

ASSESSMENT OF SOME PHYSICO-CHEMICAL CHARACTERISTICS OF TEXTILE WASTEWATER OBTAINED FROM LAGOS, NIGERIA.

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Abstract

Wastewater discharges from two textile industries in Lagos (Nigeria) were analyzed for some pollution characteristics such as temperature, pH suspended solids (SS), total solids (TS), permanganate value (PV), biochemical oxygen demand (BOD) and chemical oxygen demand (COD). For the first textile industry the range of values for the above named characteristics were: Temperature (29.10 - 33.50)⁰C, pH (9.25 - 11.18), SS (506.50 - 663.20) mg/l, TS (5157.50 - 6930.30) mg/l, PV (528.70 - 728.60) mg/l, BOD (646.10 - 880.00)mg/l, and COD (2190.00 - 2984.00)mg/l. Also for the second industry range of values were: Temperature (31.40 - 41.80) ⁰C, pH (9.22 - 11.60), SS (455.60 - 684.90) mg/l, TS (5099.20 - 7624.10) mg/l, PV (469.60 - 746.40) mg/l, BOD (584.30 - 885.00)mg/l and COD (2012.13 - 2960.00)mg/l. The study revealed that the textile wastewaters were highly polluted. The polluted wastewaters are discharged daily into nearby receiving surface waters. Urgent attention is needed to protect the quality and portability of the receiving surface water so as to reduce its adverse health implications on consumers in the surrounding environment.

Keywords: Textile wastewater, Textile industries, Characterization, Pollution, Treatment, Disposal.

Introduction

Textile industries produce large volumes of wastewater daily which can cause pollution hazards if discharged indiscriminately [1]. In a developing country like Nigeria, indiscriminate dumping of untreated wastes is still the current practice, where both domestic and industrial wastewaters are discharged into rivers, streams and drainage systems. Pollutants enter the groundwater, rivers and other water bodies causing adverse effects on ecological systems [2], [3]. Ultimately, such water which ends up in our households could affect the aesthetic quality of portable water and pose threats to public health on the side of consumers if not treated [4].

Generally textile wastewaters can vary from one industry to another depending on the raw materials used. There are three to four stages involved in textile manufacturing which are yarn fabrication, fabric formulation, wet processing, and textile fabrication. Some of the steps involved in these stages mentioned above include pre-treatment, dyeing, printing and finishing operations. These production stages consume large quantities of water and also generate large volumes of wastewater [5]. Most of the wastewater generated is during the wet processing stage (slashing/sizing, bleaching, mercerizing, dyeing and finishing). Little or no wastewater is generated during fiber preparation, weaving, knitting, and textile fabrication processes.

Wastewater from printing and dyeing units is often rich in colour, containing residues of reactive dyes and chemicals therefore such wastewater requires proper treatment before being released into the environment [6],[7]. Textile wastewater exhibit very high toxicity. Because of increased awareness of worldwide environmental issues, there has been a great interest in introducing ecologically friendly, wet-processing textile

techniques which would help reduce pollution resulting from indiscriminate textile wastewater discharges [8].

Although wastewater disposal has become a significant cost factor, it is an important aspect to be considered in running textile industries. Characterization of such wastewaters is a pre-requisite for the investigation of pollution potential and necessary treatment options. Hence the aim of this study was to determine some pollution characteristics of textile wastewater obtained from textile industries in Nigeria, assess their pollution level and possibly make useful recommendations on the treatment and disposal.

Materials and Methods

Source of textile wastewater

The textile wastewaters used for this study were obtained from two textile factories manufacturing mostly cotton fabrics

Sampling Technique

The textile wastewater samples were collected from the pipe conveying all the wastewater out of the factory works into a stream. Samples were obtained on hourly basis for 11 hours beginning at 7am and ending at 6pm. The day for sample collection in the new week was different from that of the preceding week. This was done so that the total exercise might account for the cyclic and intermittent variations occurring at the work site. Each sample was collected in clean well labelled plastic bottles and kept in the refrigerator maintained at 4⁰C. For each sampling the rate of flow was measured using a flow meter. Flow rates of the batch samples obtained at one hour interval ranged from 1.72 to 2.48 litres per second. At the end of each sampling period, a total volume was obtained by mixing the samples together with volume of each sample (ranging from 172ml to 248ml) proportional to their flow rates. This mixture was the composite sample that was analyzed

for the pollution characteristics. The final volume of composite sample taken for analysis after each sampling ranged from 2457ml to 2578ml. All together twenty four (24) composite samples (twelve from each textile industry) were obtained and used for analysis at an interval of once a week.

