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HEAVY METAL PRESENCE IN SOIL DUE TO INDUSTRIAL WASTE DISPOASAL IN CHHATTISGARH

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ABSTRACT

Growth in population has forced mankind for rapid and quick measures to meet the demand and this has forced to go for quick , mad and thoughtless industrialization which corrupting our environment and is damaging the ecological balance. In this context the heavy industry which are growing across the major cities are seen as greater contributor to adverse pollutants. The extent of pollution in all sphere needs to be examined. The special concern is the unseen pollutants in form of wastes of heavy metals sipping in the underground water and polluting our reserve. The extent to which they are spreading and are demining has been dealt in this paper. The industrial zone of Chatisghar has been taken as case study. Proper sampling has been done from the sites and analysis in the most scientific manner through Atomic Absorption Spectrophotometer has been carried out The heavy metals like Cd, Cr, Cu, Fe, Mn, and Pb, which are mostly present in the industrial waste shows highest concentration. This is spoiling our underground reserve and at same time it is changing our soil texture and is leading to a situation where agriculture is not possible in this area.

Keywords- *Heavy Mental, Industrial waste, Soil texture, Deposits, Hygiene, Environment, Ecology .*

I. INTRODUCTION

Industrialization and human need of faster growth has lead to urbanization and need of fast development has lead to industrialization. Out of this a special type of problem and waste pattern can be experienced. Various types of wastes are generated and out these some are hazardous to human health and hygiene and some are deadly to environment. The wastes whose disposal affect environment in open manner is well evident and often think of mitigating these but the real threat is ne which is not seen by naked eyes but are changing the environment and even underground serves for now and decades to come. The wastes which are polluting our underground resources are mainly the industrial wastes. The gases and solid wastes are effecting the atmosphere which are seen and realized by man on day to day basis but the wastes , particularly slag and chemical wastes which are in liquid form get drained out in rivers , ponds or get accumulated in the nearby areas and slowly get absorbed in the soil and change their texture and in rainy season these penetrate to the underground layers also which contaminate the underground water resource and are responsible for long term affects to human being and environment. The texture change of soil is well evident when we examine the soil through soil test in labs and egt the concentration of deadly metals and chemicals in compound form. These changes affect the habitants by affecting the food chain also. The present article deals with this situation from the area around Raipur and other industrial areas in Chatisghar where major ferrous and non ferrous industries are established.

Types of Pollutants and effects

Types of pollutants seen in these areas are as follows

- i Heavy metals which are highly hazardous to the environment and organisms.
- ii These effects humans through food chain.
- iii Once soil texture is affected it is be remediated .
- iv Presence of Inorganic residues presence is also seen which cause serious problems .
- v Metals contents have high potential of toxicity.
- vi Industrial activity emits large amounts of arsenic fluorides and sulphur dioxide (SO2).
- vii Copper, mercury, cadmium, lead, nickel, arsenic are the elements which gets accumulated in the soil, if they get entry either through sewage, industrial waste or mine washings.
- viii Fungicides containing copper and mercury are also reported which add to soil pollution.
- ix Smokes coming from automobiles contain lead which gets adsorbed by soil particles and are toxic for plants which can be reduced by building up soil organic matter, adding lime to maintain soil alkaline .
- x Variety of trace elements in form of fly ash pollute the environment which leads to the leaching of pollutants into surface water and soil.

xi Coal ash leachates impact on receiving surface waters sources together with increased elemental concentrations changes water pH

xii Solid waste disposal sites close to water sources are potentially serious sources of pollution to the environment

xiii Slag generated in integrated steel plant produce , 2 to 4 tonnes of wastes (including solid, liquid and gas) per tonne of steel production.

xiv Ash disposal lead to dumping of fly ash in open land. Irregular accumulation and inappropriate disposal lead to degradation of the soil and danger to both human health and the environment.

xiv Leachate is a liquid which in course of passing through matter, extracts soluble and suspended solids, including any other component of material through which it has passed involves the elements of water imbalance and have proved to be toxic and recalcitrant.

xv Leachate mainly contains four groups of contaminants: dissolved organic matters; inorganic compounds such as ammonium, calcium, magnesium, sodium, potassium, iron, sulphates, chlorides and heavy metals such as cadmium, chromium, copper, lead, zinc, nickel; and xenophobic organic substances.

