Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 4, Issue, 12, pp.160-162, December, 2012

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

DETERMINATION OF HEAVY METALS IN SOME SELECTED WASTE DUMPSITES IN GBOKO METROPOLIS, BENUE STATE, NIGERIA

Anhwange Benjamin, * Kaana Asemave, Leke L. and Igbum O. G

Department of Chemistry, Benue State University P. M. B. 102119 Makurdi, Nigeria

ARTICLE INFO

Article History:
Received 19th September, 2012
Received in revised form
20th October, 2012
Accepted 11th November, 2012
Published online 18th December, 2012

Key words:
Concentration,
Dumpsites,
Heavy Metals,
Soil samples.

ABSTRACT

Heavy metals were determined from waste dumpsites in Gboko metropolis, Benue state, Nigeria. The mean pH values of the soil samples were found to be 7.70 and 7.15 for Gboko North and South respectively. The analysis of heavy metals indicate that samples from Gboko North show mean concentrations (mg/kg) of heavy metals as; Pb (0.966), Ni (0.514), Cd (0.298), Al (0.223), Cr (0.092), As (0.051). Samples from Gboko South indicate mean levels of heavy metals as follows; (1.300mg/kg), (0.377 mg/kg), (0.191mg/kg), (0.009mg/kg), (0.18mg/kg), (0.042mg /kg) for Pb, Al, Cr, Ni, As, and Cd respectively. In Nutshell, Ni, and Cd were found to be relatively higher in Gboko north than Gboko south. On the other hand, the levels of Pb, Cr, Al, and As were higher in Gboko South than Gboko North. All the heavy Metals were within the WHO acceptable limits except Cd and Cr which were slightly above these limits in some dumpsites. Although Heavy metal concentration in refuse dumpsites of Gboko metropolis may not appear to pose a very serious environmental problem at the moment, continuous accumulation of these metals in Gboko metropolis may result into some health threat to human and the environment in future.

INTRODUCTION

Like many cities among developing country, Gboko, a major town in north central Nigeria is faced with environmental challenges such as improper disposal of refuse near residential areas and other public places within the town. It is very common to find huge refuse dumpsites within residential areas and along some minor and major roads. Most dumpsites in Gboko especially those located on undeveloped plots of land are used as 'fertile soils' for the cultivation of vegetables and other annual crops. The cultivation of these crops on these dumpsites may lead to physical and chemical interaction between the waste materials and the crops [1]. Such interactions may be short or long depending on the type of materials and their degree of exposure [2]. Leachates from refuse dumpsites may result into contamination of soil (i.e invariably the vegetation) and the aquatic environment [3].

The most common pollutants found from refuse dumps are the heavy metals. The contamination of soils and hence the vegetation by heavy metals via dumpsites means has being a major concern for all [4]. High and excessive accumulation of heavy metals in soil may eventually contaminate the food chain [5]. Studies have shown that municipal refuse may increase heavy metal concentration in soil and underground water which may have effects on the host soils, crops and biodiversity. Total heavy metal content is a critical measure in assessing risk of a refuse dumpsite [1]. Predicting the impact of the emission of heavy metal on the environment requires the evaluation of not only the short-term fate of the pollutants, but also of their medium-and long-term interaction with the ecosystem. The information obtained can be used to establish risk assessment criteria and to design remediation strategies [6]. This study is therefore target to investigate the level of some heavy metals (lead Pb, nickel Ni, cadmium Cd, aluminum Al and chromium Cr) in soils from refuse dumpsites found within Gboko municipal area of Benue state, central Nigeria.

***Corresponding author:** kasemave@gmail.com

MATERIALS AND METHODS

Sample collection and preparation

Soil samples of topsoil (0-12cm) were collected in triplicate from three dumpsites in each of the two zones of Gboko metropolis (Gboko North and South). Composite samples were made out of them in a polyethylene bag and taken to the laboratory for analysis. The samples were air dried, ground to pass through a 2mm sieve using mortar and pestle.

Digestion of samples

0.5g of the sieved soil sample was digested in 12ml of aqua regia (3:1 HCl-HNO_3 v/v) using a hotplate in a fume cupboard at until white fumes were observed. The sample was allowed to cool to room temperature and then diluted with 20ml of 2% nitric acid (v/v). The mixture was transferred into a 100ml volumetric flask after filtering using whatman no.42 filter paper and made to mark with distilled water [7]. The extracts were analyzed for heavy metals using AAS.

