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RESEARCH ARTICLE

Physico-Chemical Studies of Effluent in Sanganer Area

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ABSTRACT

The Physico-chemical study was made in industrial Sanganer area to assess the quality of effluent, soil quality, and effects of effluent on crop plants. The samples were alkaline besides having high chemical oxygen demand. They had more than the permissible concentrations of heavy metals like copper, zinc, lead, chromium, and manganese. These industries also caused an adverse impact on its surrounding flora, fauna, and residents.

Key words: Physico-Chemical analysis, textile effluent, Sanganer, xenobiotic.

INTRODUCTION

Water is the most important and precious natural resources, essential for the survival of living organisms. Water exhibits different Physico-chemical properties in pure form. Contaminants are impurities found in water which can be both natural and/or anthropogenic. The effluents from industry, domestic agriculture and runoff surface water affect the water quality by their color, high organic content, widely varying Ph, presence of heavy metals and other pollutants (Daly and Warren 1994). Sanganer, situated 20 km away from Jaipur, popular for dyeing and printing industries, and waste paper recycling. There are about 1100 block and screen printing units. A number of azo dyes are using in textile industries. As a result huge volume of untreated textile dye waste water (10,000-15,000 Kl/day) loaded with dyes and other chemicals, is discharged either on the land forming pools adjoining the dyeing units or directly in the Amanishah drain (Khan *et al*., 1995). The azo dyes are xenobiotic in nature. Xenobiotic compounds are chemicals which are foreign to the biosphere. The dominant means of transformation and degradation of xenobiotic compounds on Earth resides in microorganisms. The Physico-chemical properties of natural habitats are affected by these compounds. Sorptions to soil and sediments as well as micropore entrapment are major causes for the persistence of many xenobiotics.

MATERIALS AND METHODS

The textile effluent (Effluent) and the adjoining soil (Soil) samples were collected from two different spots located in Sanganer, Jaipur. The effluent samples were collected from Gullar Ka Bandha, in Sanganer, and Ramsinghpura, Shikarpura Road of Sanganer. The soil samples, adjoining the effluent samples from the 5 points were collected in polythene bags up to a depth of few centimeters. All the samples were collected in two sets. One set was then transported to the laboratory and used for isolation of native micro flora and Physico-chemical analysis. The soil samples were dried in hot air oven (Approximately 10 g of all the soil samples were preserved at 15 ^{0}C in a refrigerator for isolation of native micro flora), at 60 ^{0}C for 7 days. The dried soil samples were ground and sieved through 80 mesh sizes and then stored in plastic bags for Physico-chemical analysis (pH and Electrical conductivity. The other set was deposited at the Pollution Department, Jhalana Dungari, and Jaipur for analysis of other Physico-chemical parameters (Metals; Chloride content; Organic carbon; Phosphate; Potash). Temperature and pH was recorded in the field. Physico-chemical analyses of soil and effluent samples were done by standard methods (APHA, 1992).

OBSERVATION AND RESULTS

The Physico-chemical analysis of the soil samples are presented in (**Table 1**) and, the standard range for the different parameters (as provided by the Soil Testing Laboratory, of Durgapur Agricultural

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Research Center, Jaipur) have been also considered (**Table 2**) for the comparative study.

Table 1: Physico-Chemical characteristics of soil samples collected from two spots located in Sanganer

Parameter		Spot 1st		Spot 2nd		
		$S_{1.1}$	$S_{1.2}$	$S_{2.1}$	$S_{2.2}$	$S_{2.3}$
pH		8.4	8.0	9.2	8.2	9.2
Electrical Conductivity (mmho/cm)		0.27	0.19	0.78	1.03	0.83
Chloride (mg/L)		13.1	13.5	2 4.2	25.1	24.8
Organic Carbon (%)		0.18	0.10	0.18	0.20	0.24
Total Organic matter (%)		0.31	0.17	0.31	0.34	0.41
Nitrogen (%)		0.015	0.009	0.016	0.017	0.021
Phosphate (Kg/Hectare)		28	36	28	36	44
Potash (Kg/Hectare)		240	310	180	260	190
Heavy Metals (ppm)	Cu	0.36	0.24	4.75	2.35	3.32
	Zn	0.82	0.64	3.56	3.84	3.71
	Fe	4.92	4.72	4.54	4.96	4.9
	Mn	2.92	2.76	3.12	2.98	3.2

Table 2: Standard values for the various Physico-Chemical characteristics of soil (Provided by the Soil Testing Laboratory, of Durgapura Agricultural Research Center, Jaipur)

Parameter	Range		Status
pH	7-8.5		Normal
	More than 8.5		Alkaline
Electrical Conductivity (mmho/cm)	0-1.5		Normal
	More than 1.5		Saline
Organic Carbon (%)	0-0.5		Low
	0.5-0.75		Medium
	More than 0.75		High
Nitrogen (%)	0-0.5		Low
	0.5-0.75		Medium
	More than 0.75		High
Phosphate (Kg/Hectare)	0-23		Low
	23-56		Medium
	More than 56		High
Potash (Kg/Hectare)	0-142		Low
	142-337		Medium
	More than 337		High
Heavy Metals (ppm)	**Cu**	0.2	Normal
	Zn	0.6	Normal
	Fe	4.5	Normal
	Mn	2.0	Normal

The five effluent samples collected from the two spots in Sanganer were analyzed for the various Physico-chemical parameters (Table-3) and the data was compared with the standard limits for industrial effluents (**Table 4**), to understand the type of pollution load in the textile effluent.

