Scholars Academic Journal of Biosciences (SAJB) **ISSN 2321-6883 (Online)**
Sch. Acad. J. Biosci., 2017; 5(4):320-324 **ISSN 2347-9515 (Print)**
©Scholars Academic and Scientific Publisher
(An International Publisher for Academic and Scientific Resources)
www.saspublishers.com DOI : 10.36347/sajb.2017.v05i04.010

Original Research Article

Determination of Heavy Metals (Pb, Cd and Ni) in Soils of municipal solid wastes Dumpsite, Yenagoa Metropolis, Bayelsa State

Orodu V. E, Leizou K. E
Department of Chemical Sciences, Niger Delta University, Wilberforce Island, P.M.B 071, Yenagoa, Nigeria

***Corresponding author**
Orodu V. E
Email: lv.orodu@yahoo.com

Abstract: The extent of some heavy metals concentration in an open dump along Yenagoa – Tombia road has been examined, in order to understand the levels, distribution and fate of the surrounding susceptible environment. A total of 27 samples were collected at different depths (0-5cm, 5-10cm and 10-15cm) from 3 different locations on the dumpsite, also 3 samples were collected for comparison from three control stations. The samples were digested, filtered and the filtrate was analyzed for heavy metals using a GBC Avanta PM. Ver 2.02 AAS. The mean concentrations (mg/kg) for the three metals in soils of the dumpsite samples were: 0.47-14.33(5.17±5.04)Pb, 0.19-1.84(1.03±0.16)Ni and 0.09-1.10(0.22±0.08)Cd respectively. To contextualize the degree of anthropogenic contribution to the total heavy metal pollution comparison with studies from other environment, single contamination indices and ecotoxicological sense of heavy metal contamination was employed. The results of this study were found to be within permissible levels recommended and does not pose a threat to anyone and particularly the surrounding susceptible environment.
Keywords: non-biodegradable, Yenagoa – Tombia.

INTRODUCTION

The problems of arable land pollution in developing countries through disposal of municipal solid wastes in landfills popularly called open dumpsites are likely to exacerbate and pose significant ecological risk and public health risk in the coming years, if these lands are not adequately rehabilitated. Rural-urban migration has led to growth of the urban population and the resultant effect is huge production of different types of municipal solid wastes(MSW) ranging from degradable to non-degradable, deposited in landfills popularly described as dumpsite, which have adverse effects on the environment and human health.

Open dumps are generally unsanitary and constitute malodorous places in which disease-carrying vermin such as rats and flies proliferate [1]. The dumpsites are not basement prepared for selective adsorption of toxic substances hence; it is susceptible to the discharge of pollutants to nearby water and to the air through leachates and dumpsites gases respectively [2]. Industrialization, population growth and unplanned urbanization have partially or completely turned our environment to dumpsites [3, 4].

Metals are non-biodegradable and accumulative in nature [5, 6]. The prolonged presence of the contaminants in the urban environment can significantly amplify the exposure of the urban population to metals via inhalation, ingestion, and dermal contact [7, 8]. Anikwe and Nwobodo (2001) [9] reported that continuous disposal of municipal waste on soil may lead to increase in heavy metals in the soil and surface water that would be inimical to deep feeding plants. Heavy metals such as cadmium, lead, nickel, etc., are of concern primarily because of their ability to harm soil organisms, plants, animals and human beings [10].

Few studies have been made on the dumpsite along the Yenagoa – Tombia road of the Yenagoa metropolis, but not much is known about the biogeochemistry of heavy metals. Due to the global public health concern and environmental pollution on the disposal of waste prompted this study. The Yenagoa – Tombia road is a major road linking Amassoma, where the Niger Delta University is situated and the area is fast growing with human population. The environment is constantly impacted with vehicular emission; in addition, there is HPEB 119 oil company, oil and gas pipelines, and the municipal solid wastes (MSW) open dump and other human activities. This study was carried out to understand the present levels, distribution and fate of the surrounding susceptible environment of some toxic heavy metals (lead, cadmium and nickel) in soils of the open dump along the Yenagoa – Tombia road, Bayelsa State, Nigeria.

MATERIALS AND METHODS

Description of study area

The study area lies between the coordinates of latitudes 04o15” North and latitude 05o23’ South and longitude 05o22”West and 06o45” East. The dumpsite is located in Yenagoa metropolis, Bayelsa State, along the road which serve as a link between Yenagoa, Tombia and as well as the Niger Delta University, Wilberforce Island (Fig 1).

