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Research Article

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Heavy metals and physicochemical properties of soils and water from sewage treatment plant

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ABSTRACT

In the present age of industrialization, world is facing the hazards of pollution in some form or the other and particularly industrial waste water imposes serious damage to the quality of soil. Variable results were recorded in the application of sewage sludge in agricultural land whether treated or untreated effluents added to the soil. Some of soil containing sewage sludge may accumulate the heavy metals in soil as well as plants. In this investigation, water and soil samples of polluted sewage treatment plant, polluted and unpolluted agricultural fields were analyzed for their eco-physico-chemical parameters such as pH, EC, carbonate, bicarbonate, Cl, Mg, Na, K, P, NO3 and heavy metals like Cu, Cd, Zn, Hg,Ni, Cr, Pb, were studied.

Key words: Heavy, Metal, Physicochemical, Properties, Sewage, Soils, Water

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INTRODUCTION

Increasing population and rapid urbanization have increased the soil pollution; discharge of industrial wastewater imposes serious damage to the quality of soil. Soil pollution results from contaminants added to the soil environment beyond permissible levels, which cannot be absorbed through the normal nutrient cycling present in the system. One of the oldest methods of sewage treatment is agricultural disposal, which is still employed to a limited extent today. By this means, either raw sewage or mechanically or biologically treated sewage is brought into contact with the soil, with aid of infiltration or surface irrigation system. It is the content of harmful substances in the sewage and sewage sludge; especially the metals such as cadmium, chromium, mercury, zinc, lead, copper, nickel etc. which enter the sewage or sewage sludge of industrial discharges also through galvanized water pipes. Some of the soils, which received sewage sludge, showed accumulation of heavy metal both in soils and plants reported that continuous application of sewage effluent increase the salt content and pH of the soil. (1, 7 , 9 ,12) Application of sewage sludge resulted in build up of Cu, Cr, Mn, Pb, and Cd in surface upland and low land soil reported (1) . Presence of Cd, Zn, Cr, and Pb in the sewage irrigated (Secondary treated) soil. Crops and vegetables grown in soils contaminated with heavy metals have greater accumulation of heavy metals than those grown in uncontaminated soil (13,19, 21). Wastewater is a valuable source of nutrients and organic matter. Meanwhile, it may contain undesirable chemical metals and pathogens that pose negative environmental and health impacts (2).Water and soil samples from polluted sewage treatment plant, polluted and unpolluted agricultural fields were analyzed for physico-chemical parameters show higher values due to continuous deposition of pollutants in agricultural field which has become grossly polluted whereas unpolluted site become slightly polluted appeared from the result of physicochemical parameters.

EXPERIMENTAL SECTION

The surface sediment samples from the water bodies were collected. To sample the deeper layer in area of site special type of the boring equipment khurpi was used for taking soil samples. The soil and water samples were

collected from the following sampling stations: Ordnance Factory Disposed soils samples and Water from treatment pond .

Site 1 : a) Soil sample no. **1-** Disposed waste soil from treatment pond.
b) Water sample no. 1- Water sample from treatment pond.
Site 2 : a) Soil sample no. **2-** Agricultural soil from the outlet of treatment water.
b) Water sample no. **2-** Water sample from outlet of treatment pond using for agriculture.
Site 3 : a) Soil sample no. **3-** Agricultural unpolluted soil.
b) Water sample no. **3-** Water sample from well using for agriculture .

Analysis of Soil: An average value of physico-chemical parameters of soil sample has taken into account. Physico-chemical analysis of soil for chemical and microbiological properties was followed according to the methods of soil analysis (American Society of Agronomy).

Analysis of Water: Procedures for selected sewage water constituents followed for Analysis have been in accordance with the Standard Methods for Examination of Water and West water **(5**)

RESULTS AND DISCUSSION

Analysis of soil and water gives salient features of soil and water from sewage treatment plant and agricultural field. In present investigation it was found that these elements were present in higher amounts in water and soil of samples of site no.1 which was collected from the polluted industrial area, and were least present in water and soil sample collected from the unpolluted agricultural field. A few of these metals were present below detectable level. In these samples these metals were found in slight higher amount in the samples collected from polluted agricultural field. This was due to the use of treated sewage water supply to these fields. In site no.1 pH of water and soil was nearly neutral having slight difference in their respective values. In site no.2 and site no.3 pH obtained was slightly alkaline in both cases of water and soil. (all data shown in table no 1& 2)

