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Impact Of Industrial Effluents On Ground Water Quality And Soil In Beechwaal Industrial Area , Bikaner, Rajasthan, India

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ABSTRACT

The present research paper focused towards the heavy metal contamination in agricultural soil because of contaminated water system with defiled ground water influenced by mixed industrial effluents at Bikaner city in India. Tests of ground water and soils from hearea under concern were accomplished for different heavy metals, viz. Mn, Ni, Fe, Cu, Cd, Pb and Zn, utilizing Atomic Absorption Spectrophotometry. Metal exchange components from ground water to inundated rural soil and from soil to ground water were computed for these metals. The results describe the appropriation of heavy metals in ground water and agricultural soil. The transfer Factor for heavy metals from effluent to ground water were seen to be 0.398, 1.210, 5.989, 2.956, 2.569, 3.257 and 0.598 for Cd, Cu, Fe, Mn, Ni, Pb and Zn separately. These were observed to be high from ground water to agricultural soil because of the characteristic shale value of metals in soil framework . Accordingly, untreated industrial effluents can make an ecological risk to ground water resources and affects soil quality and crop production.

KEY WORDS: Agriculture soil, Groundwater, Heavy metals, Industrial effluent, Transfer facor.

INTRODUCTION

The composite effluents from industries comprising of heavy accumulation of heavy metals, organic contaminations and harmful hues, which may influence the nature of surface water, soil, ground water of the area . theses contaminants percolate down thrugh the soil profile and meets with the ground water , finally generates health hazards for human beings and live stock (Malik and Bharti, 2010). The waste water with not any treatment may bring about unfavorable impact on the health of human, local animals, wild life and environment . Cont aminated ground water has deteriorated the drinking water quality and effects on soil frameworks and agricultural productivity.

Heavy metals are generally present in traces in normal water yet a large number of them are lethal even at low concentration however a few of the heavy metals are the essential parts of the biological framework.

Metals, for example, As, Pb, Cd, Ni, Hg, Cr, Co, Zn and Se are profoundly dangerous even in minor amount. Expanding amount of heavy metals in aquatic natural resources now present a range of more noteworthy concern as the large no of industries discharge their effluents directly in to the water resources

Particularly since countless release their metal containing effluents into new water with no satisfactory treatment (Canter, 1987). Polluted water when utilized for water system

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influences soil quality and agricultural productivity of the ecosystem. The industrial effluents are consisting of trace to higher amount of heavy metals, which finally generates hazards to the trophic levels of bio community as well as for the human beings, and live stock of the ecosystem. (Malik et al., 2004).

In this way, it is especially significant to access the nature of wastewater before releasing it and to build up a temperate technique for the aversion and control of ground water contamination. Ground water polluted by material effluents, has affect on agricultural water system, drinking utilities, soil and agricultural frameworks (Rajendra and yogita, 2013). Thus, it is very basic to access the status of industrial effluents and circulation and scattering of heavy metals in the region of industrial territory.

MATERIAL AND METHODS

Bikaner is an Industrial city situated at Rajasthan State in western. Beechhwaal industrial area is in the vicinity of Bikaner city and consisting of many woolen spinning , dying and textile units.

SAMPLING: Textile effluents in composite form were collected from normal gushing channel of dying units and surface water for test were collected from the closest little water bodies, while lake water was collected from a heavy lake, the Beechwal lake (11 ha) debased by industrial effluents. The ground water for tests were collected from hand pumps/tube wells of town Beechwal arranged close to the industrial region, where the profluent deplete winds up into a lake and permeate down into shallow aquifers. Soil for tests were collected from the agricultural fields close to industrial territory. Soil samples for tests were collected in polythene bags and trans ported to laboratory. Roughly 500gm soil test was collected from a profundity of 15 cm from each of the site. An aggregate number of 21 water and 9 soil tests were collected and protected. Tests collected in Borosil BOD jugs and some Jeri sticks for research facility tests. A few parameters were resolved instantly on testing locales and for rest of the parameters and heavy metals, samples to be tested were put away in icebox at 4°C.

