I.J.A.B.R, VOL. 3(2) 2013: 181-183 ISSN 2250 – 3579

INTERNATIONAL JOURNAL OF ADVANCED BIOLOGICAL RESEARCH

www.scienceandnature.org

RESIDUAL EFFECT OF GARBAGE DISPOSAL SITE IN GUWAHATI, ASSAM

Bijoya Choudhury & Amalesh Dutta
Department of Zoology, Gauhati University, Jalukbari, Guwahati 781014

ABSTRACT
A study was conducted to examine the long term effect of open dumping of Municipal solid waste (MSW) in the city of Guwahati. This paper presents concentration of three trace elements (Cd, Zn, Pb) in the soil in a 3 year old abandoned dumpsite used for MSW disposal over a five year period (2002-2006). The residual trace elements were analyzed in soil collected at various depths (15 to 60cm) as well as at various radial distances (0 to 40m) from the source during monsoon and post monsoon seasons. The study allowed us to estimate residual amount of these elements 3 years after garbage disposal was stopped. Cd and Pb showed higher concentration in surface soil whereas Zn was within Maximum permissible limit (MPL). At different depths Cd was within permissible limit, Pb concentration was less in Monsoon but it was in higher range in post monsoon and Zn was within MPL in both the seasons. Accumulation of these elements in soil can contaminate surrounding water sources as surface runoff reaches neighboring water bodies and may lead to bio-magnification through food chain.

KEY WORDS: Solid waste, Cadmium, Lead, Zinc, Unsorted, Open dumping.

INTRODUCTION

Solid waste management is an inevitable task in urbanization process. With increasing population waste generation also increases and becomes one of the biggest sources of environmental degradation. Solid waste management in many of the cities of India was restricted to transportation of the waste from the source to the open unsorted waste disposal sites. From time to time these sites are abandoned. This had negative impact on surface water as well as ground water pollution as further monitoring of toxicity generated from these sites is not monitored. Study of environmental impact of abandoned composting unit in Bangalore (D'souza and Somashekar, 2012) has revealed that water reserves have been deteriorated by the percolation of untreated leachate. It is established that the leachate generated from the closed landfills can have equal or more contamination potential in comparison to the active landfill sites and hence the remediation actions and post-closure monitoring should be ensured at the closed landfills till the leachate generated is stabilized and pose no further threat to the environment (Kumar and Alappat, 2005). Heavy metals may accumulate unnoticed to toxic levels (Ahmed *et al*. 2002). Guwahati is the only major city in the North East India with a population of about 10 million. Earlier as the population was less the enormity of the problem was not felt. Since 1965 unsorted MSW (Municipal Solid Waste) is being dumped in the open. So far five locations have been changed (Marakhali till 1965, Present Swahid park at Fatasil 1965-1977, at Barsapara 1977-1995, Back side of Adabari bus terminus 1996-2002, Chachal, 2002-2006 and Boragaon, 2006 till date. In the present study a dumping site used during 2002 – 2006 (Chachal) was taken for investigation three years

after it was abandoned since 2009. The aim was to record whether soil retains heavy metal concentration beyond MPL and further eco-restoration is required. Three heavy metals were considered for this study. Zn is included in the essential metals and Cd and Pb are included in the highly toxic metals based on their human health importance (Sharma and Agrawal, 2005). Residual high concentration of heavy metals can have adverse effect on flora and fauna through bio magnification.The study area is located at Chachal (26^{o} 8.58$^{/}$ N and 91^{o}48$^{/}$ 43.23$^{//}$ E), Guwahati. The site was used for open dumping of unsorted MSW from 2002 to 2006. Average temperature of Guwahati is 12^{o}C - 35.5 ^{o}C. and Average annual rainfall in Guwahati is 1,600 millimetre (mm)

MATERIALS AND METHODS

Topsoil from the dumping site was collected at various radial distances (0 - 40m) from the dumping ground. Soil samples were collected from different depths (15 cm, 30 cm, 45 cm and 60 cm). After analysis data were pooled so that a clear picture emerges to assess the extent of contamination if any. The collected soil samples were air dried and other debris were removed manually, ground, sieved through 2mm sieve and stored in polyethylene bags for further analysis. Sample preparation for analysis of trace metals in soil was done as per the procedure given by Pinta (1975). Digestion was done in a fume-hood until white residue remained. The sample was then made up to 50 ml and then filtered. An elemental analysis was done at SAIF, NEHU, Shillong.

