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Assessment of Heavy Metal Toxicity in Soils Nearby Municipal Solid Waste Dumping Site, Mathuradaspura - Jaipur

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Abstract : Increasing population and unplanned urbanisation have resulted in vast problem of disposal of municipal solid waste. MSW has its inevitable effects on pollution of air, water and soil depending upon the type of waste material. The soil pollution not only affects the human health but also the total ecosystem including the flora and fauna of the area. The present study is aimed to evaluate the soils around the MSW dumping site (Mathuradaspura-Jaipur) with special reference to heavy metals (Fe, Zn, Cr, Ni, Cu, Pb and Cd). The soils of all the four seasons was collected, analysed and found that the heavy metals are present in all the samples of the study area.

Key words : MSW, Heavy metals, Soil, Seasonal variation, Toxicity.

Introduction

Heavy metals is a general collective term which applies to the group of metals and metalloids with atomic density greater than 4 g/cm^3 or 5 times or more, greater than water (Nriagu and Pacyna, 1988; Hawkes, 1997). Heavy metals can accumulate in soils in and around solid waste dumping site and can reach toxic levels. These heavy metals can be harmful for plants and animals and human beings directly or indirectly. Such an accumulation is a major threat to human population

Land filling is the oldest and cheapest way of disposing Municipal Solid Waste (MSW). Almost 95% of the solid waste generated world wide is currently disposed in landfill. Large amount of the waste comprise organic material, but there are considerable proportions of plastic, paper, metal rubbish and batteries which are known to be real sources of heavy metals (Lisk, 1988; Zhang *et al.*, 2002; Pasquini and Alexander, 2004). Municipal composts and yard wastes often contain high concentration of heavy metals like Cu, Zn, Cd, Cr, and Ni than those found in soils (He *et al.*, 2001).

In India conventional handling of MSW poses a serious threat to environment as well as public health as most landfills are not well engineered and use the technique of open dumping and burning.

Materials and Methods

The present study was carried out in the Mathuradaspura area. It is located on Jaipur Jamwa Ramgarh road. The municipal solid waste is dumped in the site allocated for dumping. It is around 22 kms. from the Jaipur city. The method of solid waste disposal is open dumping in the primitive water channels and ravines. Soil samples were collected from the villages (Badi Ka Bas, Meena ki Dhani (Core site), Langriyabas and Rupa ki Nangal) around the municipal solid waste dumping site. The sampling was done from the agriculture land located in these villages. The soil samples were collected from 0-10 cms. depth at all sites. Four season soil sampling was done in the months of May, August, November and February signifying the summers, monsoon, winter and autumn. Five soil samples were collected from the study area and analysed for heavy metals such as Fe, Ni, Cd, Cr, Zn, Pb etc. Heavy metals were analysed by AAS method. Atomic Absorption Spectrophotometer (AAS) utilises the principle that elements in the gas phase absorb light at very specific wavelengths and this absorption is proportional to the concentration of the element. Quantification is achieved by preparing standards of the element and comparing unknown sample to a set of samples of known concentration.

Results and Discussion

During the analysis varied results were found for different locations and seasons. In summer the Cu

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content was in the range of 6.36 to 14.21 mg/kg, Zn from 38.35 to 346.51 mg/kg, Ni from 5.73 to 24.01mg/kg, Cr from 29.31 to 97.18 mg/kg, Fe from 3934.64 to 15223.3 mg/kg while Pb and Cd were not traceable. In the month of August (Monsoon) the Cu was not traceable, Zn varied from 27.5 to 69.56 mg/kg, Ni from 8.8 to 18.69 mg/kg, Cr from 33.45 to 88.62 mg/kg Fe from 3592 to 10970.42 mg/kg while Pb and Cd were not traceable. In winters the Cu was again not traceable, Zn from 32.155 to 175.98 mg/kg, Ni from 2.85 to 16.27 mg/kg, Cr from 24.37 to 88.36 mg/kg, Fe from 4951.36 to 10207.68 mg/kg while Pb and Cd were not traceable as other seasons. In the Autumn season Cu ranged from 1.26 to 23.64 mg/kg, Zn from 23.95 to 43.36 mg/kg,

