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Elemental Analysis of Soil, Water, Plants and Fishes Across Industrial Capital City Of Chhattisgarh State

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The object of this work undertaken was to study the influence of industrialization. Trace element or toxic elements concentration in big cities is higher as compared to village {1}. Sludge treated earth worm contains larger percentage of trace elements as compared to plain soil {2}. For example, Zn, Mn and Mo concentrations in control and sludge treated soil and in control earthworm are as mentioned below (concentration expressed in ppm).

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TABLE 1
Concentration of trace and toxic elements in soil

ELEMENTS	IN SOIL		EARTH WORM	
	In Control	In Sludge treated	In Control	In Sludge treated Soil
Zn	14-20	40-50	50-60	200-210
Mn	10-15	20-30	40-50	100-110
Mo	0.15-20	0.30-0.40	0.35-0.40	2.5-3.5
Pb	14.4+5.1	24.4+4.2	1.5+4.5	18.5+5.5
Cd	0.4+0.2	0.5+0.32	0.35+1.50	0.5+1.00

I. Introduction

Fly-ash, Soil, Water, Plants and Fish species of NTPC, HTPP Korba areas were analyzed for trace elements and some toxic elements. The relative proportion of the trace and toxic elements comprising so8il, plant or fish differ according to the locality and the degree of pollution the species has suffered. For examples sand fractions contained relatively smaller amount of trace elements except for Sr, Sn or Cr. Le Riche and Weir (1963) [3]. Investigated the distribution of several elements in soils. They found that the extracted oxides (by Ammonium Oxalate at pH 3.3 under UV Light) were richest in traced elements (3). In a well-drained soil Be, Cr, Pb and Zn decreased with depth. Different plants take up and utilize trace and toxic elements in different ways. Trace elements in plants differ markedly for example, Cu varied from 2 µg /gram V from 02 µg /gram to 1.00 µg/gram.

For the total analysis of a soil by chemical procedures, all the elements have to be brought into solution. Probably most widely used method for the total analysis for detection/estimation (by A.A.S. Technique) is to take accurately weighed amount (1gm) of sample in 250 ml. of beaker. 20 c.c. of concentrated nitric acid is added. 10 c.c. of 60% $HClO_4$ is added and the sample is digested. Filtered thought a Whatman 41 filter 0paper. The residue of SiO_2 is washed with 0.5 N HCl acid. Silica is determined separately. Filtrate is used for detection of Pb, Cd, Zn, Mo, Cr, Se and their estimations spectrophotometrically or by atomic absorption spectroscopy (AAS).

Sampling Locations (Surface Water)
SW 1 Hasdeo river at Bango reservoir.
SW 2 Hasdeo river at barrage reservoir.
SW 3 Hasdeo river at village Barbaspur
SW 4 Ahiran river just upstream of confluence with Hadeo.
SW 5 RBC of Hasdeo reservoir just downstream of KSTPS hot water discharge.
SW 6 Hasdeo river at village Ghamota.
SW 7 Hasdeo river at near Sarvamangla Devi Temple
SW 8 Hasdeo river at near village Jhinka.

Sampling Location (Ground Water)
GW 1 Hand pump in village Amgaon.
GW 2 Well in village Parasabhata.
GW 3 Well in village Balrampur.
GW 4 Hand pump in village Amagon.

Sampling Locations (Effluents)
E 1 KTSTPS and BCPP combined main plant effluent
E 2 NTPC ash pond effluent
E 3 KTSTPS ash pond effluent
E 4 Effluent from MPEB(W) Lot lota ash pond.
E 5 BALCO aluminum plant effluent.
E 6 Balco township effluent.
E 7 Effluent from new permanent ash pond of MPEB (E).
E 8 Mines water from manikpur colliery
E 9 Waste water from IBP factory.
E 10 BALCO smelter plant effluents
E 11 Manikpur CHP effluents
E 12 BALCO emulsion treatment plant effluent
These are monitoring locations.

METHODS ADOPTED FOR SAMPLING AND ANALYSIS
SAMPLING METHODOLOGY:

Samples were collected and analyzed as per procedures led down into the standard for examination of water and waste water of American Public Health Association (APHA)[4].

Random sampling method was adopted for collection of ground water sample, while composite sampling method was adopted for collection of surface water and effluent sample.