Table 3: Physico-Chemical characteristics of effluent samples collected from two spots located in Sanganer

Parameter		Spot 1st		Spot 2nd		
		$W_{1.1}$	$W_{1.2}$	$W_{2.1}$	$W_{2.2}$	$W_{2.3}$
pH		8.2	8.0	7.5	7.6	7.9
Electrical Conductivity (mmho/cm)		1.95	1.68	3.50	3.50	3.60
Chemical Oxygen Demand (mg/L)		54	62	910	894	912
Total Solids (mg/L)		973	958	1286	1542	1664
Cations (mg/L)	**Ca**	7.9	7.3	10.8	11.0	8.8
	Mg	8.3	9.5	10.7	11.4	8.5
	Na	23.0	24.7	25.2	25.4	27.4
	K	0.1	0.1	0.1	0.1	0.2
Anions (nmg/L)	**Cl**	21.2	20.3	21.2	21.0	23.8
	HCO3	9.1	10.5	12.0	12.2	10.8
	CO3	0.2	0.3	1.8	1.6	0.4
Heavy Metals (ppm)	**Cu**	1.47	1.75	3.23	5.78	3.65
	Zn	0.83	0.96	3.24	3.5	3.12
	Cd	0.14	0.02	1.18	1.24	1.09
	Pb	0.08	0.06	0.72	0.54	0.79
	Cr	1.5	1.21	2.8	2.5	3.2
	Mn	1.5	1.2	2.32	2.12	2.54
	Fe	1.0	1.12	1.73	1.3	1.8

Table 4: Tolerance limits for industrial effluents discharged into inland surface waters [As per IS: 10500 (Part – A: Effluents) – 1992 Reaffirmed 1993].

S. No	Parameter	Standards
1	pH	5.5-9.0
2	Chemical Oxygen Demand (mg/L)	250
3	Lead (as Pb) (mg/L)	0.1
4	Cadmium (as Cd) (mg/L)	2.0
5	Total Chromium (as Cr) (mg/L)	2.0
6	Copper (as Cu) (mg/L)	3.0
7	Zinc (as Zn) (mg/L)	5.0
8	Chloride (as Cl) mg/L	1000
9	Manganese (as Mn) (mg/L)	2.0
10	Iron (as Fe) (mg/L)	3.0

DISCUSSION

Physico-Chemical characteristics of soil samples: On the basis of Physico-chemical analysis of the soil samples, an overview of the effect of textile effluent on the adjoining soil habitat can be obtained. The pH of the samples from both the spots was slightly the in alkaline range. This might be due to use of higher quantities of basic dyes for dyeing, and use of other alkali based chemicals during different steps of printing and dyeing. The EC values for all the samples were well within the normal range (0-1.5 mmho/cm), but the values of samples from spot 2nd were higher than that for samples for Spot 1st. this might be because the spot 1st which is a closed printing/dyeing house was receiving textile effluent from the single bleaching, printing/dyeing and washing units, whereas the drain which was selected as spot 2nd was receiving textile effluent load from the numerous printing/dyeing industries located along its side, which might be rich in a variety of ions, and dyes that contribute towards EC. The chloride content of the soil samples from spot 2nd was somewhat higher than that of the samples from spot 1st.Similar reason as in case of EC can be cited for the difference in the values at the two spots. The chloride content was the contribution of the various chemicals used during the bleaching steps. The values for Organic carbon, Total Organic matter and Nitrogen were slightly higher for the samples of spot 1st than the values for the samples of spot 2nd. The values for percent Organic carbon and Nitrogen were within the lower range for all the samples. The phosphate content was similar in all the samples from both the spots, but No fixed trend was observed in case of the potash content. The phosphate and potash

contents at all the sampling points were found to be within the medium range. These parameters are more related to the characteristic feature of soil of that area, but effect of textile effluent on these parameters cannot be ruled out, because it has been observed that vegetables and crops grown in this area are bigger in size, which is an index of their good health but the increase in size might be due to the availability of plant nutrients such as urea and nitrates in the dye wastewater. The concentration of heavy metals like Cu, Zn and Mn was higher at sampling points of spot 2nd than the sampling points of spot 1st. In case of Fe content all the sampling points were nearly similar. When these values were compared with the standard range, it was observed that all the sampling points were showing higher than normal concentration for all the heavy metals tested (Cu, Zn, Fe and Mn). These higher concentrations of all the heavy metals might be due to their accumulation in the soil samples adjoining the textile effluent. Use of metal based dyes in the textile printing/dyeing industry is the main source of these metals.

