PHYSICO-CHEMICAL AND MICROBIAL ANALYSIS OF THE SOIL CONTAMINATED BY TEXTILE INDUSTRIES LOCATED IN SANGANER INDUSTRIAL AREA, JAIPUR

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Abstract

Sanganer town (Jaipur) which is famous for its textile printing and dying, having large number of textile units. The industrial effluents discharged from these textile units contains largely alkalies, residual dyes, starches cellulose, soluble salts mainly sodium and calcium, silicate, oil and other impurities. The industrial effluent, which is being generated from these fast emerging textile and dying units is generally discharged untreated, in Amanishah drainage or onto ground surface, due to lack of economically viable technologies for its treatment. As a result, there is a deterioration of soil and even of ground water quality and has potentials for contamination of other biophysical resources along the discharged area. In the present study attempt has been made to investigate the physico-chemical properties and microbial flora and fauna of soil contaminated with the effluents from textile industries. Uncontaminated soil from forest area (Smriti Van; artificially developed man-made forest) was used as control.

Index Terms- Biophysical, Contaminated, Deterioration, Effluents, Physico-chemical, Technologies, Textile.

Introduction

In the process of the development of human civilization, the use of cloth was a definite stage with the passage of time, cloth become a basic need for human. These days textile is one of the largest organized sector of India and environmental impact of textile mills wastes is fairly documented (Patel and Shrivastava, 1999). In Jaipur only there are estimated to be around 500 block and screen printing units in Sanganer.

Textile industries generate pollutants mainly at the time of processing of cloth, which consists of scouring, bleaching, mercerizing, dyeing, scouring, bleaching, mercerizing, dyeing, printing and finishing operations. Such processing operation involves use of a large number of chemical including acids, alkalies, oil detergents, dyes etc (Mathur and Bhatnagar, 2003). During ancient times people used dyes from natural resources like tesu flowers, to make their cloths bright and

colourful. Such dyes were almost biodegradable, therefore not hazardous but were very expensive and required a lot of labour in their manufacture. Thus, preferably cheaper and easily available sources such as chemicals were used as dyes.

The wastes released from textile industries cause soil, surface and groundwater pollution, besides causing a number of adverse effects on agricultural products, animals and health of people living in that area. The degradation of soil quality ultimately affects the groundwater quality as well as crops or other vegetation production in and around the contaminated areas. The toxicity introduced into the soil by effluents may persist for years and adverse effects may be felt aver a long period of time (Deka and Bhattacharyya, 2007).

In the present study, an attempt has been made to asses the impact of textile industries on the soil quality of Sanganer industrial area, Jaipur by monitoring various physico-chemical and microbial parameters of contaminated soil of textile industries and comparing them with the forest soil.

Study Area

The Sanganer Industrial Area and Smriti Van of Jaipur were selected for the study area. Sanganer Industrial Area is located at 26^{o}49' North and 75^{o}47' East about 16 kms from Jaipur city on Tonk road. About 205 small-scale, 125 medium-scale and 15 large-scale textile industries are located in the vicinity of Amani Shah Ka Nallah drainage, which flows through Sanganer.

Smriti Van is a man made forest. It is located on Jawaharlal Nehru Marg. It is spreaded over 108 acres in the city itself. Aprox. 5 kms from the centre of the city. It is a biodiversity forest.

Methodology

For the study, the soil samples were collected, in clean polyethylene zipper bags at an interval of 15 days (fortnightly) for two months (January2009-February 2009) from four different contaminated sites of Sanganer Industrial Area and from four different sites of Smriti Van and were used as a control during the evening hours (3pm-4pm). All chemicals used were of analytical grade and standard methods (APHA 1996) were followed. Physico-chemical parameters like colour of soil sample was recorded and temperature was measured on the spot, pH, acidity, alkalinity, electrical conductivity were measured taking 1:10 soil water suspension. Organic carbon was measured by Walkey and Black method, Inorganic phosphate was measured by Stannous chloride colorimetric method, for fungal culture Potato Dextrose Agar wasd used as medium and for bacterial culture Nutrient Agar was used as medium and soil dilutions of 10^{-6}, 10^{-7}, 10^{-8} were used.