Table No. 1 Physico-chemical properties of soil of various sites

PARAMETER	Sample No1	Sample No 2	Sample No 3
pH	Nil	8.2	7.9
Conductivity (dsm^{-1})	242	133	135
Carbonate*	Nil	Nil	0.135
Bicarbonate*	0.6	1.22	0.457
Chloride*	0.23	0.26	0.35
Sulphate*	8.57	2.3	0.43
Calcium*	0.064	0.012	0.06
Magnesium*	0.24	0.06	0.02
Sodium$	36	48.99	43
Potassium$	17.6	15.3	9.82
Phosphate$	30.4	20.7	43
Nitrogen$	876.9	520.5	323
Copper#	1,220	135	10
Cadmium#	780	24	2
Lead#	432	54	3
Zinc#	10,470	254	12
Nickel#	31	16	2
Chromium#	8,000	210	10
Manganese#	90	20	16
Mercury^	740	20	Nil

** Values in gl^{-1} $ Values in $Kgha^{-1n}$ # Values in mgl^{-1} ^ Values in ppb*

Electrical conductivity was found to be highest in site no.3 658 dsm^{-1} for water and lowest 395 dsm^{-1} in site no.1. While in case of soil samples, electrical conductivity was highest 242 dsm^{-1} in site no.1 and lowest 133 dsm^{-1} in site no.2. In this study, carbonate $40gl^{-1}$ obtained in water sample of site no.1 and almost equal in both the water samples of site no.2 & no.3, and it was estimated 35 gml^{-1}. While in soil samples carbonate was absent in soil sample no.1 and sample no.2 but it was found 0.135 gl^{-1} in sample no. 3. Bicarbonate recorded to be highest in both water and soil samples of site. Maximum chloride was recorded 0.35 gml^{-1} in the soil samples of site no.3, while minimum chloride was observed in water and soil samples of site no.1. The analyzed sulphate content was highest in samples of site no.1 the values in (table no 1& 2) the lowest sulphate content was $10mgl^{-1}$ in water samples and 0.43 gl^{-1} in the soil of samples of site no.3. Similar type of report shown by (17) showed high fluctuations in the physicochemical parameters indicating the intensity of pollution. Further in this investigation the nutrient content sulphur, calcium & magnesium were recorded highest in samples of site no.1, while their

values are least in samples of site no.3 (Data shown in table no. 1 & 2). In case of sodium, potassium, phosphate and nitrogen content were estimated highest in samples of site no.1 except sodium, which was found in highest amount in samples of site no.2. Similar results were found by (7) impact of industrial effluent on soils. In present investigation heavy metals was found that these elements were present in higher amounts in water and soil of samples of site no.1 which was collected from the polluted industrial area, and were exceed the permissible present in water and soil sample collected form the unpolluted agricultural field. (Data shown in table no. 1 & 2).

Table No. 2 Data showing Analysis of water

PARAMETER	Sample 1	Sample 2	Sample 3
pH	7.2	8.1	8.12
Conductivity (dsm^{-1})	395	589	658
Carbonate*	40	35	35
Bicarbonate*	60	61	58
Chloride*	31.98	38	32.28
Sulphate*	20	13	10
Calcium*	58	48	50
Magnesium*	36	31	30
Sodium*	16	31	28
Potassium*	8	29	26
Phosphate*	1.6	1.4	0.03
Nitrogen*	30	22	18
Copper*	0.026	0.01	0.05
Cadmium*	0.022	0.01	BDL
Lead*	0.018	0.01	BDL
Zinc*	0.99	0.09	0.067
Nickel*	0.01	0.005	0.01
Chromium*	0.05	0.04	0.01
Manganese*	0.39	0.66	0.015
Mercury**	40	NIL	NIL

** Values in mgl^{-1} ** Values in ppb. BDL: Below Detecting Limit*

Health risk due to heavy metal contamination of soil has been widely reported (9, 14,18) Impact assessment of treated /untreated wastewater toxicants discharged by sewage treatment plants on health , agricultural , and environmentally quality in the waste water disposal area in different area water soil vegetation and food grains adverse effect on disposal area (11). Report of tolerance of crop plants grown in mining areas with high level of Zn, Cu, and also with Ni or Cr were quite rare (4). The effect of heavy metal on young primary barley has been over a considerable range of condition (8). Effect of tannery effluent and tannins on microbial population and nutrient status was studied by (21) chemical properties of soil; and germination and mineral composition of water was studied at Varanasi, (24). Sludge application tended to increase concentration of zinc, exceptionally high reported that in cauliflower, mustard, spinach, gourd, radish, mung bean (21), Although the concentration of heavy metals in sewage effluents are low, long-term use of these waste waters on agricultural lands often results in the build-up of the elevated levels of these metals in soils (15, 16). However, because of the potential content of toxic compounds (heavy metals, detergents, pesticides retardants and other), the introduction of sewage sludge into the soil environment creates the risk of a harmful effect on soil micro-organisms and on plants, as well as on the soil structure (25)

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