Kandhro, Nusrat Jalbani, Khalida Faryal, M. Saffar Mirjat, Gulzar H. Jhatial, Sofia Qaiser (2019). Assessment of Groundwater Quality Affected by Open Dumping Site in Hyderabad Pakistan. International Journal of Environmental Chemistry, 5:1.