Samples for chemical analysis were collected in polythene bottles. Samples collected for metal content were acidified (1 ml HNO_3 per liter of sample). Samples for bacteriological analysis were collected in sterilized glass bottles. Some of the parameters likes pH, temperature, odor, free CO_2, free chlorine and dissolved oxygen were analyzed on site using portable water analysis kit. The other parameters were analyzed at VITRC LABS, Hyderabad. Metals concentration were determined using Atomic Absorption Spectroscopy. Whereas pesticides and Hydrocarbons were analyzed using gas chromatography.

ASSESSMENT METHODOLOGY:
The assessment of the water quality is based on:
* Review of the prescribed standards for water and waste water by different agencies.
* Review of the water quality data collected by in the region over one year.
* Quantitative description highlighting the results and characterization along the comparison amongst sources.
* Maximum, minimum, and average values have been evaluated to study the seasonal variation in water and waste water sample.
* Comparison of ground water quality characteristics with drinking water standards IS: 10500 and inland water surface water characteristics with drinking and irrigations uses as per IS:2296.

The concentration of trace and toxic elements in soil increases due to industrialization, due to waste products from coal washeries, from leeching of Bauxite, from fly ash obtained from Thermal power station.

The results have been mentioned in the below mentioned tables. The concentration (in ppm) of trace and toxic elements in soil, water, plants, and animal species of areas along with fly ash affected soil of Korba in table no.2 and table no. 3 have details of water analysis describes of fly ash affected Dengur nala in NTPC, Korba (C.G.). Name of the plants, species analyzed were Oriza Stiva. Name of the fish is Anabinus (Kewai-vernacular name).

TABLE NO.2
Meteorological data of the study area

Parameters	Year 2020-21 Months					
Highest temperature	Oct,	Nov.	Dec.	Jan.	Feb.	March
	38.00	35.00	34.00	33.00	34.00	41.00
Lowest temperature	20.00	12.00	11.50	6.00	9.00	13.00

Rainfall, mm	117.00	14.20	Nil	Nil	30.00	4.00
Minimum wind velocity km/h	--	--	--	--	--	1.83
Maximum wind velocity km/h	--	--	--	--	--	11.10
Wind direction	North-eastern in October and February, North-western in November in March irregular in other months.					

TABLE NO.3

(A) ANALYSIS DATA OF MACRO COMPONENTS AND TOXIC METALS IN SAMPLES OF FLYASH AND SOILS

Microcomponent %					Toxic metals in ppm				
Fe_2O_3	**CaO**	**MgO**	**Na_2O**	**K_2O**	**Mn**	**Ni**	**Pb**	**Cd**	
2.95	3.50	2.65	0.69	1.88	250	80	62	0.50	
2.68	3.51	2.69	0.58	1.87	240	85	70	0.40	
2.69	3.49	2.70	0.60	1.98	250	80	60	0.38	
2.85	3.60	2.70	0.65	1.97	260	79	58	0.29	
2.69	3.75	2.66	0.88	1.80	240	79	64	0.23	
2.79	3.65	2.70	0.00	1.80	260	82	65	-	
2.775	3.57	2.68	0.50	1.83	255	80.83	63.15	0.30	

(B) ASH POND EFFLUENT SAMPLES (MG/L) TOXIC METALS AVERAGE VALUES:

CaO	**MgO**	**Na_2O**	**K_2O**	**Mn**	**Ni**	**Pb**	**Cd**
41.5	17.8	55	20	37	4	8	0.28

(C) CONTAMINATED EFFLUENT SAMPLES (MG/L) AVERAGE VALUES:

Fe	**CaO**	**MgO**	**Na_2O**	**K_2O**	Mn	Cd
4.89	6.59	0.88	2.59	4.60 76	147	0.21

TABLE NO.4

INDIAN STANDARD FOR INDUSTRIAL EFFLUENTS IS AS DESCRIBED BELOW:

S.NO.	**PARAMETERS**	**LIMIT**
1	Suspended Solids	100 mg/l
2	Dissolved Solids	2000 mg/l
3	pH	5.5 to 9
4	B.O.D.	30 mg/l
5	C.O.D.	250 mg/l
6	Pb^{++} Concentration	0.1 mg/l
7	Cd^{++} Concentration	0.2 mg/l
8	Cr^{+++} Concentration	0.1 mg/l
9	Total Cr	2.0 mg/l
10	Se	2,0 mg/l
11	Zn	5.0 mg/l

