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Content of Pb and Zn in Soils Collected in the Vicinity of Selected Automobile Workshops in Kaduna, Nigeria

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Abstract
To assess the availability of metals in soil for absorption, the chemical forms must be determined. In this regard, a modified sequential extraction technique was used to determine the geochemical partitioning of Pb and Zn concentration of the soil sample obtained from these workshops were determined using flame Atomic Absorption Spectrometry (FAAS). The soil samples were digested and extracted using different digestion and extraction media. The results revealed that the concentrations of Pb and Zn in the samples varied from one automobile workshop to another and similarly the Pb concentration bound to the residual phase (HNO_3: H_2O_2 (2:1)) was highest in all locations followed by that bound to magnesium chloride, EDTA and Oxalic acid. Thus HNO_3/H_2O_2 >$MgCl_2$>EDTA>Oxalic acid. While the Zn concentration bound to the oxide phase (Oxalic acid) was highest in all the sampling locations followed by that bound to magnesium chloride, EDTA and nitric acid/ hydrogen perioxide. Hence, oxalic acid>$MgCl_2$>EDTA>HNO_3/H_2O_2.
Keywords: Bioavailability, metal content, soil, Automobile workshop.

Introduction

In many developing countries like Nigeria, soils are affected by mine waste disposal, acid deposition, sewage sludge and other anthropogenic and agricultural practices. Heavy metal contamination of arable soils through industrial and anthropogenic activities is a source problem in Nigeria. The impact of contamination on the environment should be of scientific concern inorder to minimize the threat of soil and ground water contamination (Metos *et al.,* 2001). Heavy metals pollutants like some other pollutants on ''acute" or ''chronic" exposure, affect different body organs. Some of the organs are affected in a poisoning situation by different chemical pollutants (Yaman *et al.,* 2000) Lead affects every organ system in the body. It is absorbed into the body and distributed to the blood, soft tissue and bones. The central nervous system is the most vulnerable to head toxicity particularly in developing children (Yaman *et al.,* 2000). Lead damages the kidneys, liver, gastro-intestinal tract, reproductive systems and the immune system. Prenatal exposure may cause premature birth and under developed babies. Young children exposed to lead exhibit mental retardation, learning difficulties and reduced physical growth (Yaman *et al.,* 2000). According to report over 400 hundred children in Zamfara State, Nigeria, died of lead poisoning due to illegal mining activities (Galadima and Garba 2013). In adults, lead may cause weakness in the fingers, wrists, ankles, hypertension and affect memory. It can also cause anaemia, abortion and damage the male reproductive systems (Yaman et al., 2000). Zinc deficiency syndrome manifests itself by growth retardation, anorexia, lesions of the skin and appendages, impared development and function of reproductive organs (Stoeppler, 1991). Zn, unlike Cd, As and Sb is not commulative. Some workers exposed for 2 to 35 years to Zinc oxide dust, poor in Pb and Cd did not show any acute or chronic illness attributable to zinc (Stoeppler, 1991). Therefore, Zinc as an essential trace element, affects the normal functions of plants, animals and man either by its deficiency or surplus (Stoeppler, 1991). Chemical speciation is the determination of various chemical and physical forms of the elements which together make up the total concentration of that element or sample (Hiraokate et al., 1998). Speciation of toxic metals in the environment using new analytical methods has attracted attention in recent years, because comprehension of chemical forms of the toxic metals in the environment is essential for assessing potential hazards (Hiraokate et al., 1998). In this research work, Pb and Zn concentrations in soil samples obtained from the automobile workshops were extracted using chemical reagents, such as the mixture of HNO_3/H_2O_2, $MgCl_2$ oxalic acid and EDTA.

MATERIALS AND METHODS

A flame atomic absorption spectrophotometer model 8010 Young Lin was used for the Pb and Zn determination. In the extraction procedures, HNO_3/H_2O_2 (2+1), 1.0M $MgCl_2$, 1.0M Oxalic acid and 0.05M EDTA were used.

PREPARATION OF SAMPLES

The research covered four different automobile workshops in Kaduna Metropolis, Nigeria. The sites are Poly Road, (PR), Tudun Wada Cinema Road (TWC), Oriapala Mechanic Village (OMV) and Hamdala Swimming Pool Road (HSP). The samples were collected in November, 2012. Triplicate samples were collected from each automobile workshop randomly at a distance of 100meter depth of 10cm from soil surface (Yaman et al., 2005).