Result and Discussion

The values of physico-chemical parameters of the soil samples in each case are given in the table No.1.

TABLE No.1

SAMPLES	Forest Soil	Textile Soil		Forest Soil	Textile Soil		Forest Soil	Textile Soil		Forest Soil	Textile Soil	
PARAMETERS	*A*	*B1*	*B2*	*A*	*B1*	*B2*	*A*	*B1*	*B2*	*A*	*B1*	*B2*
Colour	*Dark brown*	*Blackish red*	*Greenish brown*	*Dark brown*	*Bluish brown*	*Greenish brown*	*Dark brown*	*Bluish brown*	*Greenish brown*	*Dark brown*	*Bluish brown*	*Greenish brown*
Temperature (^{O}C)	*17.25*	*19.0*	*18.5*	*18.25*	*19.5*	*19.8*	*18.35*	*19.8*	*20.9*	*18.85*	*20.0*	*19.9*
pH	*6.42*	*9.6*	*8.0*	*6.13*	*9.1*	*8.13*	*6.34*	*8.24*	*7.72*	*6.86*	*8.04*	*9.06*
Electrical Conductivity (µs/ms)	*0.182*	*0.440*	*0.450*	*0.57*	*1.125*	*0.661*	*0.235*	*1.110*	*3.38*	*0.185*	*0.225*	*2.95*
Organic Carbon (%)	*0.72*	*1.48*	*1.24*	*0.67*	*1.15*	*1.32*	*0.79*	*1.92*	*1.60*	*0.78*	*1.86*	*1.60*
Alkalinity (mg/l)	*4.0*	*20.0*	*12.0*	*4.0*	*50.0*	*20.0*	*5.0*	*43.0*	*14.0*	*4.0*	*38.0*	*16.0*
Acidity (mg/l)	*70.0*	*0.0*	*8.0*	*62.0*	*2.0*	*18.0*	*58*	*4.0*	*16.0*	*67*	*16.0*	*0.0*
Inorganic Phosphate (mg/l)	*13.5*	*70.0*	*58.0*	*13.0*	*27.0*	*32.0*	*12*	*29.0*	*35.0*	*13*	*68.0*	*72.0*
Moisture Content (%)	*7.45*	*5.22*	*9.2*	*7.14*	*5.22*	*9.2*	*6.16*	*5.04*	*9.2*	*5.12*	*4.00*	*8.00*
Specific Gravity (gms)	*0.75*	*0.812*	*0.761*	*0.735*	*0.852*	*0.810*	*0.75*	*0.798*	*0.825*	*0.80*	*1.409*	*0.671*
Bulk Density (gm/cm^3)	*1.73*	*1.30*	*1.29*	*1.45*	*1.1*	*1.15*	*1.39*	*1.09*	*1.02*	*1.54*	*1.29*	*1.45*

The colour of the contaminated soils were reddish brown, greenish brown and bluish brown and colour of 'A' was dark brown.

The temperature of the contaminated soil sample was greater than that of the forest soil in all the four rounds this may be be due to the reaction of chemicals present in the effluents in the soil.

The pH of all the samples shows that the soil was highly alkaline (pH range 7.72-9.6) indicating the flow of alkaline effluents from the textile mill. It is seen that pH is higher than the 'A' value (6.13-6.42).

Ionic matter in the industry's effluent has increased the conductivity of the soil around the industry. The conductivity has a range of (0.66-3.38mS/µS). All the values are higher than 'A' (0.18) indicating more availability of cation and anion present in those areas.

High value of organic carbon was found around the industry indicating the accumulation of organic wastes, which may adversely affect the soil quality by reducing bulk density. The highest value is 1.92% and lowest 1.15%, which is much higher than the control value (0.67%).