RESULTS

In Guwahati unsorted open dumping was done in the Chachal area from 2002 to 2006.The site was abandoned since 2006. The site was taken for present investigation since 2009 *i.e*. three years after the garbage dumping was stopped. Soil samples collected from various radial distances and at different depths were tested for three heavy metal accumulations. Cd, Pb and Zn were selected for the study. Table 1 shows concentration of these elements in soil at various depths. Control samples were taken from private garden away from the garbage dumping site. Cd was within permissible limit, Pb concentration was less in Monsoon but it was in higher range in post monsoon whereas Zn was within MPL. Concentrations were always higher than the Control data in both the seasons.

TABLE 1: Concentration of Cd, Pb and Zn (in mg/l) at 15-60cm depths in Monsoon and Post Monsoon season

Element	Monsoon					Post-Monsoon				
	Control	Range	Mean	S.D	S.E	Control	Range	Mean	S.D.	S.E.
Cadmium	0.0065-0.0558	0.025-0.135 N=18	0.086	0.026	0.006	0.0246-0.0428	0.027-0.135 N=40	0.078	0.023	0.004
Lead	BDL	0.008-0.558 N=15	0.346	0.251	0.067	BDL-0.644	0.142-1.283 N=39	0.576	0.261	0.424
Zinc	0.141-0.265	0.139-0.834 N=17	0.449	0.56	0.14	0.068-0.332	0.125-0.800 N=36	0.484	0.236	0.039

Top soil was collected from different points away from the source. (Table 2) shows the concentration of these elements in soil at various (0 to 40m) radial distances so that concentration in monsoon as well as in post monsoon could be ascertained. Cd and Pb showed higher concentration in surface soil whereas Zn was within permissible limit (MPL). More data were recorded in post monsoon season so that extent of surface spreading after monsoon could be ascertained. Monsoon and post monsoon data analysis revealed that data were similar with minor variation**.**

TABLE 2: Elements at Radial Distances from the center (in mg/l) (Values represent mean of three replicates)

Element	Radial distance	Monsoon ppm (n=3)		Post Monsoon ppm (n=3)		MPL (as per WHO, 1993)	IS:10500 (1993)
		Control	Exptl	Control	Exptl		
Cadmium	0-40m	0.107	0.017 -0.096	0.015	0.015-0.064	0.003	0.01
Lead	0 – 40m	0.169	0.2-0.83	0.69	0.29-0.35	0.05	
Zinc	0 – 40 m	0.405	0.160-2.420	0.420	1.314 – 2.420	5.0	10.00

Data were compared with national and international standards of inland surface water. In Guwahati during monsoon most of the areas are inundated with rainwater and percolates to deeper soil layer. The runoff water carries the dissolved material to neighbouring aquatic systems thereby contaminating surface water as well as ground water. The superimposed data shows that Zn and Cd were within MPL and Pb was always on the higher range. Table-3 shows comparison of data with Central pollution control board (CPCB) limit (1996), Indian standard for inland surface water (1993) and WHO limit (1993).

TABLE 3: Comparison of trace elements in inland surface water with national and international standards (in mg/l)

Elements	Surface soil (0-40m), n=3		Depth (15-60cm)		CPCB (1996)	WHO (1993)	IS:10500 (1993)
	Monsoon	Post Monsoon	Monsoon	Post Monsoon			
Cadmium	0.017-0.096	0.015-0.064	0.025-0.135	0.027-0.134	2.0	0.003	2.0
Lead	0.2-0.83	0.29-0.35	0.008-0.558	0.142-1.283	0.1	0.05	0.1
Zinc	0.160-2.420	1.314 – 2.420	0.139-0.834	0.125-0.800	5	5	5.1