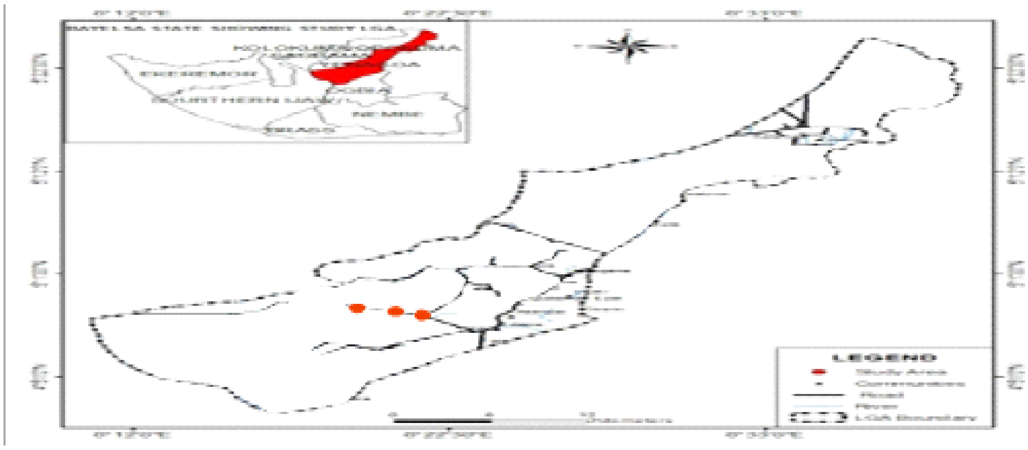

Fig 1: Map of study area showing sampling

SAMPLING AND ANALYSIS

Sampling points were randomly selected on the dumpsite. Sampling points were geo-located with Geographical Position System (GPS) to ensure consistency. Soil samples were collected from three locations on the dumpsite using auger at depth of (0-5, 5-10, 10-15) cm. The samples were transferred into pre-cleaned polyethylene bags and were then transported to the laboratory. At the laboratory, each soil sample was air dried at room temperature for days. Organic debris and other unwanted large particles were handpicked from each sample. The dried samples were homogenized with a mortar to pass through a 2mm sieve. The samples were labeled appropriately, stored in sealed polythene bags for digestion and analysis. The soil samples were digested in a mixture of concentrated nitric acid (HNO_3), concentrated hydrochloric acid (HCl) and 27.5% hydrogen peroxide (H_2O_2) according to the USEPA method 3050B for the analysis of heavy metals and major ions [11-13].

RESULTS AND DISCUSSION

A total of 27 samples were examined for three soil quality chemical parameters (Pb, Cd and Ni) in this study. The mean contents of heavy metals in soils are presented in Table 1-2. The percentage of the heavy metals is represented graphically in Fig.2.

Table 1: Total mean concentrations (mg/kg) of heavy metals in soils

	N	Range	Minimum	Maximum	Mean		Std. Deviation	Variance	Skewness		Kurtosis	
Metals	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Cd	12	1.01	.09	1.10	.22	.08	.28	.079	3.40	.64	11.66	1.23
Pb	12	13.86	.47	14.33	5.17	1.46	5.04	25.42	.69	.64	-1.27	1.23
Ni	12	1.65	.19	1.84	1.03	.16	.54	.29	-.17	.64	-.64	1.23
Valid N	12											

Table 2: Range, STD and mean concentrations (mg/kg) of heavy metals in soils

	SITE A		SITE B		SITE C		CONTROL	
METALS	RANGE	MEAN± STD	RANGE	MEAN ±STD	RANGE	MEAN ±STD	RANGE	MEAN ±STD
Cd	0.11-0.16	0.14± 0.29	0.09- 0.21	0.14± 06	0.12- 1.10	0.45± 0.56	0.12- 0.13	0.12± 0.01
Ni	0.26-1.82	1.09± 0.78	0.19- 1.37	0.92± 0.64	0.39- 1.84	1.13± 0.73	0.84- 1.13	0.98± 0.15
Pb	1.60-10.15	6.54± 1.43	0.47- 14.33	5.40± 7.75	0.92- 11.54	1.21± 0.58	1.33- 1.67	1.53± 0.18

The concentration of lead ranged from 0.47 – 14.33mg/kg with a mean of 5.17±5.04mg/kg and the control ranged from 1.33-1.67 with a mean of (1.53 ± 0.8)Pb. Khalid *et al,* 2006 reported a range of 25.0 -1198mg/kg with median of 175mg/kg for lead in roadside soils of Northern England. Amos-Tautua, et al, 2014 [14] reported the mean levels of Pb ranged from 14.75±0.04 to16.14±0.05 mg/kg in the soil samples from the same dumpsite. These values were lower than EC (1986) [15] upper limit of 300 mg/kg and the maximum tolerable levels proposed for agricultural soil, 90-400 mg/kg set by WHO (1993) and NEPCA (2010). This is in agreement with the results obtained from similar study by Olayiwola and Onwordi (2015) in Soil of Ido-Osun Waste Dump Site, Osogbo, Osun, Nigeria.

