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Analysis of Cr and Cu in Soils around Selected Automobile Workshops of Kaduna, Nigeria.

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Abstract: *In this research, speciation analysis of soil samples from selected automobile workshops of Kaduna Metropolis, Nigeria was carried out. A modified Tessier extraction procedure was employed for the analysis. The concentrations of Cr and Cu in the samples 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 Cr and Cu in the soils varied from one automobile workshop to another. The result also showed that Cr concentration was minimal in the various extraction media and followed the trend; HNO_3 > $MgCl_2$ > EDTA > Oxalic acid. Similarly, Cu concentration was found to be highest in the oxide phase, followed by that bound to the exchangeable phase. The distribution followed the trend oxalic acid > $MgCl_2$ > HNO_3: H_2O_2*

Keyword: *Bioavailability, metal content, soil, Automobile workshop*

I. Introduction

Soils are receptacles for heavy metals released from industrial activities, municipal wastes sludge, urban composts, road traffic, atmosphere deposits and other anthropogenic activities, which of course spread out in the environment, [1]. Heavy metals are persistent in the environment, they are non-thermo degradable and the readily accumulate to toxic levels [2]. Many soils, especially those in hazardous waste sites are contaminated by heavy metals such as Ni, Cu, Zn, Cr e.t.c. Heavy metal contamination of soils through industrial and anthropogenic activities is a serious problem in Nigeria.

Laboratory studies have shown several physiological functions involving copper. Defects in pigmentation, bone formation, reproduction, myelination of the spinal cord, cardiac function and connective tissue formation, in addition to defects in growth and haematopoiesis are manifestations of copper deficiency [3].

Chromium is present everywhere and can be found in three forms: metal ores, trivalent chromium (Cr (iii)) and hexavalent chromium (Cr (vi)). Hexavalent chromium is more toxic than the trivalent chromium. Chronic exposure to chromate dust has been correlated with increase incidence of lung cancer. Oral administration of excessive levels has been associated with liver and kidney damage. Exposure to hexavalent chromium causes allergic skin irritations, dermatitis, irritation to mucous membranes and conjunctiva and gastro-intestinal ulcers [4].

The total heavy metal content in soils provide a convenient means of expressing a measure of pollution, numerous reports have highlighted that such measures are deficient in predicting toxicity of metal pollutants [5]. Heavy metals may be distributed among many components of the soil or sediment and may be associated with them in different ways [6]. The nature of the association is referred to as speciation. The general approach for the soil speciation studies has been to separate the soil using different chemical reagents or solvents fractions and by analysing each fraction to determine the amount of element combined or associated with each fraction or phase [7].

In this research, the extractable Cu and Cr in the soil samples were determined by Flame Atomic Absorption Spectrometry (FAAS). The samples were extracted using the reagents; HNO_3/H_2O_2, EDTA, $MgCl_2$ and Oxalic acid.

II. Materials And Methods

A flame atomic absorption spectrophotometer model 8010 Young Lin was used for the Ni and Cd 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 [8].

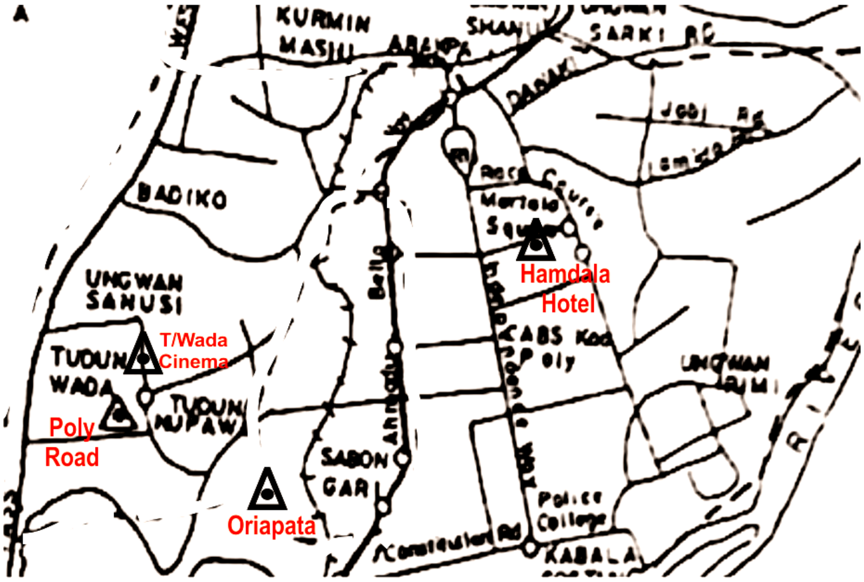

Fig. 1: Map of Kaduna Metropolis showing sampling sites

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 Cr and Cu using FAAS model 8010 Young Lin. A blank digest was prepared in the same way.

