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Physico-Chemical Characterization of Soil and Effluent of Dye Industries in Kaithun region of Kota, Rajasthan

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ABSTRACT

Industrial Effluent entering the water bodies is one of major source of environmental toxicity. It not only affects the quality of drinking water but also has deleterious impact on the soil. Industries keep on releasing effluents, which are quite toxic. Soil is the most favorable habitat for a wide range of microorganisms that includes bacteria, fungi, algae and viruses. In the present study was an attempt to assess quality of polluted soil and the physico-chemical properties of dye industries effluent of Kaithun Region, Kota.

Keywords*: Dye industrial effluent, contaminated soil, physico-chemical analysis.*

INTRODUCTION

Nature has an amazing ability to cope up with small amount of water wastes and pollution, but it would be hazardous if billions of gallons of waste water produced everyday are not treated before releasing them back to the environment. The quantities and characteristics of discharged effluent vary from industry to industry depending on the water consumption and average daily product. Dye effluent mainly contains 1.) Large amount of total dissolved solids limiting the industrial and agricultural use of water 2.) High levels of chemical oxygen demand (indicating high degree of pollution) and biological oxygen demand[6]. Soil is also one of the vital resources on living planet Earth. It is heterogeneous in nature. Many scientists have documented adverse effects of different industrial effluents on the growth of plants and dye waste water has also been found toxic to several crop plants[4].

One of the main sources with severe pollution problems worldwide is the textile industries and its dye-containing wastewater. 10-25% of textile dyes are lost during the dyeing process and 2-20% is discharged as aqueous effluents in different environmental components[1]. Waste water from any industries is often rich in color, containing residues of reactive dyes, organic chemicals and bleaching agents. Heavy metals like zinc, copper, manganese, iron etc are present in the dye effluents. The present investigation was aimed to know the effect of dye industrial effluent on water and soil quality. It have been reported that the major problem associated with textile processing effluents is presence of heavy metal ions, which arise from material used in the dyeing process or in a considerably high amount, from metal containing dye. Most of the heavy metals are essential for growth of organisms but are only required in low concentrations.

The present study was carried out to characteristic dyeing industry effluent in turn to their physico-chemical properties and to evaluate the impact of industrial effluent on the soil near small dyeing industries in Kaithun region near Kota (Rajasthan).

MATERIALS AND METHODS

Collection of Effluent Samples:

The sampling was carried out in October 2013. The sampling site in the present paper is a local textile mill (STM) located near Kota city in Rajasthan. Samples were collected from the 2 different sites of the selected area in a wide mouth plastic bottle. Reference water sample was taken from hand pump 1 km away from the mill area and tap water 2 km away from the mill area.

Collection of Soil Samples:

The soil samples were collected from 0-30 cm depth from three locations immediate to dumping site of effluent printing cluster for the study. The collected soil samples have been analyzed for physicochemical parameters like pH, organic carbon, electric

conductivity,nitrogen, calcium, magnesium, potassium, phosphorus, water holding capacity and heavy metals like Zn, Cu, Mn, Fe.

Methods:

1. Physico-chemical analysis of the textile industry effluents-

The site of sample collection was identified at point where the effluent is discharged from the mill. The color of the effluent and smell was observed at the time of collection

of the sample in sterile bottles. The wastewater discharged from the textile industries is characterized by a variety of chemicals generated from dyeing and washing processes. It also constitutes suspended solids, organic and inorganic matters, acid and alkalis. Textile wastewater contains substantial pollution loads in terms of BOD, COD, TSS and heavy metals. The environmental concern of discharged textile wastewater is mainly its high chemical oxygen demand (COD) as well as high strength of color content. The analysis were carried out as per the standard methods [2].

2. Physico-chemical analysis of the soil contaminated by textile industrial effluent-

The soil sample**s** were collected from the experimental site where untreated effluent was discharged by the industry. Three replicates of each samples from three different sites (S1, S_2, S_3) were collected from 0-30 cm. depth from various locations. The homogenized samples were air dried for seven days, gently crushed with a wooden roller and passed through 2 mm sieve. All samples were analyzed by carried out as per the standard methods.

The physic-chemical parameters like pH, Ec, BOD, COD, TDS, Hardness, organic carbon, Water holding capacity, N, P, K and Heavy mtals etc assessed in the dyeing effluent and polluted soil were higher than the recommended standard for discharge of industrial effluent by BIS.

RESULT AND DISCUSSION

Physico-chemical characterization of the textile dye effluent samples were analyzed for different Physico-chemical parameters as shown in Table 1. It showed that effluent have dark blue and black color with pungent smell, relatively high temperature 45^0 (measured by a laboratory thermometer).The pH of the effluents was slightly to moderate basic range ranged from 7.2-7.9.