ANALYSIS : Water/soil tests were treated in the field with concentrated HNO3 (5 ml/l of water test to decrease the pH of the specimen, pH > 2.0) for the aggregate metal estimation. Total metal content in soil was determined by processing 0.5 g of soil and digested for physico-chemical parameters and heavy metal concentration using standard methodologies. (Trivedi and Goel (1984) and (APHA, 2005).Transfer factor between ground water and soil, was find out and figured for each of the metal as indicated by the accompanying equation:

**TF = Sw (mg g–1 dry wt)/Wt (mg g–1 dry wt), where Sw is the soil metal

TABLE 1. PHYSICO-CHEMICAL PARAMETERS OF COMPOSITEINDUSTRIAL EFFLUENT.

Parameters(Unit)	Summer Mean±SD	Monsoon Mean±SD	Winter Mean±SD
Temperature (°C)	30.87±3.42	32.83±2.65	26.12±1.04
pH	9.91±0.39	10.72±0.75	10.16±0.29
TS (mg/l)	2479.25±109.11	2643.67±220.73	2262.75±31.24
TSS (mg/l)	259.5±66.84	570.67±94.87	165.75±83.69
TDS (mg/l)	2219.75±55.18	2073±193.91	2097±52.89

EC (mho/cm)	3.45±0.09	3.27±0.31	3.24±0.13
DO (mg/l)	1.2±0.91	3.23±1.25	3.52±0.47
Free-CO (mg/l) 2 BOD(mg/l)	2.5±0.72 162.5±23.12	0.73±1.27 158.33±14.57	0.42±0.49 157±21.43
COD(mg/l)	415±48.71	437.33±20.40	386.5±47.33
Total alkalinity (mg/l)	813.5±77.35	889±47.88	642.5±73.53
Ca (mg/l)	20.25±6.95	27.37±6.78	11.45±3.84
Mg (mg/l)	13.27±6.73	16.07±2.67	8.95±2.43
K (mg/l)	7.75±0.71	8.83±0.57	7.95±0.23
Cl (mg/l)	657.25±95.50	825.67±29.94	691.75±55.02
Temperature (°C)	30.87±3.42	32.83±2.65	26.12±1.04
pH	9.91±0.39	10.72±0.75	10.16±0.29
TS (mg/l) TSS (mg/l)	2479.25±109.1 1 259.5±66.84	2643.67±220.7 3 570.67±94.87	2262.75±31.2 4 165.75±83.69

TABALE-2. HEAVY METALS IN COMPOSITE INDUSTRIALEFFLUENT.

Heavy metals	Summer Mean±SD	Monsoon Mean±SD	Winter Mean±SD
Cadmium (ppm)	0.028±0.01	0.009±0.001	0.005±0.004
Copper (ppm)	0.430±0.13	0.367±0.09	0.180±0.030
Iron (ppm)	0.542±0.17	0.287±0.13	0.240±0.100
Manganese (ppm)	0.176±0.06	0.110±0.02	0.215±0.034
Nickel (ppm)	0.066±0.04	0.007±0.003	0.029±0.012
Lead (ppm)	0.475±0.11	0.330±0.03	0.407±0.158

TABLE 3. PHYSICO-CHEMICAL PARAMETERS OF GROUNDWATERINBINDUSTRIALAREA.