Table 1: The analysis of Heavy Metals for the month of May 2009 (Summers)

S.No	Location	Cu	Zn	Ni	Pb	Cr	Fe	Cd
1	S1	6.36	38.35	5.73	NT	31.36	4529.57	NT
2	S2	9.49	346.51	13.86	9.02	64.28	9542.33	0.47
3	S3	NT	84.12	5.69	NT	29.31	3934.64	NT
4	S4	NT	96.26	14.63	NT	67.88	8865.57	NT
5	S5	14.21	58.43	24.01	NT	97.18	15223.3	NT

Table 2: The analysis of Heavy Metals for the month of August 2009 (Monsoon)

S.No	Location	Cu	Zn	Ni	Pb	Cr	Fe	Cd
1	S1	NT	66.44	14.88	NT	78.4	10445.66	NT
2	S2	NT	54.91	18.69	NT	88.62	10970.42	NT
3	S3	NT	43.28	9.34	NT	36.54	3592	NT
4	S4	NT	69.56	8.8	NT	65.62	4625.49	NT
5	S5	7.7	27.5	11.12	NT	33.45	7250.5	NT

Table 3: The analysis of Heavy Metals for the month of November 2009 (Winters)

S.No	Location	Cu	Zn	Ni	Pb	Cr	Fe	Cd
1	S1	NT	140.37	15.4	NT	32.155	7779.53	NT
2	S2	NT	117.88	12.12	NT	41.16	8508.23	NT
3	S3	NT	175.98	2.85	NT	24.37	4951.36	NT
4	S4	NT	175.86	16.27	NT	88.36	14437.36	NT
5	S5	NT	32.15	12.8	NT	39.89	10207.68	NT

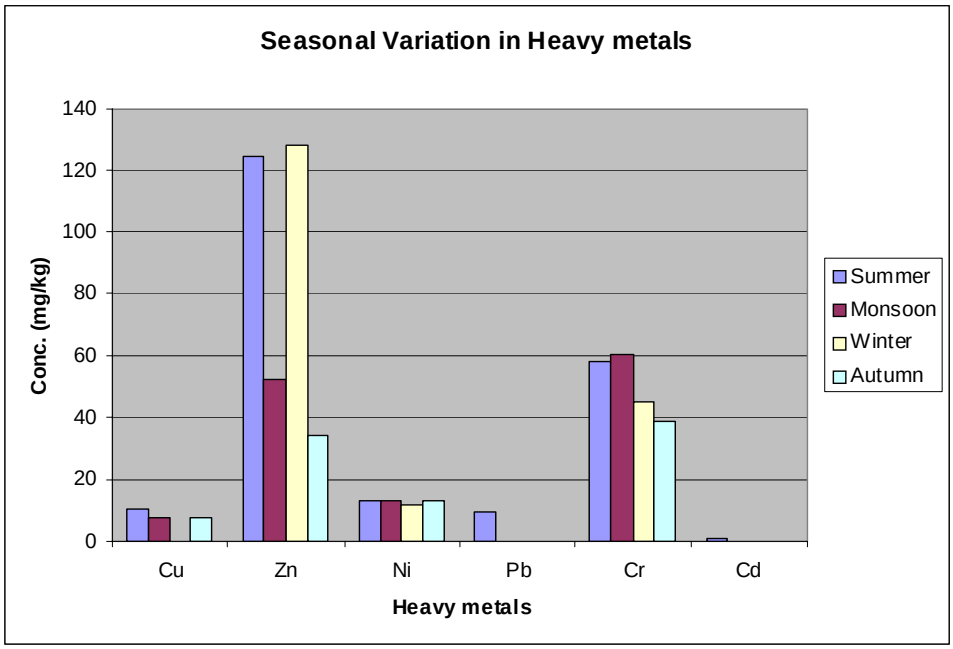
Table 4: The analysis of Heavy Metals for the month of February 2010 (Autumn)

