

Analysis of Lead, Zinc, Chromium, and Iron in the major dumpsite on North Bank Mechanic Village in Makurdi Metropolis Benue State

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ABSTRACT

Dumpsites soil samples in North Bank Auto- mechanic workshop locations in Makurdi, the Benue State capital located on7°43′50″N 8°32′10″E in a valley in north central Nigeria were analyzed. This location is chosen for investigation; being the major mechanic workshops sites in Makurdi. Workshop wastes are made up of metal pieces, wasted and used oils, paints, carbide byproducts ,used batteries, acid waste ,domestic and other industrial wastes. Atomic Absorption Spectrophotometer (UnicamSolaar32 model) was used for analyzing the digested soil samples for heavy metal content. Mean concentrations of the selected heavy metals in the dumpsite soil at North bank were 114.02 mg/Kg, 37.46 mg/Kg, 53.74 mg/Kg, and 48.28 mg/Kg for Pb, Zn, Cr and Fe respectively .The results were higher than their controls indicating a clear case of pollution. Heavy metals from the wastes were suspected to be the feeding source in the soils. Such a situation could be regarded as "unsafe" as these metals are eventually taken up by plants and subsequently get into the food chain. Ground. and surface water quality is also threatened as these heavy metals get leached and washed into them, making the water unfit for human consumption. Advocacy of waste disposal and its effects with legislation are recommended. This study is important to the host communities of the auto-mechanic locations as a source of awareness of the environmental effects of refuse dumpsite soils. It will also form a baseline of the environmental effects of indiscriminate dumping of refuse.

Keywords concentration , consumption, automobiles, metals and pollution .

1.INTRODUCTION

Metals are natural components of the earth's crust. they enter our bodies via food, drinking water. And dust particles. Heavy metals contamination of dust is problematic to children who through hand-to- mouth activity ingest as much as 90 milligram of dust or soil per day lamp, L. (2003). Heavy metals are defined as metals having density greater than 5g/cm^3 by Taraskevicius and Radzevians A. (1999). They are classified into transition and atomic weight metals of group III and V of the periodic table. Examples of heavy metals are Fe, Cu, Pb, Cr, Zn, Pt, Cd, etc. Concentration of soil by heavy metals arises when the concentration is high, to Lead to degradation of the soil. Merian E. (2000).

Since pollution is the contamination of the environment by undesirable materials known as pollutants and arise from the addition of such harmful or offensive substances to soil and general atmosphere, contamination of heavy metals in the environment is a major concern because of their toxicity, threat to human life and environment . Yakowitz H. (1998).

Soils are contaminated by heavy metals if they originate from areas of mining activities, industrial, automobile [mechanic] workshops ,heavy vehicular traffic, agricultural practices such as application of fertilizers, pesticides, and sewage disposal in the soil. Heavy metal concentration in soil can lead to enhanced crop up take and negatively affect crop growth and productivity, that also pose danger on humans that feed on these crops Adam F.A pp 150 - 163.

2.Materials and Method

2.1 Study Area

This study was carried out in Makurdi which serves a dual purpose as a Local Government head- quarters and state capital. It is a town with an area of about 16km radius. North Bank Mechanic Village is located North of Makurdi town along Lafia road. A dumpsite is a site for depositing waste of all materials used and unused . Activities carried out in this auto mechanic village are sales and maintenance and are involved in the use and dumping of plastic cans, metals scraps, glass pieces, workshop sweep, paint, papers, fibers, rubbers, polythene bags, oil, grease and burning of tyres .

2.2 Materials

Mortar and Pestle (ceramic) Glass Cylinder ,pH Meter , Stirring Rod
Spatula Volumetric Flask (of various capacities), Bucher Funnel, Whatman Filter Paper **(No.1) ,** Thermometer, Sieve (2mm) Beaker (of various capacity) Wash Glass ,Burette and Pipette

2.3 Sample Collection

Four soil samples were collected with the use of a hand trowel. The samples were transferred into polythene bags and transported to the laboratory. In the laboratory the samples were exposed and allowed to dry at room temperature for a period of 2-3 weeks and large object (sticks, stones, broken bottles were removed). The air-dried samples were then crushed in a ceramic mortar with a pestle made of porcelain.