RESULTS AND DISCUSSION

Results

The result for determination of heavy metals in waste dumpsites in Gboko municipality is presented in Figure 1.0 below, as obtained from Table 1.0 and 2.0:

Discussion

The values of nickel (Ni), and cadmium (Cd) were found to be relatively higher in Gboko north than Gboko south. On the other hand, the levels of Lead (Pb), chromium (Cr), aluminium (Al), and Arsenic (As) were higher in Gboko south than Gboko north as contained in Table 1.0 and 2.0. The levels of Pb were found to be higher than any of other metals analysed in the refuse dumpsites. This can be attributed to the presence of lead containing waste at the dumpsites, which eventually leached into the underlying soils. It could also be as a result of their proximity to mechanic workshops and the highways which are associated with or heavy traffic [8]. Lead level of 10µg/dL or above is a cause for concern. Lead had been is known to have harmful health effects even at lower levels and there is no known safe exposure level.

It is pertinent to not that exposure to amount of lead above 0.01mgL^{-1} is detrimental to health, as it may result in possible neurological damage to foetuses, abortion and other complication in children under three years old [9].

Aluminium and arsenic were found in small concentrations in all the sites. This indicates that wastes carrying aluminium and arsenic were present low concentrations in the dumpsites. The low concentration could be attributed to the absence of Al and As based industries, low use of materials containing Al and As and smelting activities in Gboko.

Chromium (Cr) was also detected in all the dumpsites as observed in Figure 1.0, with particularity worrisome level in three of the dumpsites (A, B and E) that gave concentration above WHO standard. This may also be attributed to use of Cr containing materials. Chromium +3 is less damaging to the health due to their absorption by the body (<1%), but Cr +6 is acutely poisonous and on contact with the skin, it triggers dermatitis, allergies and irritations, thus considered as carcinogenic to humans [9] Cadmium (Cd) was detected in all the dumpsites as found in Figure 1.0. Cd level was found to be slightly above the WHO limits in dumpsites C. Cadmium batteries, metal scraps etc. are being dumped from the industrial and residential areas, which might have contributed to the large concentration of the metal [10, 11]. Uba *et al*. [12] reports that Cd has highest level bioavailability in dumpsites. In general, the Concentration of Pb, Cd, Ni, Cr, Al, and As may be attributed to various sources, some of which include automobile tire dust, burning of oil and tyre, plastic wrappings, paints, dyes, and especially, refuse dumps and commercial activities [13]. The levels of heavy metals detected in these refuse dumpsites fall within the allowable limit set by the world health organization [14] except for Cr and Cd

Conclusion

From the studies, all the dumpsite in Gboko metropolis contained most of these heavy metals. It was also observed that some dumpsites had higher concentration of these metals than others; this could be attributed to the presence of waste carrying higher amounts of these heavy metals. The heavy metals concentration in these dumpsites were all within the WHO acceptable limit in some dumpsites except Cd and Cr which were slightly above this limits in some dumpsites.

Table 1.0: Results of heavy metal concentration (mg/kg) in Gboko North Waste Dumpsite

site	Pb (mg kg^{-1})	Ni(mg kg^{-1})	Cr(mg kg^{-1})	Al(mg kg^{-1})	Cd(mg kg^{-1})	As(mg kg^{-1})
A	1.575± 0.003	0.592± 0.005	0.242± 0.002	0.092± 0.003	0.075± 0.002	0.055± 0.003
B	0.334± 0.004	0.350± 0.002	0.350± 0.010	0.083± 0.004	0.070± 0.006	0.047± 0.002
C	0.990± 0.002	0.602± 0.004	0.005± 0.010	0.495± 0.002	0.751± 0.001	0.055± 0.003
Mean	0.966± 0.003	0.574± 0.003	0.092± 0.007	0.223± 0.003	0.298± 0.003	0.051± 0.002