DISCUSSION

Waste disposal sites pose a serious threat of pollution to the environment, especially when located very close to human settlements and water sources and operated unscientifically. Landfill leachate is very harmful to the surrounding soil and water as it percolates to neighbouring ecosystem during monsoon as surface runoffs. Various studies have highlighted the effect of MSW runoff on the ecosystem (Zafar and Alapat, 2012, Rana *et al*, 2010, D'Souza, 2012 and Nie *et al*, 2011). In the present study sampling was planned in such a way that contaminants could be recorded from surface soil layer as well as from different depths. The three elements were selected because Zinc belongs to a group of trace metals which are essential for the growth of human health, animals and plants and are potentially dangerous for the biosphere when present in high concentrations. The main sources of pollution are industries and the use of liquid manure, composted materials, and agrochemicals such as fertilizers and pesticide in agriculture (Romic et al. 2003). The other two elements Cd and Pb are included in highly toxic elements. In the present study Zn was found within MPL both in topsoil as well as in 0-40cm depth. D'Souza and Somashekar (2012) found that lake water near an abandoned MSW composting site in Bangalore showed concentration of Zn, Cd and Pb in higher range during monsoon and in lower range during post monsoon season. In the present study minor variation in Seasonal difference in concentration was observed. This may be due to partial restoration of the soil that might have taken place in three years' time as every year during monsoon accumulated material is carried by runoff water. Concentration of metals in soil is hazardous as bioaccumulation through plants and soil organisms increases the concentration in subsequent food chain. With increasing population and urbanization, the generation of solid waste has increased tremendously from domestic, commercial, industrial, agricultural and other sources. Precipitation infiltrates the solid wastes disposed on land mixing with the liquids already trapped in the crevices of the waste and leach compounds from the solid waste (Vasanthi *et al*. 2007). The continuous use of sewage waste water for crop production result in accumulation of trace elements in concentration that may become phytotoxic (Kirkham, 1983). Shifting of waste disposal sites within the city and non-monitoring of abandoned sites is of concern as surface water quality is affected by landfill surface runoff. This is one of the causes of river pollution. Similar study was done in the capital city of Delhi (Zafar and Alappat, 2004) where 12 large landfill sites are located very close (0.5-6km) to the river Yamuna. The river water quality was affected by the presence of landfill surface runoff. In Guwahati so far five locations have been changed since 1965. Therefore a long term environment friendly solution is required for the city of Guwahati.

REFERENCES

Central pollution control board (CPCB) (1986) General standards for surface water, cpcb.nic.in/General standards.pdf

D'Souza, P. and Somashekar, R.K. (2012) Environmental impact of an abandoned composting unit in Bangalore. International Journal of Science and Nature. vol. **3(3):**651-661.

Indian standard specifications for drinking water.hppcb. gov.in/eiasorang/spec.pdf.

Kirkham, M.B. (1983) Study on accumulation of heavy metals in soils receiving sewage water. Agri. Ecosys. Environment., **9,** 251-255.

Kumar, D and Alappat, B. J. (2005) Evaluating leachate contamination potential of landfill sites using leachate pollution index. Clean Technol. Environ. Policy **7**, 190-197.

Nie,Y., NIU, D. and Bai, Q. (2000) the management of Municipal solid waste in China. Journal of environmental Science and Health, part A, **35**: 10, 1973 – 1980.

Pinta, M. D. (1975) Detection and determination of trace elements, ANA, Arbor Science Publication INC.

Rana, L., Dhankhar, R. and Chhikara, S. (2010) International journal of environmental research **4(3):** 513-518.

Romic M, Romic D (2003) Heavy metals distribution in agricultural topsoils in urban area. Environmental Geology **3**:795–805.

Sharma, R. K. and Agrawal, M. (2005) biological effects of heavy metals : An overview. J. Environ.Biol., **26(2** suppl**)**, 301-313.

Vasanthi, P., Kaliappan S. and Srinivasaraghavan R. (2007) Impact of poor solid waste management on ground waste. Environmental Monitoring and Assessment, **143**:227 -238.

www.who.int/water_sanitation_health/.../surfacewater/en/index.html.(surface water quality standards.)

Zafar, M. and Alappat, B. J. (2004) Landfill surface runoff and its effect on water quality on river Yamuna. Journal of Environmental science and health. Part a-Toxic /hazardous Substances 7 environmental engineering Vol. A **39**, no.2.pp.375-384, 2004.

Abbreviations:
SAIF-Sophisticated Analytical Instrumentation facility
NEHU-North Eastern hill University, Shillong