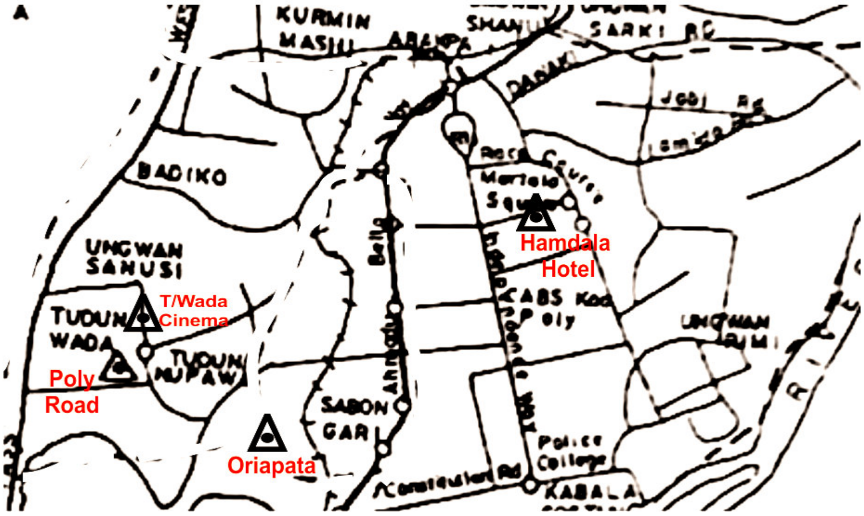

Figure 1. Map of Kaduna Metropolis showing sampling sites

DIGESTION AND EXTRACTION OF SOIL

Soil extracts from automobile workshops were obtained by shaking separately 5g of soil sample with 10ml of HNO_3/H_2O_2(2:!), 0.05M(for residual phase). 0.05M Na_2 EDTA (for carbonate and organically bound phase), 1.0M Oxalic acid (for oxide phase) and 1.0M Magnesium Chloride (for exchangeable phase). The mixture was evaporated with occasional shaking on a hot plate. Four cm³ of 1.5M nitric acid was added to the remainder and centrifuged. The digest was diluted to 60cm³ with distilled water and filtered. The resultant solution was analysed for Pb and Zn using FAAS model 8010 Young Lin. A blank digest was prepared in the same way.

RESULTS AND DISCUSSIONS

The lead content in the soil samples obtained from the selected automobile workshops varied from one sampling location to another. This could be attributed to the degree of activities going on in the workshops. The distribution of the metal in the soil samples showed that it exists in carbonate/organic, oxide, exchangeable and residual fractions. The concentration of Pb bound to residual fraction was found out to be highest in all the sampling locations. This is in agreement with the results reported by Hickey and Kittrick (1984), Yaman *et al.,* (2000), Yaman and Bakirdore (2002) and Takac et al. (2009). From the regressional analysis, it showed that HNO_3/H_2O_2 function has 58% better extraction of Pb as against 40% for $MgCl_2$, 19% for EDTA and 4.8% for Oxalic acid was depicted in Fig 2.