II. MATERIALS AND METHODS

Industrial Areas of Chhattisgarh Identified as Study Area

Chhattisgarh is a mineral rich state of India and have imminence potential of industrialization and houses many ferrous and non ferrous industries. It is a reasonable good producer of electricity and steel which accounts for 15 % of produce in country for India. Chatisghar produces 20% of country's cement produce in different forms and has highest reserve of coal The available iron ore is high to the tune that state is 3 rd state and topmost tin production.

To study the contamination level of heavy metals and other types of affects of wastes dumps samples from two sites 1 and 2, located around 1.5 km from disposal sites of slag and fly ash, from a depth of 30 cm from top layer were collected. Samples were properly labeled for identification in high quality polythene bags. These samples we forwarded to laboratory for further analysis.

For analysis of heavy metals due to leachate released from the dumps samples aware collected in similar manner and sent to labs for analysis.

Digestion of soil: Samples collected were air dried, then placed in electric oven at a temperature of 40 °C approximately for 30 minutes for removing the moisture contents. This powdered dried sample was homogenized through IS sieves of stainless steel 2 mm mesh. Packets of 0.1g sample by weight was made and this is one by one in three trials transferred to reaction vessel. 2.0 ml of concentrated nitric acid and 5.0 ml of concentrated hydrochloric acid were then added to each vessel. This Vessel is then placed in rotor and the rotor in microwave at the given instrument condition. At end of microwave program, the vessels were allowed to cool for half hour before removing them from the microwave. After opening the vessels the digests were filtered through appropriate filter papers and the filtrate was collected in a 100-mL volumetric flask, the volume was adjusted to 100 ml by adding 0.5% HNO3.This is then once again made in ten samples for further needful actions.

In order to know concentration of selected elements in study area due to leachate on surface water quality, ten samples from different locations were collected in pre and post monsoon seasons were collected and placed in sterilized polythene bottles. The samples were preserved with help of 1 N HNO3 and were sealed and sent / brought to laboratory for measuring heavy metal concentration by analysis.

Metal Analysis: To verify and measure the contents of heavy metals a setting of parameters as per table 1 were maintained in the Atomic Absorption Spectrophotometer (AAS) was done. The samples containing Iron, Copper, Chromium, Lead, Copper and Manganese were analyzed. Samples were diluted with 2% 1N nitric acid solution when ever required.. Table 1 shows operating conditions of AAS for selected elements.

Condition of Instrument	Cr	Cu	Fe	Pb	Mn	Zn
Lamp	Cr Hollow cathode	Cu Hollow cathode	Fe Hollow cathode	Pb Hollow cathode	Mn Hollow cathode	Zn Hollow cathode
Slit	3	4	3	4	4	4
Wavelength	358.3	324.7	248.3	283.3	279.8	670.8
Fuel	Acetylene	Acetylene	Acetylene	Acetylene	Acetylene	Acetylene
Oxidant	Air	Air	Air	Air	Air	Air
Flme Type	Slightly yellow	Oxidising	Oxidising	Oxidising	Oxidising	Oxidising

Table 1 Atomic Absorption Spectrophotometer Operating Condition

In the above mentioned table all the conditions on which the readings and experimental setup has been fixed has been outlined.

III. OBSERVATIONS, RESULTS & DISCUSSIONS

From the Atomic Absorption Spectrophotometer (AAS) selected heavy metal concentrations results of surface water samples shows that the total concentrations of the heavy metals vary seasonally in small variation with more variation of chromium (Cr). The concentration of heavy metals in Surface water near the disposal/dumping sites during pre-monsoon and post monsoon is presented in fig. 1and 2 respectively. Also it was observed that the concentration of Mn, Fe and Cr have the high concentration in pre monsoon surface water samples. In post monsoon analysis of surface water samples only the Cr has been found with high concentration. It is observed from above analysis that after monsoon seasons the heavy metals may be transported or diluted by rain water and thus concentration of metals is less.