Physico-Chemical characteristics of effluent samples: the Physico-chemical analysis of the textile effluent samples gives an idea of the extent type and possible source of pollution and can be used as an argument to emphasize on the treatment of textile effluent prior to its discharge on the open land or local water bodies. The pH values for samples of spot 1st were very slightly alkaline (8.2 and 8.0) and well within the permissible limit. In case of samples from spot 2nd the values were very close to neutral (7.5-7.9). This difference at the two spots can be attributed to the higher ratio of alkaline chemicals being used during the various processing steps, in the printing/dyeing unit. Whereas in case of spot 2nd which was an open drain receiving effluent from numerous textile industries, the alkaline effluents might be neutralized by the acidic effluents depending upon the type of process carried out and the chemicals used in the different printing/ dyeing units. As aquatic life is highly susceptible to change in the pH of water body. Therefore, continuous addition of effluent with non-neutral pH tends to change the pH of the receiving body to the point which may drastically after the habitats. Degree of potential impact depends on the degree of alteration in that habitat. In other words, altered pH leads to dominance of some species while cause extinction of others. EC is a salinity rating of water (Hagin and Tucker, 1982) is an indicator of dissolved solids and suspended solids. The EC values were quite higher for the sampling points of spot 2nd (3.5 and 3.6), in comparison to that of spot 1st (1.95 and 1.68). According to Goel et. al. (1988), the higher values of EC have been assigned to higher concentration of dyes in the effluents. So the higher values of EC at spot 2nd might be due to the higher concentration of various salt ions and dyes contributed by the effluents from the numerous printing/dyeing houses. Chemical Oxygen Demand (COD) value is a measure of O_2 demand of water, against total chemicals. It was observed that the COD values were very low and well within the permissible limit for spot 1st, but the sampling points of spot 2nd were showing very high values (894-912 mg/L) much higher than the permissible limit (250mg/L). This indicates towards the oxygen deficiency in the drain due to discharge of textile effluents (from the numerous units), rich in organic compounds.

High values of this parameter indicate potential depletion of dissolved O_2 in the water body. Deficiency of O_2 in receiving water could cause adverse effects on biological activity in water environment. In worst case, this can result in total depletion of O_2 in receiving water, causing an anaerobic environment, thus changing the habitat from aerobic to anaerobic life. The total solids were present at much higher concentration at the sampling points of Spot 2nd (1286-1664 mg/L), in comparison to their concentration at spot 1st (958 and 973 mg/L). This higher Total solid content at spot 2nd can also be attributed to the contribution of numerous units in comparison to the contribution of a single unit at spot 1st. Total solid concentration in textile effluent may not be very high; however, total load of this parameter may still be significant, as the use of large amount of water in textile industry offsets the effect of low concentrations. Many dissolved solids are undesirable for health of the receiving water body. Dissolved minerals and organic constituents may produce aesthetically displeasing color and odour. The solids will increase the turbidity of water, induce septic conditions in the water body by retarding the photosynthetic activity affecting the symbiotic process, and also interface with O_2 transfer mechanism of air- water interface. As it can be seen that the concentration of all the cations (Ca, Mg and Na) except K, are present at slightly higher concentrations at the spot 2nd when compared to their presence at spot 1st. In case of K, its concentration was similar at both the spots.

The presence of these cations at both the spots indicates the use of chemicals based on these metals in the textile industry. The spot 1st was showing lower concentrations of all the anions tested (Cl, HCO_3 and CO_3), in comparison to sampling points of spot 2nd. These anions are component of the various chemicals utilized during bleaching, printing/dyeing and fastening/washing steps in a printing/dyeing unit. All the heavy metals (Cu, Zn, Cd, Pb, Cr, Mn and Fe) were present at lower concentrations at the sampling points of spot 1st, in comparison to the spot 2nd. The Cu content was above the permissible limit (3.0 mg/L) at the spot 1st but was within the limit at spot 1st. Zn and Cd content was within the standard limits (5mg/L and 2.0 mg/L respectively) at both the spots. Although Pb contents was within limit at spot 1st but much above the limit (0.1mg/L) at spot 2nd. The presence of Cr and Mn was within limit (2.0 mg/L each) at spot 1st but not at spot 2nd. Although Fe was detected at all the 5 sampling points, but within the permissible limit (3.0 mg/L). The detection of these heavy metals at all the spots might be due to frequent use of metal-based dyes in the textile industry located in the sampling area. These heavy metals can be toxic to plant and animal life. Usually heavy metals have cumulative effect, thus their concentration tend to increase in the food chain.

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