III. Results And Discussion

The distribution of chromium in the soil samples obtained from the selected workshops varied from one location to another. This may be due to the burning of fossil fuel and chrome plating which vary from one workshop to another. Similar results were reported [7,9]. The result showed that the metal existed in carbonate/organic, oxide, residual and exchangeable fractions. The concentration of the metal in the samples obtained from the various workshops was found out to be low and it followed the trend; HNO_3/H_2O_2 > $MgCl_2$ > EDTA> Oxalic acid. Copper distribution varied from one sampling site to the other. This may be due to the leakage from machinery and pipe work [10], which varies from one workshop to another. The metal existed in carbonate/organic oxide, exchangeable and residual fractions. From the results, oxalic acid was found out to extract the highest amount of copper across the sampling locations. This is shown in Figs. 2 and 3.

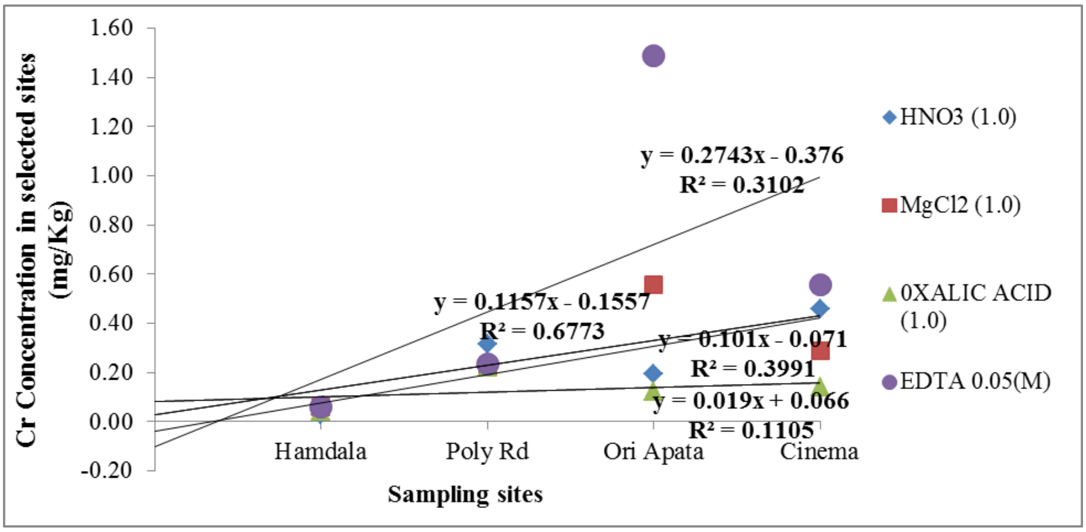

Fig. 2: Concentration of Cr against the sample sites

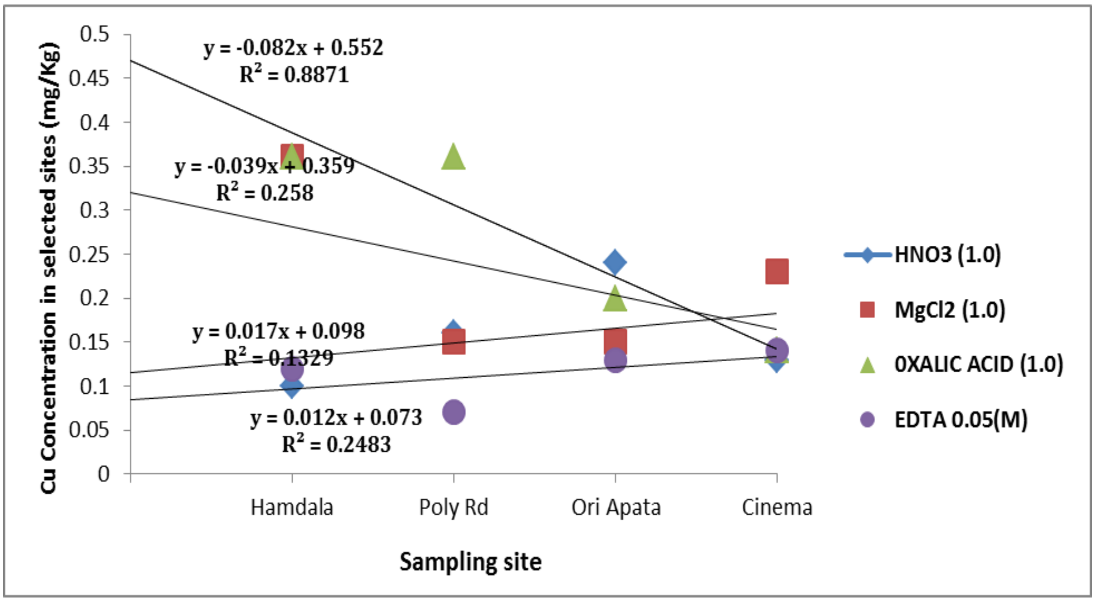

Fig. 3: Concentration of Cu against sample sites

IV. 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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