Samples	**Cr**	**Cu**	**Fe**	**Mn**	**Pb**	**Zn**
1	**0.324**	**0.001**	**0.712**	**0**	**0.25**	**0.0513**
2	**0.641**	**0**	**1.132**	**2.135**	**0.18**	**0.02191**
3	**0.808**	**0.002**	**0.7145**	**0.756**	**0.16**	**0.0289**
4	**0.491**	**0.003**	**0.345**	**0.514**	**0.14**	**0.0041**
5	**0.291**	**0.001**	**3.306**	**2.341**	**0.16**	**0.0671**
6	**1.813**	**0.011**	**1.981**	**0.148**	**0.12**	**0.3791**
7	**2.129**	**0.013**	**0.713**	**0.2109**	**0.18**	**0.0918**
8	**3.199**	**0.002**	**1.341**	**0.143**	**0.17**	**0.1162**
9	**3.031**	**0.003**	**0.495**	**0.249**	**0.17**	**0.0513**
10	**1.761**	**0.001**	**0.541**	**0.312**	**0.19**	**0.0514**

Table 2 Pre -monsoon Metal concentrations

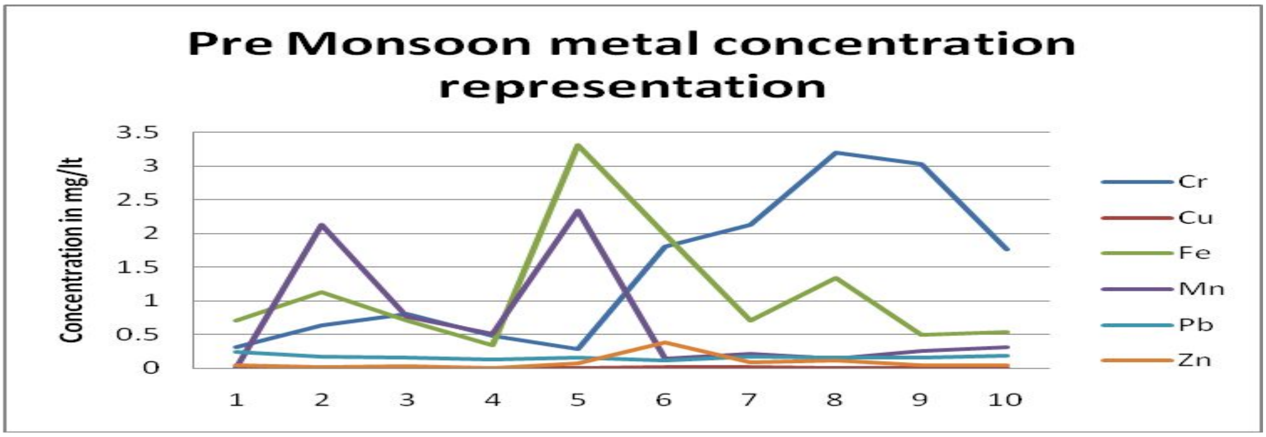

Figure 1

In the pre-monsoon season data, the Atomic Absorption Spectrophotometer (AAS) analysis reveals that heavy metals concentration of soil samples which was obtained from different distances location as per length and depths from the natural level of ground of surrounding disposal/dumping sites area is presented in various figures. Analysis reveals that concentration obtained confirms the earlier reported findings i.e. in Zn > Pb > Fe > Cr > Mn manner. The concentration of metals is higher near the site and is gradually decreasing depth and distance wise. The concentration of Fe is maximum for the sample 5 whereas for Cr it was at sample 8. The highest concentration of Mn is at sample 5 and slightly less at sample 2. The presence of Zn and Cr is low throughout because of the low content in the discharge getting accumulated near the site of samples which is coming out of the industries. Highly localized concentrations of Fe, Mn, Cr are visible from the results.

Samples	Cr	Cu	Fe	Mn	Pb	Zn
1	0.324	0.001	0.712	0	0.25	0.0513
2	0.641	0	1.132	2.135	0.18	0.02191
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9	3.031	0.003	0.495	0.249	0.17	0.0513
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Table 3 Post Monsoon Metal concentrations