The two industries were chosen due to the similar fabrics they produce so as to obtain detailed account of the pollution characteristics studied.

Methods of Analysis

The samples were analyzed as described in the Standard Methods for the Examination of Water and Wastewater

[9], Standard Method for Water and Effluents Analysis [10] and Bureau of Indian Standards [11]. Where analysis was not immediately possible, the samples were preserved by refrigeration at 4°C.

Results and Discussion

Results of the analysis carried out in both industries are as shown in Tables I and 2. The result show mean values obtained for the pollution characteristics in both factories.

TABLE 1: Pollution Characteristics of raw textile wastewater (Final Discharge) obtained from the first factory.

Sampling Code	Temp	pH	SS (mg/l)	TS (mg/l)	PV (mg/l)	BOD ₅ (mg/l)	COD (mg/l)
			mean ± SD	mean ± SD	mean ± SD	mean ± SD	mean ± SD
1	30.10	9.57	506.50 ± 0.21	5157.50 ± 0.24	609.70 ± 0.46	646.10 ± 0.33	2190.00 ± 0.80
2	33.40	10.44	514.80 ± 0.14	5302.50 ± 0.64	528.70 ± 0.35	654.80 ± 0.29	2236.66 ± 0.12
3	31.80	10.48	561.30 ± 0.15	6080.40 ± 0.27	627.10 ± 0.12	715.30 ± 0.08	2404.80 ± 0.18
4	29.80	9.67	583.90 ± 0.75	5601.20 ± 0.22	622.40 ± 0.13	730.50 ± 0.08	2468.31 ± 0.59
5	30.70	9.36	563.40 ± 0.85	5857.90 ± 0.55	658.50 ± 0.34	726.90 ± 1.73	2546.00 ± 0.70
6	30.60	9.58	569.30 ± 0.14	6188.70 ± 0.31	626.40 ± 1.13	729.00 ± 1.16	2456.80 ± 0.30
7	29.90	11.18	596.70 ± 0.39	6109.70 ± 0.23	723.80 ± 3.49	804.00 ± 0.13	2725.63 ± 0.66
8	32.60	10.21	606.30 ± 0.45	6148.30 ± 0.39	623.40 ± 0.25	779.30 ± 0.35	2650.00 ± 1.19
9	30.90	10.48	616.10 ± 0.12	6205.10 ± 0.12	714.30 ± 0.20	829.40 ± 0.08	2858.00 ± 1.01
10	31.00	9.48	629.40 ± 0.65	6643.40 ± 0.32	669.50 ± 17.19	790.00 ± 0.73	2660.23 ± 0.52
11	29.10	10.33	623.90 ± 0.49	5997.90 ± 0.83	680.40 ± 0.17	802.80 ± 0.25	2706.14 ± 1.00
12	33.50	9.25	663.20 ± 0.66	6930.30 ± 0.66	728.60 ± 0.17	880.00 ± 0.95	2984.0 ± 0.81

TABLE 2: Pollution Characteristics of raw textile wastewater (Final Discharge) obtained from the second factory.