Table 2.0: Results of heavy metal concentration (mg/kg) in Gboko South Waste Dumpsite

site	Pb(mg kg^{-1})	Ni(mg kg^{-1})	Cr(mg kg^{-1})	Al(mg kg^{-1})	Cd(mg kg^{-1})	As(mg kg^{-1})
D	1.220± 0.001	0.009± 0.002	0.042± 0.004	0.503± 0.007	0.036± 0.002	0.466± 0.003
E	0.650± 0.003	ND	0.472± 0.003	0.023± 0.001	0.025± 0.006	0.037± 0.002
F	2.032± 0.005	0.019± 0.001	0.078± 0.002	0.605± 0.001	0.067± 0.002	0.038± 0.002
Mean	1.300± 0.003	0.009± 0.003	0.191± 0.003	0.377± 0.003	0.042± 0.002	0.180± 0.002

Key Mean = Average of three samples; ND = Not detectable.

Heavy metal concentration in refuse dumpsite of Gboko metropolis may not appear to pose very serious environmental problems at the moment; however accumulation of the concentration may later pose a threat to human health and the environment.

Recommendations

Designated places should be used as dumpsites and not indiscriminate marking of dumpsites as it is the case. Dumpsites should be treated before use especially for cultivation. Also the people living around these dumpsites should stop farming on or around them.

REFERENCES

[1] Uba, S., Uzairu, A., Harrison, G.F.S, Balarabe, M.L., and Okunola, O.J. (2003). Assessment of heavy metals bioavailability in dumpsites of Zaria metropolis, Nigeria. African Journal of Biotechnology 7(2): 122-130.

[2] Adekunle I M and Owolabi D A (2003) international Journal of Environmental Issues 2 (1)

[3] Obaliagbon, O.K and Olowoyoba, G.B (2006): "Distribution of some heavy metals in leachates from a municipal waste dumpsite". Paper presented at the international conference on engineering Research and Development, University of Benin, Benin city.

[4] Song, Q.J. and Greenway, G.M. (2006). Kinetic speciation of BCR reference materials. Intern. J. Environ. Anal. Chem. 8615). 359-366.

[5] Iwegbue, C.M.A., Enuh, F.N, Isirimah, O.N., and Egun, A.C. (2007) fractionation,characterization and speciation of heavy metals in composts and compost amended soils. Afr. J. Biotechnol. 6(2): 067-078.

[6] Pueyo, M., Mateu, J., Rigol, A Vidal, M., Lopez Sanchez, J.f., Rauret, G. (2008). Use of the modified BCR three-step sequential extraction procedure for the study of trace element dynamics in contaminated soils. Environmental pollution 152:330-341.

[7] Chen, M. and Ma, Q.L. (2001). Comparison of three aqua regia digestion methods for twenty fluoride soils. Soil science society of America Journal 65: 491-499.

[8] Akaeze, C. S. (2001), Solid waste analysis, a research project of chemistry/Biochemistry University of Uyo, Nigeria.

[9] K. Asemave, S.T. Ubwa, B. A. Anhwange and A. G. Gbaamende. (2012). Comparative Evaluation of Some Metals in Palm Oil, Groundnut Oil and Soybean Oil from Nigeria. *International Journal of Modern Chemistry*, 1(1): 28-35.

[10] MAFF and Welch Office Agriculture Department (1992). Code of Good Agricultural Practice for the Protection of Soil. Draft Consultation Document, MAFF, Lodon.

[11] USEPA (1986). Test Methods of Evaluation for Solid Waste (USEPA S/W 846 UEPA Washington DC).

[12] S. Uba, A. Uzairu, G. F. S. Harrison, M. L. Balarabe and O.J. Okunola (2008). Assessment of Heavy Metals Bioavailability in Dumpsites of Zaria Metropolis, Nigeria. *African Journal of Biotechnology*, Vol. 7 (2): 122 – 130.

[13] Ali, N.,Oniye, S. J., Balarabe, M. L. and Auta, J. Concentration of Fe, Cu, Cr, Zn, and Pb in Makera – Drain, Kaduna, Nigeria. *ChemClass Journal*. 2005, Vol. 2, 69 – 73.

[14] G.R. Bradford, A. L. Page, L. J Lund and W. Olmstead, (1975). Trace Elements Concentration of Sewage Treatment Plant Effluents and Sludge: their Interactions with Soil and Uptake by Plants

****