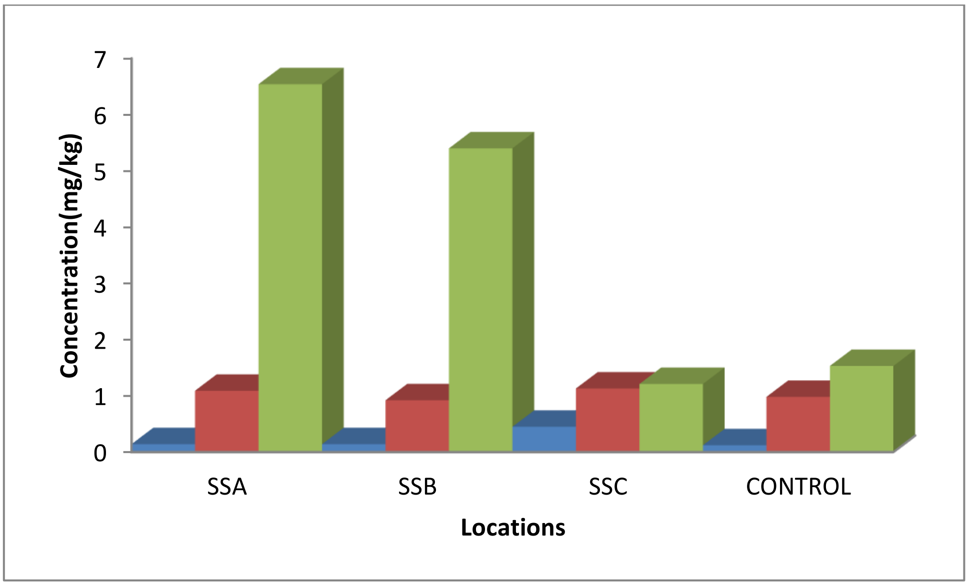

Fig 2: Percentages of heavy metals in soils of dumpsite

The data shows that, concentration (mg/kg) of nickel in soils from the dumpsite ranged from 0.19-1.84 with mean value of (1.03±0.16) Ni and the control ranged from 0.84-1.13 with a mean of (0.98±0.15mg/kg)Ni. A comparative analysis between nickel levels in other studies of dumpsite and values of nickel in this study, the values of this study were low. The result agreed with concentration of nickel in natural environment [12]. The concentration of cadmium ranged between 0.09 – 1.10 with an average of (0.22 ± 0.08 mg/kg) Cd in the dumpsite while the control ranged from 0.12 – 0.13 with an average of (0.12±0.01 mg/kg)Ni. The levels were also lower when compared with levels in natural environment [12]. The overall total metals content in soils of the dumpsite shows the abundance order of: (Pb > Ni >Cd).

Assessment of metal contamination

$$\text{Contamination factor (Cf)} = \frac{\text{Observed concentration of the metal}}{\text{Background value of the metal}}$$

Turkian and Wedepohl (1961)

Table 3: Categories of contamination factors (Hakanson, 1980)

Contamination	Category
Cf<1	Low contamination factor
1<Cf<3	Moderate contamination factor
3<Cf<6	Considerable contamination factor
6<Cf	Very high contamination factor

Table 4: contamination factor and ecotoxicological values

metal	Contamination factor	categories	TEl	PEL	ERL	ERM
Pb	0.26	Low contamination factor	30.20	110.00	46.70	218.00
Ni						
Cd	0.73	Low contamination factor				

In this study, single indices such as contamination factor was used to assess heavy metal contamination in soils of the dumpsite to contextualize the degree of anthropogenic contribution to the total heavy metal pollution. The low contamination factor values obtained indicate very little anthropogenic effects.

Assessment of pollution based on ecotoxicological sense of heavy metal contamination

These effects are as follow: a) The effect range low (ERL) / effect range median (ERM) b) The threshold effect level (TEL) /probable effect level (PEL) (Mac Dona etl al.,2000 , Bakan and Ozkoc, 2007). The heavy metals studied in soils of the dumpsite do not exceed TEL values which can lead to adverse impact on the environment (Table 4). The guideline thereby has shown that the dumpsite soils and the surrounding susceptible environment is uncontaminated with (Pb, Cd and Ni).

CONCLUSION

The results realized from the sampling stations indicate that Pb , Cd and Ni concentration levels in soils of the dumpsite are within permissiveable limits and concomitant with studies of other dumpsites. The problems of arable land pollution in developing countries through disposal of municipal solid wastes in landfills popularly called open dumpsites are likely to exacerbate and pose significant ecological risk and public health risk in the coming years, if these lands are not adequately rehabilitated . In conclusion, soils of the study area are safe within the limits for use as arable land. Consequently, the regulatory authorities should be encouraged to institute environmentally friendly framework to maintain the immerse biodiversity and aesthetic value.