Sampling Code	Temp	pH	SS (mg/l)	TS (mg/l)	PV (mg/l)	BOD ₅ (mg/l)	COD (mg/l)
			mean ± SD	mean ± SD	mean ± SD	mean ± SD	mean ± SD
1	36.10	10.20	455.60 ± 0.14	5144.30 ± 0.24	535.30 ± 0.16	628.50 ± 0.10	2123.55 ± 0.05
2	36.90	10.80	457.20 ± 0.07	5099.20 ± 0.53	506.30 ± 0.11	602.30 ± 0.35	2025.36 ± 0.18
3	37.30	9.80	456.80 ± 1.08	5056.30 ± 0.06	469.60 ± 0.28	584.30 ± 0.21	2012.13 ± 0.63
4	35.60	10.65	574.20 ± 0.77	6349.20 ± 0.65	621.40 ± 0.09	740.00 ± 1.06	2512.00 ± 0.79
5	33.00	11.60	499.50 ± 29.52	5831.80 ± 0.59	613.80 ± 0.76	725.00 ± 2.90	2650.00 ± 1.29
6	41.80	9.22	525.40 ± 0.27	5450.40 ± 0.27	584.70 ± 0.23	665.20 ± 0.10	2265.00 ± 0.33
7	38.40	10.12	573.45 ± 0.33	5726.50 ± 0.16	604.90 ± 0.23	751.00 ± 0.72	2620.00 ± 0.58
8	40.70	11.15	624.30 ± 0.25	6884.40 ± 0.32	657.30 ± 0.11	789.10 ± 0.09	2645.00 ± 1.12
9	37.30	10.12	587.30 ± 4.72	6236.40 ± 0.22	652.40 ± 0.06	835.30 ± 0.23	2950.12 ± 0.19
10	31.40	9.82	658.10 ± 16.4	7624.10 ± 1.04	734.50 ± 0.15	860.00 ± 1.22	2892.00 ± 0.67
11	39.40	9.79	665.30 ± 0.39	6530.30 ± 0.51	729.80 ± 0.41	843.40 ± 12.79	2865.09 ± 0.38
12	36.30	10.40	684.90 ± 0.96	6970.50 ± 0.22	746.40 ± 0.36	885.00 ± 1.07	2960.00 ± 0.84

Most of the pollution characteristics measured from both industries had high values, indicating high pollution level. Wastewater temperatures from both factories ranged between 29.00 – 33.50°C and 31.40 – 41.80°C.

High values recorded for the various pollution characteristics may be linked to the various chemicals employed during processing and the nature of the raw materials for example, different enzymes, detergent dyes, acid sodas and salts used during processing.

The pH values (9.25 - 11.18; 9.22 – 11.60) show that the wastewaters were typically alkaline. Alkalinity

increases with wastewater strength. High alkalinity is quite objectionable. It is an indication that the wastewaters have the capacity to neutralize acids. Values of suspended solids (506.50 - 663.20mg/l; 455.60 – 684.90mg/l) and total solids (5157.50-6930.30; 5099.20-7624.10mg/l) were quite high. This is significant. It is a reflection of the amount of oxygen required to synthesize both organic and inorganic solids present in the textile wastewaters. Suspended solids provide information on the amount of BOD present in the wastewater. The total solids include both organic

and inorganic solid constituents dissolved or suspended in the wastewater.

The PV values (528.70 – 728.60mg/l; 469.60 – 746.40mg/l) shows the magnitude of organic and inorganic substances readily available for oxidation in the textile wastewaters [2].

The high BOD values obtained (646.10 - 880.00mg/l; 584.30 – 885.00mg/l) show that the wastewaters have high pollution strength. COD values (2190.00-2984.00mg/l; 2012.13 - 2960.00mg/l) were about three times higher than BOD. The remarkable increase in COD levels compared with BOD also indicates that significant levels of toxicants e.g. heavy metals may be possibly present in the wastewater [12]. All these must have contributed towards toxicity in the wastewater which makes it necessary for its characterization in order to access the pollution level. Industrial processes generate waste water containing heavy metal contaminants. Most of these heavy metals are non-degradable into non toxic end products which could be harmful to the environment [13]. It therefore becomes necessary to reduce their concentration to acceptable levels using the necessary wastewater treatment process before discharging them into the environment. This will help reduce the detrimental effect of polluted water and general pollution of the environment caused by such discharges.

Conclusion

Results obtained from the analysis show that the textile wastewaters studied contained substantial pollution load. Such polluted wastewaters pose a threat to the environment.

Treatment in a wastewater treatment plant with optimization of the basic operating conditions is currently in practice. Combined treatment processes would be necessary to reduce the pollution load and avoid adverse pollution effect of the textile wastewaters on both the affected surface waters and the surrounding environment.

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