TABLE NO.5

INDIAN STANDARD FOR DRINKING WATER

(IS: 10500-1998[2])

S.NO.	**PARAMETERS**	**LIMIT**
1	pH	6.5 mg/l
2	Total hardness as $CaCO_3$	300 mg/l
3	Ca	75mg/l
4	Mg	30 mg/l
5	Cu	0.05 mg/l
6	Fe	0.3 mg/l
7	Mn	0.1 mg/l
8	Cl^-	250 mg/l
9	SO_4^{-2}	0.01 mg/l
10	Se	0.01 mg/l

II. Result And Discussion:

Water from river, pond and other sources have shown to be changing in quality parameters. Total dissolved solids, suspended solids, Ph and conductivity have showed increasing trend. Mine discharge showed increasing concentration of trace and toxic elements in water. BOD, COD showed increasing trends, and

alarming situations for fresh water ecosystem. Also showed increasing trend, an alarming situation for fresh water of kusmunda mines discharge.

A plain of Chhattisgarh has limestone deposits of Cuddappa age. This time stone is mainly responsible for the hardness of water. Climate is tropical and mansoony. Forty five percent of the total area is covered by forests. Soil of Chhattisgarh plains has not been properly analyzed for trace element concentrations. Recommended daily and dietary allowances designed for the maintenance of good nutrition draws attention for the spectrophotometric and A.A.S. determination. Below mentioned table shows recommended daily dietary allowances for healthy people.[5]

TABLE NO.6
RECOMMENDED DAILY ALLOWANCES

S.NO.	**MACRO AND OF MICRO ELEMENTS**					
1.	Ca(mg)	P(mg)	Mg(mg)	Fe(mg)	Zn(mg)	Se(µg)
	1200	1200	350	10	15	70

SAFE DAILY INTAKE:

	Cu(mg)	**Mn(mg)**	**Cr(mg)**	**Mo(µg)**	**K(mg)**
2.	1.5-3.0	2 to 3	0.05-0.02	75-750	1100-3300

Deficiency affects various parts of plant growth [6][7] Zn deficiency plays a role in limiting crop yields [18]. Despite lesser degree of pollution the plants showed higher concentrations of toxic elements like Pb and Cd and lower concentrations of Zn, Mo and **Se** as has been revealed by plants and animals species analysis. In effect of fly ash this has become more prominent as shown by the Table No.2 in the several areas of NTPC, Korba district C.G.

'**Se'** is an integral component of glutathione peroxidase, provides defense against free radical oxidation, which can damage cell membranes' addition, Se is required for the digestion and absorption of lipids. Certain plants like Astragalous, accumulates Se to the tune of 1500 ppm. Mechaeranthera haploppapus and Stanleya also concentrate Se in the plants tissues. Aster, Atriplex and Grindelia also accumulate Se [19].In experimental animals, the highest concentrations, of Se has been found in the liver, kidney spleen, pancreas, heart and lungs. Of the Se administered, 35-45% was excreted within 48 hrs. And 50-60% within 12 days. Higher Se levels in the blood of people living in seleniferous regions have been reported by all away et al.

The toxicity of seleniferous plants towards sheep has been noted by a number of investigators. Thus, 340 mature sheep died within 24 hours after consuming the plant Astragalus bisulcates [20]. A 3-ppm level of Se in a 15.7% protein diet consuming seleniferous sesame cake which was fed to rats had an unfavorable effect on growth after ten days [8][9][10].

Zn deficiency has been shown to be 25- 50% in Bilaspur district.

Soil of Bilaspur and Raipur division shows Mo deficiency.

The areas under investigation show deficiency of trace elements like Zn, Mn and Mo.

Due to pollution effect of heavy mining, toxic elements like Pb and Cd have shown high concentration in soil especially in kusmunda area,

Tobacco plants of NTPC area have been found to absorb 8.0 to 7.0 mg of Cd from soil.

Pb content in fresh water shell fish in NTPC Korba have been found to be between 0.363-2.136 ppm. Shellfish is a sensitive indicator of trace and heavy metals accumulation [11].

Lead toxicity in the albino rats have been demonstrated by Bhargava, S. et al. [12] Pb is known to have multiple hematotoxin effects.

Cd concentration in fresh water Shell fish (to study the effect of fly-ash pollution) was found to be between 0.43 to 0.09 ppm depending upon the toxicity due to heavy exposure to fly-ash of river and ponds.

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