Electrical Conductivity of effluent samples ranged from 1470-2200 µS/cm.Biological Oxygen Demand was ranged from 488-1090 mg/l and Chemical Oxygen Demand was ranged from 3120-6864 mg/l. Total Dissolved Solids of effluent ranged from 980-1440 mg/l. Calcium hardness ranged between 110-800 mg/l and Magnesium hardness ranged between 120-1450 mg/l. Total hardness ranged from 230-2250 mg/l. Oil and Grease in effluent samples ranged from 21-43.6 mg/l.

The soil samples adjoining the textile effluent, of mill region also show great variation in the physic-chemical properties. The p^H of the soil samples ranged from 7.9-8.1. Electrical conductivity ranged from 0.21-0.44 ds/m. Organic carbon (%) of soil samples between 0.53-0.96%. Values of nitrogen (N), phosphate (P) and potash (K) concentration in the soil samples were also shows to have great variability. NPK concentration of soil samples exhibited that N, P, and K concentration ranged from: N (2.81-6.22 ppm), P (16.6-69.3 ppm), K (314-653 ppm). Calcium and Magnesium of soil samples ranged from 3.0-3.6 ppm and 3.4-4.0 ppm. Water holding capacity of soil samples ranged between 45.27-45.86%.

Heavy metals such as Zn, Cu, Mn, Fe ranged from: Zn (0.3-6.8 mg/g), Cu (0.8-48.65mg/g), Mn (4.3-11.5mg/g) and Fe (0.2-9.0mg/g).

Table -1: Physico-chemical characterization of Dye effluent

S/N	PARAMETERS	EFFLUENT SAMPLE		CONTROL SAMPLE	
		S1	S2	C1	C2
1.	pH	7.20	7.97	8.2	8.3
2.	Biological Oxygen Demand (mg/l)	1090	488	0.4	1.0
3.	Chemical Oxygen Demand (mg/l)	6864	3120	64	52
4.	Oil and Grease (mg/l)	43.6	21	-	-
5.	Electrical Conductivity (υmho/cm2)	1470	2200	1148	1212
6.	Total Disolved Solides (mg/l)	980	1440	861	909
7.	Calcium Hardness	800	110	160	180
8.	Magnesium Hardness	1450	120	130	130
9.	Total Hardness	2250	230	290	310
10.	Color	Dark blue	Black	Colorless	Colorless

Table -1: Physico-chemical characterization of soil contaminated by Dye effluent

S.N.	Sample	Parameters												
		pH	**EC**	**%OC**	**Na**	**P**	**K**	**Ca**	**Mg**	**%WHC**	**Zn**	**Cu**	**Mn**	**Fe**
1.	**S1**													
	10 cm.	7.99	0.21	0.95	618	44	653	3.2	3.6	45.27	6.886	48.65	11.30	0.253
	20 cm.	8.13	0.21	0.93	600	16.2	469	3.6	4.0	45.30	6.606	47.43	11.50	1.078
	30 cm.	8.13	0.22	0.96	622	69.3	389	3.4	3.7	44.38	5.404	48.56	11.27	3.094
2.	**S2**													
	10 cm.	8.00	0.44	0.74	499	16.6	597	3.1	3.5	45.86	0.778	9.372	9.353	9.02
	20 cm.	8.06	0.30	0.86	541	49.5	408	3.3	3.6	45.79	0.359	4.774	8.040	3.583
	30 cm.	8.06	0.29	0.80	535	49.9	314	3.0	3.4	43.98	0.339	3.145	8.257	3.703
3.	**S3**													
	10 cm.	8.05	0.31	0.77	509	17.5	501	3.5	4.0	43.41	2.093	0.887	5.438	5.08
	20 cm.	8.19	0.26	0.57	281	32.7	407	2.9	3.4	41.52	1.584	0.976	4.318	5.141
	30 cm.	8.17	0.23	0.53	256	18.8	325	3.4	3.8	37.91	1.625	1.103	5.631	4.316

CONCLUSION

This study has shown that KTM (kaithun Textile Mills), is well known for using eco friendly natural dyes for dyeing and hand block painting, thus the untreated textile effluent should be less polluted. But the results show the different case as some parameters like TDS, BOD, COD etc. exceeds the WHO limits at significant level. Also the concentration of heavy metals was found to be high which might be due to the use of mordents and synthetic dyes. The result indicating that the application of textile effluent/polluted water affect physico-chemical properties of soil. This study also reveals that effluent from KTM was highly polluted, there is urgent need to follow effluent treatment methods before their discharge to surface water for reducing their potential environmental hazards.

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