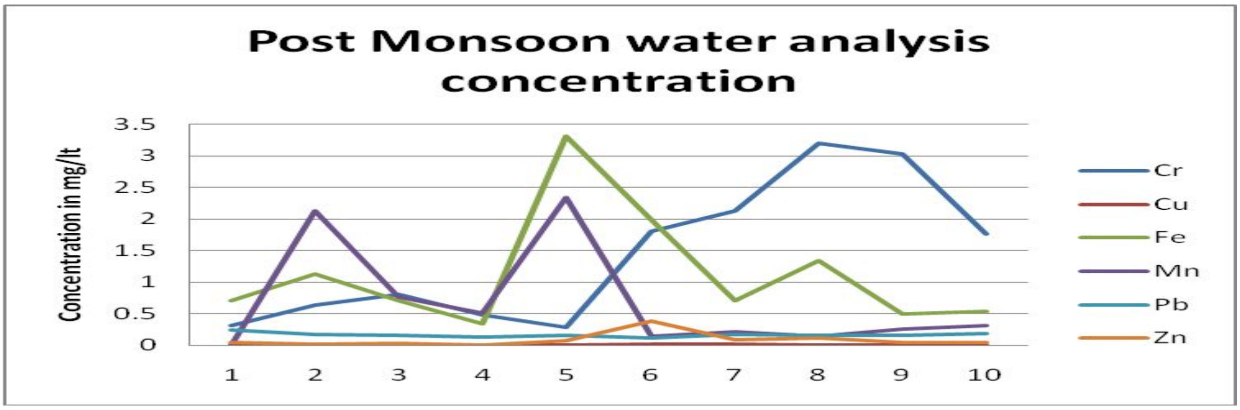

Figure 2

The result of the post monsoon observation show a similar pattern as it was in pre=monsoon observations. This shows that there is no clear indication that the pollutants leach through the falling water and the concentration of these heavy metals easily get deposited in the soil and making it less likely for its movement from site to site.

Distance in km	Cr	Cu	Fe	Mn	Pb	Zn
0.25	1.024	0.001	1.112	4.723	0.58	0.515
0.5	1.048	0.005	1.142	7.135	0.34	0.212
0.75	1.08	0.004	1.734	2.756	0.26	0.286
1	1.091	0.001	1.345	1.134	0.24	0.146
1.25	1.091	0.001	1.245	1.348	0.26	0.173
1.5	1.0813	0.001	0.91	3.043	0.12	0.107
1.75	0.59	0.002	0.043	2.701	0.08	0.08
2	0.499	0.003	0.041	1.023	0.071	0.042
2.25	0.31	0.001	0.025	2.143	0.05	0.016
2.5	0.261	0.002	0.046	4.415	0.04	0.04

Table 4 Distance wise metal concentration

The pre and post monsoon observance of metal concentration reveals that

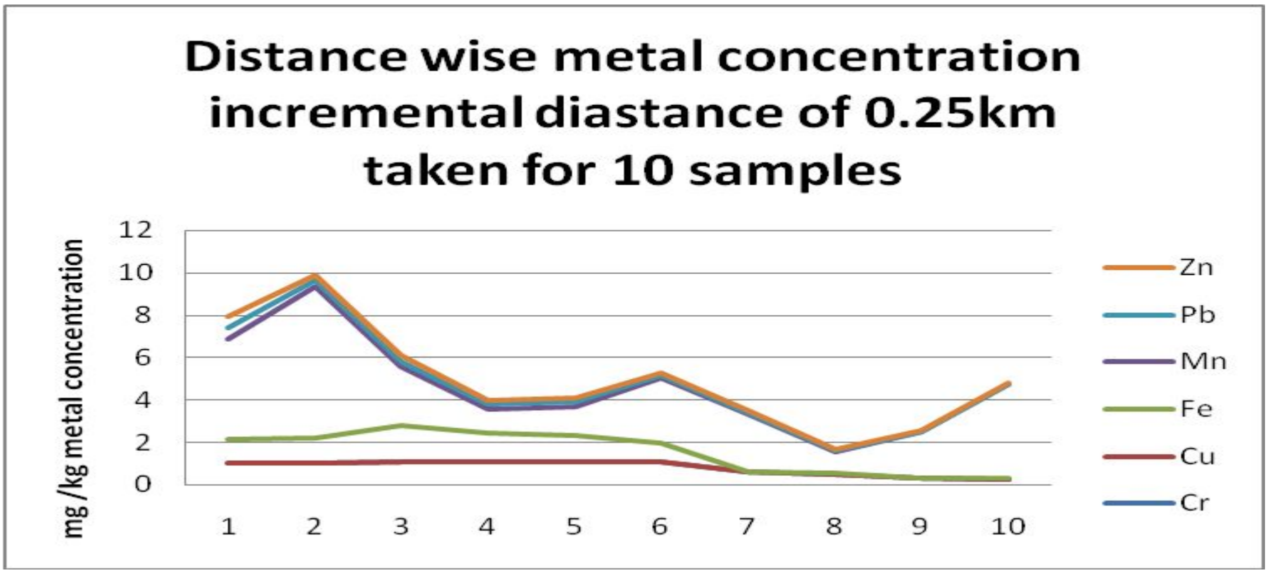

Figure 3

In the abocve graphical it is clear that the concentration of metals in gradualy decreasing with the distance we have sampled. The interesting point is that at a distance whixch is closest to the source the low level of concentration indicates that the industry oners are aware of the illegal activity and they try to remove the dirt a is one reason and other could be possibly that due to increased force due to steep slope at source the industrial waste gets drained t larger velocity and gets accomulated t a fartjer distance only. The surge in Zn after considerable distance because of the pre concentration in that area or localised dumping. The level of Cu and Fe becomes nil from distance of qarter to two km and so. The prriodical dips are perhaps because of the localised efforts due to the ersidents or the owners of industry who try to keep the environment clean.