Parameters (Unit)	**Summer Mean±SD**	**Monsoon Mean±SD**	**Winter Mean±SD**
Temperature (°C)	31.43±2.18	31.50±2.78	25.60±0.65
pH	7.70±0.10	7.43±0.05	7.46±0.11
TS (mg/l)	1464.67±191. 19	1229.00±154. 08	797.20±165.91
TSS (mg/l)	133.00±21.51	120.66±16.92	79.00±14.82
TDS (mg/l)	1331.67±169. 74	1108.33±137. 51	718.20±151.14
EC (mho/cm)	2.08±0.26	1.73±0.21	1.12±0.24
DO (mg/l)	2.56±0.21	3.96±0.68	3.80±0.60
Free-CO_2 (mg/l)	0.93±0.15	0.16±0.29	0.22±0.30
BOD(mg/l)	35.67±8.14	31.33±23.16	14.40±11.15
COD(mg/l)	93.00±16.52	75.00±48.77	37.00±30.72
Total-alkalinity (mg/l)	557.67±59.74	584.66±23.71	493.60±31.06
Ca (mg/l)	106.67±15.27	136.66±51.32	46.00±16.73
Mg (mg/l)	92.67±25.42	88.00±32.60	32.40±16.23
K (mg/l)	5.27±0.57	6.10±0.10	5.28±0.32
Cl (mg/l)	104.33±34.27	145.00±33.15	72.20±35.25
Na (mg/l)	88.33±4.16	95.00±11.79	51.00±13.45

TABLE 4 . P H YSI C O- C H E MI C AL PAR AME T E R S OF AGRICULTURAL SOIL

Prameter (Units)	**Summer Mean ±SD**	**Monsoon Mean ±SD**	**Winter Mean ±SD**
Temperature (°C)	27.87±3.56	26.20±2.55	17.40±3.92
WHC (%)	43.75±0.48	36.13±4.92	36.94±2.83

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Bulk density (mg/cm³)	1.15±0.03	1.22±0.03	1.19±0.08
Soil moisture (%)	3.52±1.04	10.64±2.42	5.27±1.18
pH	7.30±0.20	7.56±0.18	7.32±0.32
EC (mho/cm)	27.67±2.08	26.50±1.32	24.18±1.12
Cl (µg/g)	734.33±112.01	641.67±69.29	514.80±71.52
Na (µg/g)	537.33±125.08	192.00±91.99	363.40±157.27

TABLE 5. SEASONAL VARIATION IN HEAVY METALS IN GROUND WATER AND AGRICULTURAL SOIL

	Ground water			Agriculture soil		
Heavy metals	Summer	Monsoon	Winter	Summer	Monsoon	Winter
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Cadmium (ppm)	0.008±0.002	0.003±0.003	0.007±0.001	3.33±0.61	0.67±0.55	1.78±0.44
Copper (ppm)	0.44±0.07	0.41±0.14	0.29±0.09	36.30±7.42	30.20±5.34	13.40±5.97
Iron (ppm)	3.77±0.89	1.50±0.24	1.63±0.92	76.67±16.80	26.77±10.77	28.80±13.22
Manganese (ppm)	0.55±0.07	0.37±0.15	0.28±0.08	13.57±1.40	10.23±2.38	5.90±2.79
Nickel (ppm)	0.15±0.01	0.09±0.02	0.05±0.04	10.47±0.75	7.63±1.14	5.78±1.24
Lead (ppm)	1.84±0.31	1.16±0.21	0.85±0.24	62.40±10.92	39.33±11.67	25.34±9.23
Zinc (ppm)	0.20±0.04	0.13±0.02	0.13±0.05	13.17±3.91	18.53±5.15	7.68±2.80

TABLE 6. HEAVY METALS (MEAN VALUE) IN EFFLUENT,GROUND WATER AND AGRICULTURAL SOIL SAMPLES.