S.No	Location	Cu	Zn	Ni	Pb	Cr	Fe	Cd
1	S1	4.11	35.72	19.92	NT	51.4	11279.07	NT
2	S2	1.26	33.21	12.65	NT	36.27	6378.9	NT
3	S3	NT	34.18	4.9	NT	27.2	3260.57	NT
4	S4	23.64	43.36	18.83	NT	49.66	7533.87	NT
5	S5	1.4	23.95	8.59	NT	29.15	4354.55	NT

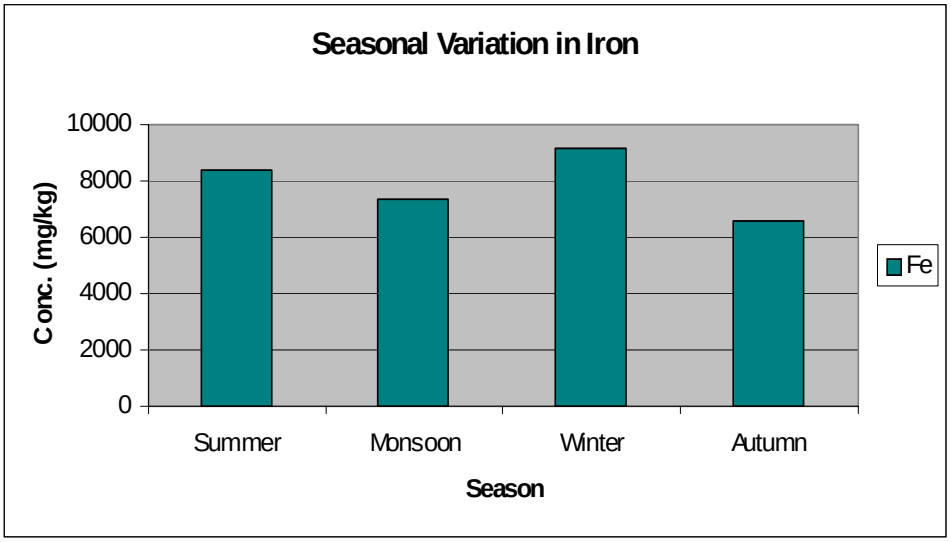
Note: *All the heavy metal contents are in mg/kg.*
The sampling locations are S1–Badi ka Baas, S2–Meena ki Dhani, S3–Rupa ki Nangal, S4–Langriyabas, S5–Bridge dumping site.

Ni from 4.9 to 19.92 mg/kg, Cr from 27.2 to 51.4 mg/kg, Fe from 3260.57 to 11279.07 mg/kg, Pb and Cd were not traceable. Table 1 to 4 depicts the results of four seasons.

It is evident from the result that iron content is maximum in the soil of study area and heavy metal such as lead and cadmium are not traceable. The other heavy metals such as Zinc is found in higher quantity in the summer and winter seasons. Chromium is higher in summer and monsoon season while the values are low for winter and autumn. Nickel is present in low concentration in all the seasons of the year. Copper is present in least quantities mainly in summer, monsoon and autumn season. Cadmium is absent in three seasons while found in traces in summers. Same result is obtained for lead. Over all the sequence of available heavy metal concentrations in these soils was found to be Fe > Zn > Cr > Ni > Cu > Pb > Cd. The graphs 1 and 2 reflect the comparative average seasonal variation for Iron and other heavy metals. It can be attributed that the heavy metals in the soil are due to the municipal solid waste being dumped in the area. Slow leaching of heavy metals from



Graph 1: Seasonal Variation of Heavy metals



Graph 2: Seasonal Variation of Iron

MSW may be the reason for soil contamination. Soils contaminated with heavy metals such as Zn, Pb, Ni, Cu and Cd are hazardous as these heavy metals may be easily taken up by crops and ultimately causing harm to human beings (Adija *et al.*, 2008). Pollution of agricultural soil by heavy methods and its absorption and accumulation in plants was also reported by Trueby (2003). Animals that graze on such plants and drink polluted waters also accumulate heavy metals in their tissues and milk if lactating (Horsfall and Spiff, 1999; Peplow, 1999).

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