Distance	Cr	Cu	Fe	Mn	Pb	Zn
0.1	1.134	0.006	1.11	3.72	0.48	0.215
0.2	1.048	0.005	1.14	3.13	0.34	0.212
.0.3	1.001	0.004	1.11	2.75	0.26	0.186
0.4	0.91	0.004	1.045	2.13	0.24	0.143
0.5	0.81	0.003	1.01	1.94	0.16	0.123
0.6	0.74	0.003	0.913	1.543	0.12	0.107
0.7	0.59	0.002	0.663	1.21	0.12	0.09
0.8	0.45	0.002	0.441	1.02	0.112	0.072
0.9	0.36	0.002	0.425	1.01	0.08	0.066
1	0.26	0.001	0.346	0.85	0.04	0.054

Table 5 Depth wise soil analysis of metals

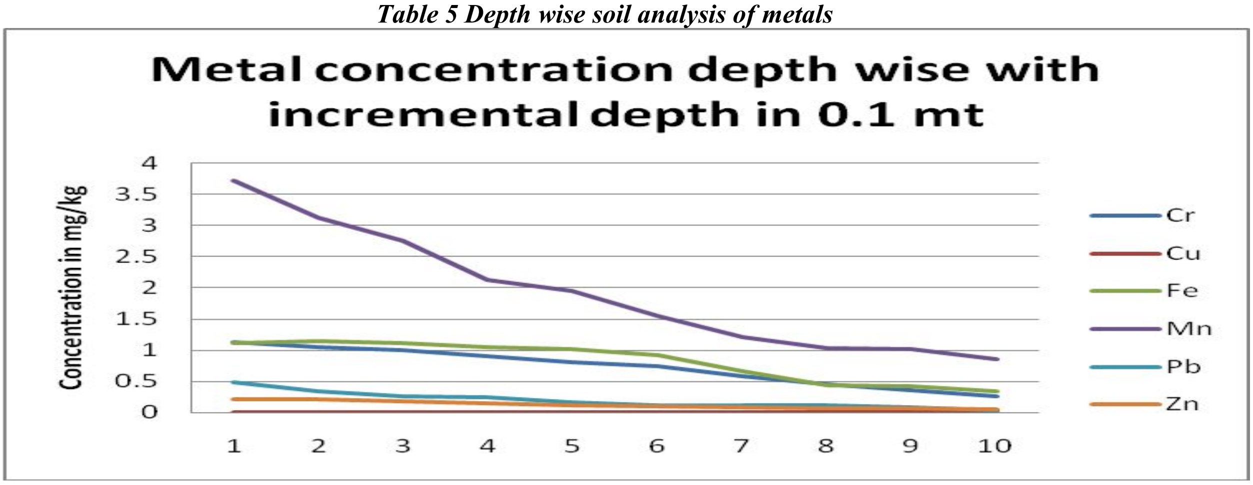

Figure 4

IV. CONCLUSION AND RECOMMENDATIONS

Soil and its biota are essential a component of the earth's living skin directly sustains life . After the analysis of soil samples, a general conclusion that could be reached is that the concentrations of heavy metals in soil near to the dumping/disposal site is more and decreases as distance increases. Also in the depth wise analysis, it was observed that the in most of the soil samples, higher concentrations of selected heavy metals are observed near the surface of ground and magnesium which has highest concentration. The surface water analysis also indicated that the concentrations of Cr and Mn are higher before and after the monsoon. Leachate pollution can be reduced by using scientific designed dumping sites with liners and if possible the amount of industrial solid waste generation may be reduced with the help of process modification of particular products. Also the higher pH (alkaline) of the disposed industrial solid wastes may reduce the leachate generation, so suitable alternatives can be used for the same at the time of industrial solid waste disposal or dumping near populated vicinity.

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