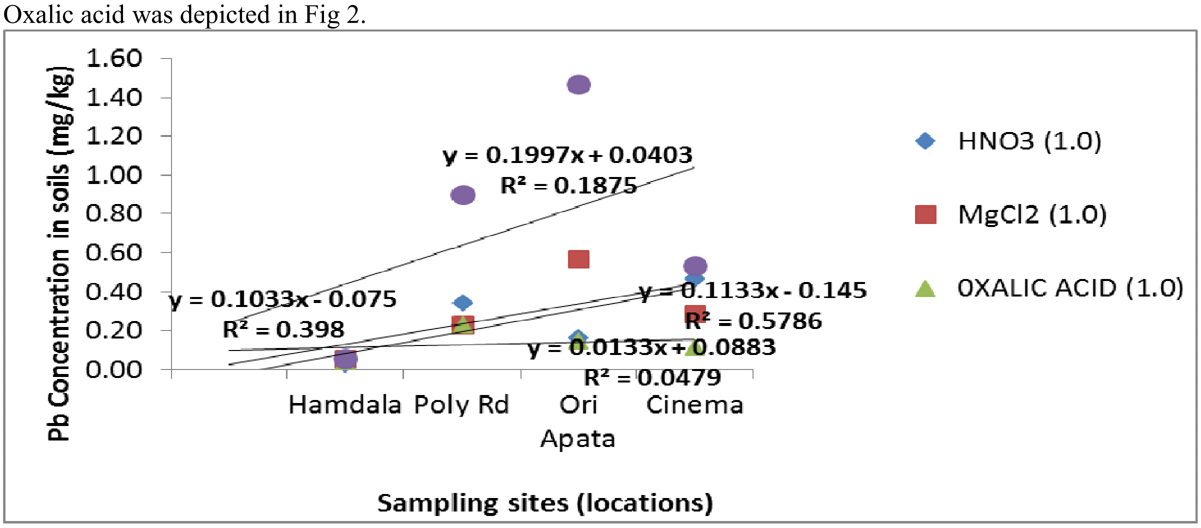

Figure 2: Concentration of Pb against Sampling sites.

Hence, the distribution followed the pattern HNO_3/H_2O_2 > $MgCl_2$ >EDTA >Oxalic acid. From the correlation analysis, it showed that Pb has a higher concentration than Zn at Hamdala workshop. This could be attributed to the nearness of the workshop to major road which gives rise to heavy traffic and lubricating oils discharged at the site and discarded lead-cadmium batteries (Hashim et al., 2006; Ads et al., 2012).

The contamination of Zn in the soil samples from the workshops varied from one location to another.

The result showed that the metal exists in oxide, carbonate, residual and carbonate/organic fractions. The concentration of the metal bound to oxide phase was highest in all sampling locations as shown in Figure 3.

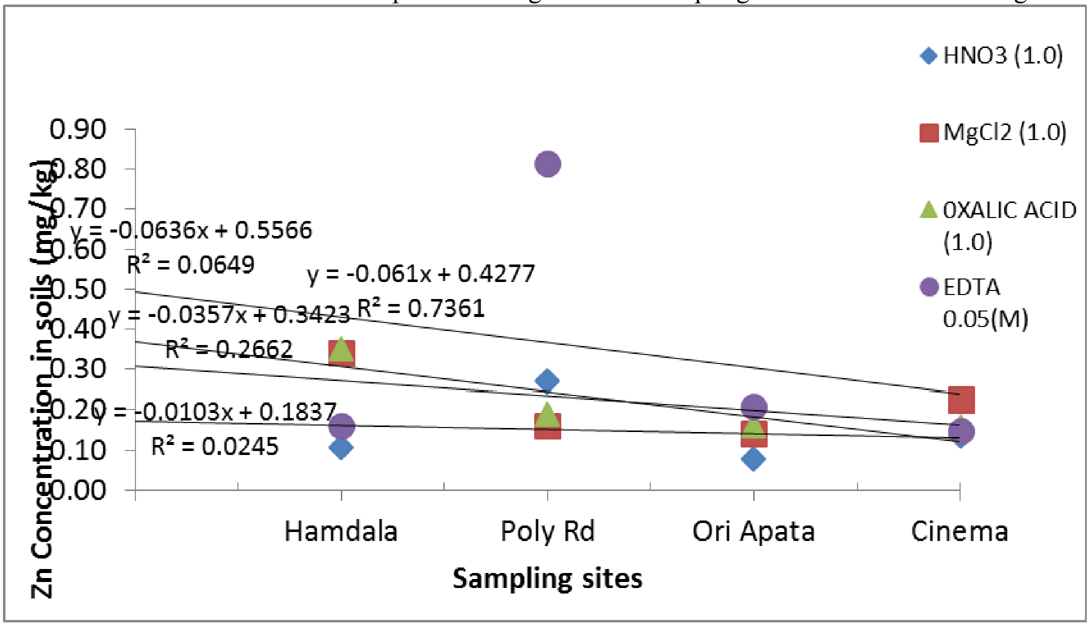

Figure 3: Concentration of Zn against sample sites

This observation was in agreement with the result reported by Hickey and Kittrick (1984) and Yaman et al. (2000). The soil samples from the mechanic workshop in Polytechnic road and Ori-Apata showed a higher concentration of Zn that Pb with correlation coefficients of 0.858 and 0.9868 respectively. This could be attributed to panel beating work, painting and spraying of vehicles, presence of old used tyres and other anthropogenic activities in the workshops. This agrees with the findings of Hashmiet et al. (2006).

CONCLUSION

The metals were distributed between residual, oxide, exchangeable and carbonate fractions. An increase of the metal concentrations in some of the sampling locations suggest higher anthropogenic activities in such areas which indicated possible soil pollution as a result of the activities carried out in such locations.

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