Metals (ppm)	Effluent (mg l^{-1})	Ground water (mg l^{-1})	Agricultural soil (µg g^{-1})
Cadmium (ppm)	0.014	0.006	1.927
Copper (ppm)	0.326	0.384	26.633
Iron (ppm)	0.356	2.303	44.078
Manganese (ppm)	0.167	0.402	9.900
Nickel (ppm)	0.034	0.095	7.960
Lead (ppm)	0.404	1.284	42.358
Zinc (ppm)	0.242	0.153	13.127

TABLE 7. TRANSFER FACTOR BETWEEN FROM EFFLUENT TO GROUND WATER; FROM GROUND WATER TO IRRIGATEDAGRICULTURAL SOIL AND FROM SOIL SYSTEM TO GROUND WATER

M etals	E ffluent vs Ground water	Ground water Agricultural soil	Agricultural soil vs Ground water
Cadmium (Cd)	0.436	321.111	0.003
Cop per (Cu)	1.180	69.358	0.014
Iron (Fe)	6.461	19.142	0.052
Manganese (Mn)	2.409	24.606	0.041
Nickel (Ni)	2.790	83.497	0.012
Lead (Pb)	3.178	32.980	0.030
Zinc (Zn)	0.634	85.795	0.012

content and Wt is the total metal content in ground water.

RESULTS AND DISCUSSION

As the significant, source of contamination are dying and spinning units of woolen textile businesses in Bikaner district and heavy metals in the effluents achieve the form of lake and

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permeate to ground water finally. Ground water is generally utilized for irrigation system of rural fields in most parts Rajasthan state, and consequently, because of this continues water irrigation system agricultural soil quality might be affected.

General charachterstics of mixed effluent and heavy metal content are depicted in Table 1 and Table 2 individually. The physico- chemical parameters of ground water and farming soil are presented in Table 3 and Table 4 to know the general qualities and nature of ground water and soil. The comparative average concentration of heavy metals in ground water and irrigated farming soil are given in Table 5 and Table 6. The outcomes demonstrated that the accumulation of a few metals like Pb and Fe are available in ground water in overabundance amount (0.74 and

2.76 mg l-1). The metals like Mn, Ni,Cu, Cd and Zn were found in ground water as a normal concentration of 0.26, 0.07, 0.3, 0.006 and 0.1 mg l-1 individually. In Bikaner city industrial area, metals from surface water may percolate down in to shallow aquifers via soil profile after a delayed time period (R.singh et. al, 2014).

Transfer factor (TF) of various heavy metals from ground water to agricultural soil (GW Vs AGS) is one of the key segments to metals exposure through the natural way of life as detailed by Rajendra and yogita (2012). In present review, the most extreme TF qualities were acquired for Cd (321.111), Zn (85.759), Ni (83.497) from ground water to agrarian soil, while from soil to ground water the TF for metals is similarly less. General TF estimations of Pb, Fe and Mn were observed to be least and noteworthy in general at both levels of industrial area . This supports the findings that ingenuity of Cu and Cd is less while that of Pb is more in ground water and soil frameworks. The present research demonstrated the exchange of substantial heavy metals from ground water to rural soil framework because of the continued irrigation system. Some amount of substantial heavy metals may again permeate by means of soil profile and scatters in ground water resources.

Soil quality and composition may likewise change in irrigated farming fields and in this way metals are accumulated in next trophic levels, which may truly generates very serious health hazards to people by direct utilization or by take-up the dietary items produced by livestock or vegetation (De, 2002).

In the area of research, woolen textile effluent is the fundamental source of water pollution by the process of leeching. As it is the significant resource for irrigation now in drought areas of Rajasthan state, which contaminate ground water with variable measures of substantial heavy metals prompts increment in accumulation of theses metals in the rural agricultural soil. (Malik and Bharti, 2007 and Rajendra et al 2020). Considering every natural condition, and assessing the transfer factor (TF) of substantial heavy metals between ground water and soil framework, it was revealed that the polluted ground water postures negative effect on rural soil framework because of repeated irrigation system, and Furthermore it may influence the crop vegetation and finally the health of the subpopulation (singh et al 2012 and Bharti, 2012).

It was revealed by this research work that the industrial effluents are detriorating the soil and ground water quality with the special reference to the substantial heavy metals in the region of Bikaner city.

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