The bulk density values of all the samples were found lower than the control value (1.73g/cm^2) indicating the accumulation of light organic matter in the soil. (Deka and Bhattacharrya, 2007).

The alkalinity of all the industrial samples were very high (4-50 mg/l) and were greater than 'A' (4mg/l) which shows that effluents from textile industry were alkaline
and were degrading the quality of soil and reducing its fertility.

The acidity of all the industrial soil samples was very less (0-18 mg/l) and was lower than 'A' (58-70). The amount of inorganic phosphate was very high in contaminated soil (27-72 mg/l) and all the values were higher than 'A' (12-13.5 mg/l).

Moisture content of one contaminated site (4-6.04%) was less than 'A' and the moisture content of site BII (8-9.6%) was greater than 'A' (5.12-7.55%). The specific gravity of the contaminated soil (0. 76-1.40gms) was greater than 'A' (0.72gms).

The results of microbiological parameters of soil sample are shpwn in table no.2. Result of bacterial colony count textile industry was very high (79×10^{-6}-120×10^{-6}) as compared to forest soil 'A' (44.33×10^{-6}-89×10^{-6}) which shows that large amount of microorganisms were taking part in the degradation of industrial effluents.

Types of bacteria present in the contaminated soil were mainly gram positive strepto cocci, cocci and rarely strepto bacilli. In 'A' gram positive strepto bacilli were more and strepto cocci were rare this shows alteration of bacterial population of the soil.

In textile soil mainly Mucor, Rizopus and Aspegillus Niger rarely Penicillum was present in forest soil mainly Mucor, Rizopus, Penicillum and Aspegillus Niger.

TABLE No.2

SAMPLE A1 (FOREST SOIL)				
	ROUND1	***ROUND2***	***ROUND3***	***ROUND4***
Bacterial culture				
Colony count	44.33×10^{-6}	73×10^{-6}	89×10^{-6}	59×10^{-6}
Type of bacteria present in culture	Gram positive strepto cocci, bacilli.	Gram positive strepto bacilli, diplo cocci.	Gram positive strepto cocci, bacilli.	Gram positive strepto cocci, strepto bacilli.
Type of fungus present in culture	Mucor, Rizopus.	Mucor, Rizopus, Penicillium, Aspergillus Niger.	Penicillum, Rizopus.	Mucor, Rizopus Aspergillus Niger.
SAMPLE B1 (TEXTILE INDUSTRY SOIL)				
	ROUND1	***ROUND2***	***ROUND3***	***ROUND4***
Bacterial culture				
Colony count	103×10^{-6}	98×10^{-6}	115×10^{-6}	95×10^{-6}
Type of bacteria present in culture	Gram positive strepto cocci.	Gram positive, cocci, strepto cocci.	Gram positive cocci.	Gram positive strepto cocci.
Type of fungus present in culture	Aspergillus Niger , Rizopus.	Mucor, Rizopus.	Aspergillus Niger , Rizopus.	Mucor, Rizopus Aspergillus Niger.
SAMPLE B2 (TEXTILE INDUSTRY SOIL)				
Bacterial culture				
Colony count	117×10^{-6}	120×10^{-6}	79×10^{-6}	86×10^{-6}
Type of bacteria	Gram positive strepto bacilli,	Gram positive cocci.	Gram positive strepto cocci, cocci	Gram positive strepto bacilli,

present in culture	strepto cocci.			bacilli
Type of fungus present in culture	Rizopus, Penicillium.	Mucor	Rizopus, Penicillium, Aspergillus Niger.	Penicillium, Aspergillus Niger.

CONCLUSION

The study area was in contact with effluent discharge by textile industries for last several years. The present work although preliminary in nature, has established that the effluents discharged from textile mills are definitely altering the soil properties. Measures should be taken by the industry owner for proper disposal of effluents after proper treatment for the conservation of this God blessed precious natural resource**.**

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