The samples were passed through a 2mm sieve,. To maintain the integrity of the samples, the 2mm air-dry samples were kept in a polythene bags and stored under dry conditions until the time of analysis. All soil samples were taken between 2 - 5cm deep .

3 Determination of Physicochemical Parameters.

3.1 pH

The pH of the soil samples were determined by measuring 10g of soil into a 250ml conical flask where 100ml of deionize water was added and swirled for a little time and allowed to stand for 15 minutes. The pH of the soil was then taken at the topmost layer of the solution using Suntex pH meter, standardized at pH 4.0 and 7.0 respectively.

3.2 **Particle Size**

Particle size analysis was done using capacity method described by Black (1965). 100g of each of the air-dried soil were weighed using a weighing balance. The weighed soil samples were transferred into an electronic machine, which separates the soil into different segments according to the soil sizes. The biggest at the top while the finest at the button end.

The separate soils were reweighed and taken for determination of water holding capacity. The particle sizes that did not allow easy passage of water through it were indicated as clay, while those that had moderate water holding capacity were recorded as the silt.

The biggest particles, which did not hold water, were recognized as sand. This was due to the fact that clay has the highest capacity to hold water and sand has the least. The weights of the soil particles were then used to calculate their percentage.

$$\text{Percentage Clay} = \frac{\text{Weight of clay particle}}{\text{Weight of the soil sample (100g)}} \times \frac{100}{1}$$

$$\text{Percentage Sand} = \frac{\text{Weight of Sand particle}}{\text{Weight of the soil sample (100g)}} \times \frac{100}{1}$$

$$\text{Percentage Silt} = \frac{\text{Weight of Silt particle}}{\text{Weight of the soil sample (100g)}} \times \frac{100}{1}$$

3.3 Cation Exchange Capacity (CEC)

The quantitative assessment of the ability of soil to interact with Cations is e Cation Exchange Capacity (CEC) and is one of the most commonly measured properties of soil. The actual Cations that occupy the exchange sites depend on the nature of the soil particles as well as other environmental circumstances. The alkaline metal (Na^+ and K^+) and the alkali earth metal (Mg^{2+} and Ca^{2+}) are the most important exchange cations, and for many soils the quantitative order of their importance is $Ca^{2+} > Mg^{2+} > K^+ > Na^+$. Only in specific circumstances do other metal cations contribute significantly to cation exchange capacity value.

3.4 Determination of Total Metals

Total metal determination of the samples were carried out with aqua regia (HCL = HNO_3) was prepared by mixing 20ml of HNO_3 and 60ml of HCl into a reagent bottle.

Procedure

1.0g each of the air-dried, ground and sieved soil samples were accurately weighted into a digestion container (centrifuge tubes) 10ml of aqua regia was measured and added into the container and swirled gently to mix the sample property. The digestion container was then placed on a water bath and boiled for 2 hours with the container shaken-intermittently every 15 minutes. On completion of digestion, the mixture was cooled and filtered into 25ml standard flask using a Whattman No. (1).

The residue was washed with deionized water. The filtrate was then made up to mark with deionized water and analyzed for Pb, Zn, Cr and Fe respectively. An Atomic Adsorption Spectrometry was used to analyze the heavy metals.

4 Results And Discussion

Summary of the results of analysis for some of the physicochemical parameters determined in soil at the North Bank mechanic dumpsite are show in Table 1 below for each sample. In the same vain Table 2 also shows the average metal concentration of some of the heavy metals found in the soil as determined by AAS (Atomic Adsorption Spectroscopy)

While Table 3 shows the mean and standard deviation of heavy metals content of soil in North Bank auto-mechanic refuse dumpsite.

Table 1: Physicochemical Parameters of the Soil Sample

Properties	Sample Location			
	A	B	C	D
pH	7.0	6.15	6.3	6.10
Particles Seize				
Sand (%)	74.2	72.2	78.6	6.73
Silt (%)	15.8	14.3	15.2	17.0
Clay (%)	11.5	12.6	10.3	15.7
Organic Matter (%)	10.50	12.01	11.14	10.00
CEC (Cation Exchange Capacity)	7.34	8.59	8.00	9.5

The result of the physicochemical parameters in Table 1 shows a pH range of 6.10 – 7.0 and indication that some of the sample is neutral, slightly acidic and slightly basic.