REFERENCES

1. Bellebaum J. Brief report Between the Herring Gull Larus argentatus and the bulldozer: Black-headed Gull Larus ridibundus feeding sites on a refuse dump. Ornis Fennica. 2005;82:166-71.
2. Abdus-Salam N, Ibrahim MS, Fatoyinbo FT. Dumpsites in Lokoja, Nigeria: A silent pollution zone for underground water. Waste Management and Bioresource Technology. 2011;1:21-30.
3. Alimba CG, Bakare AA, Latunji CA. Municipal landfill leachates induced chromosome aberrations in rat bone marrow cells. African journal of Biotechnology. 2006;5(22).
4. Oyeniyi SQ, Nwoye Elias E. Heavy Metal Assessement Of Dumpsites Soil In Ilorin Metropolis, Kwara State.
5. Faiz Y, Tufail M, Javed MT, Chaudhry MM. Road dust pollution of Cd, Cu, Ni, Pb and Zn along Islamabad Expressway, Pakistan. Microchemical Journal. 2009 Jul 31;92(2):186-92.
6. Kacálková L, Tlustoš P, Száková J. Phytoextraction of cadmium, copper, zinc and mercury by selected plants. Plant Soil Environ. 2009 Jul 1;55(7):295-304.
7. Boyd HB, Pedersen F, Cohr KH, Damborg A, Jakobsen BM, Kristensen P, Samsøe-Petersen L. Exposure scenarios and guidance values for urban soil pollutants. Regulatory Toxicology and Pharmacology. 1999 Dec 31;30(3):197-208.
8. Abdel-Latif NM, Saleh IA. Heavy metals contamination in roadside dust along major roads and correlation with urbanization activities in Cairo, Egypt. Journal of American Science. 2012;8(6):379-89.
9. Anikwe MA, Nwobodo KC. Long term effect of municipal waste disposal on soil properties and productivity of sites used for urban agriculture in Abakaliki, Nigeria. Bioresource Technology. 2002 Jul 31;83(3):241-50.
10. Adelekan BA, Abegunde KD. Heavy metals contamination of soil and groundwater at automobile mechanic villages in Ibadan, Nigeria. International journal of physical sciences. 2011 Mar 4;6(5):1045-58.

11. USEPA 1996. Test methods for evaluating solid waste. Physica l/ chemical Methods. 3rd edn., method 3050B, acid digestion of sediment, sludges and soils, USEPA, Washington, DC., SW-846.
12. Amadi A. N.1. Olasehinde, P. I. Okosun E. A. Okoye N. O. Okunlola I. A. Alkali, Y. B. and Dan-Hassan M. A. A Comparative Study on the Impact of Avu and Ihie Dumpsites on Soil Quality in Southeastern Nigeria. American J. Chem. 2, 2012: 17-23
13. Leizou KE, Okechukwu J, Tobin A. Impact and hazards to health assessment of roadside soils near an open dump in yenagoa, bayelsa state, nigeria.
14. Amos-Tautua BM, Onigbinde AO, Ere D. Assessment of some heavy metals and physicochemical properties in surface soils of municipal open waste dumpsite in Yenagoa, Nigeria. African Journal of Environmental Science and Technology. 2014;8(1):41-7.
15. EC (council of the European Communities) (1986). Directive 86278 EEC on the Protection of the Environment and in Particular of the Soil when Sewage Sludge is used EEC. Brussels
16. MacDonald DD, Ingersoll CG, Berger TA. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Archives of environmental contamination and toxicology. 2000 Jul 1;39(1):20-31.
17. Bakan G, Özkoç HB. An ecological risk assessment of the impact of heavy metals in surface sediments on biota from the mid-Black Sea coast of Turkey. International Journal of Environmental Studies. 2007 Feb 1;64(1):45-57.
18. Engler RM. Prediction of pollution potential through geochemical and biological procedures: development of regulation guidelines and criteria for the discharge of dredged and fill material. Contaminants and sediments. 1980;1:143-69.
19. Hakanson L. An ecological risk index for aquatic pollution control. A sedimentological approach. Water research. 1980 Jan 1;14(8):975-1001.
20. Akbar KF, Hale WH, Headley AD, Athar MO. Heavy metal contamination of roadside soils of Northern England. Soil Water Res. 2006;1(4):158-63.
21. National Environment Protection Council of Australia (NEPCA) (2010). Limits of heavy metals in soils. Available online at www.newzealand.govt.nz
22. Turekian KK, Wedepohl KH. Distribution of the elements in some major units of the earth's crust. Geological Society of America Bulletin. 1961 Feb 1;72(2):175-92.