Particle size distribution shows that in the four samples, the sandy fraction dominated in all the samples, (A, B, C, and CC) with 74.20%, 72.2%, 78.6% and 67.6%

Table 2: Heavy metal concentration in North Bank Auto-mechanic Refuse dumpsites expressed in mean and standard

Dumpsite	Heavy Metal Concentration in mg/kg			
	Pb	Zn	Cr	Fe
A	64.60	04.86	56.42	50.80
B	104.72	40.12	51.56	50.58
C	172.76	67.34	57.28	43.44
D	04.76	01.66	49.66	40.98

Table 3: Heavy metal content of soils in North bank auto mechanic shops refuse dumpsites express in mean and standard deviation (mg/kg)

Heavy Metal	Mean ± SD
Pb	114.02 ± 54.66
Zn	37.64 ± 31.62
Cr	53.76 ± 02.46
Fe	48.28 ± 04.18

Tables 2 and 3 present the Mean Pb content at the North bank auto-mechanic shops refuse dumpsites soil respectively. Higher levels of Pb obtained in this study is in accordance with the findings of Yahaya *et al* (2009), but disagrees with that of Uba *et al* (2008) who reported lower levels of Pb concentration in a similar study. Pb content obtained in this study is in agreement with the result of a similar study in a landfill soil in Ibadan in south west Nigeria by Ogunyemi *et al* (2003). Results recorded in this study has shown that the refuse dumpsites contribute significant levels of toxic metals to the environment. Sorting and recycling of wastes should be intensified to reduce the quantity of these toxic metals in the dumpsites.

The Mean Cr content at the North Bank refuse dumpsite soils are indicated in Tables 2 and 3 respectively. This finding is in accordance with that of Abida *et al* (2009) who carried out a similar study in India and reported higher values of Cr concentration in refuse dumpsites soil. Yahaya *et al* (2009) also reported similar concentration of Cr content in a similar study in Nigeria. Higher concentration of Cr in the refuse dumpsites soil may be attributed to the Cr content of oil waste on the sites that leaches into the underlying soil layer.

The result obtained for Zn concentration at North Bank refuse dumpsite soil are presented in Tables 2 and 3 respectively. These results conform to that of Yahaya *et al* (2009) who carried out a similar study in Nigeria.

Mean Fe concentration in the refuse dump sites soil at the north bank auto-mechanic village are shown in Tables 2 and 3 respectively. This result agrees with that of Yahaya *et al* (2009). Results recorded in this study have shown that the mean Fe concentration may be attributed to the disposal habitats and the volume of Fe content wastes in the locations.

5 Conclusion

The study revealed that the waste dumpsites soil in North bank and mechanic sites within Makurdi metropolis contain some levels of Pb, Zn Cr, and Fe. This study indicates that these dumpsites serve as the potential source of the metals in the environment. These metals are toxic at their various concentrations and could effect human and animal health as they are bio accumulative. They are taken up by plants and accumulate in the plant parts, upon eating affect man.

Also they pollute the ground and surface water bodies making them unfit for drinking.

6 Recommendation

Based on findings of this study, the following recommendations;

Further works should be carried out to obtain the concentration of other heavy metals not determined in the work.

Proper education and legislation on the handling of waste should be advocated to forestall waste related problem along food chain.

Less application of fertilizer should be· used in area where these concentrations of heavy metal are found to be more in other not to increase the accumulation of these heavy metals in the soil.

Modem waste disposal facilities should be acquire by authorities concerned.

Waste should be sorted and segregation before disposing.

Indiscriminate waste disposal should not be enhanced.

Recycling of waste should be encouraged by the relevant government authorities.

That agricultural produce from these locations are not good and are harmful to humans and should not be consumed.

All activities such as dumping of hazardous waste, mining, burning of tires and spilling of bad oil in mechanic sites should be reduced in other not to increase the concentration of heavy metals in soil.

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