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Trace Metals Determination of Soils in Mechanic Workshops using Three Sample Sites in Enugu Metropolis

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ABSTRACT

This study was on the determination of Trace metals of soils in mechanic workshops. The soil samples used for the analysis were collected from three mechanic workshops (Abakpa, Onuato and Amechi) in Enugu metropolis. The soil samples were collected form each sites by digging the sites to a depth of 15cm and were stored in a clean polyethylene bag before taken to the laboratory for analysis. During the analysis, the samples were air dried in the oven at 105°c and were pulverized and homogenized with 2mm sieve. 2 grams of each pulverized and dried sample were weighed into 250ml beaker and were digested with 20ml of 50% hydrochloric acid on a hot plate until 2/3 of the content were remaining/clear solution. The digested samples were filtered into a 100ml volumetric flask and made to mark with deionized water. The digested samples were analyzed for trace metals using Atomic Absorption spectrometer (AAS). The result gotten from the analysis showed that the concentration of lead, chromium, nickel, and cadmium in soil sample from Abakpa was 1.46, 1.56, 0.74 and 0.14 respectively. The sample from Onuato contains 0.91, 0.31, 0.08 and 0.05 respectively while that of Amechi road was 6.67, 2.34, 1.26 and 0.59 respectively. These figure as was expressed in milligram per litre (mg/1) were compared with the WHO standard which is 0.05mg/l in all and was found to be greater. This concludes that mechanic workshops contribute to trace metals bio availability in the soil.

Key words: Trace, Metals, soil, Mechanic, workshop, Enugu, Metropolis

INTRODUCTION

Pollution is a serious problems the world over in which thousands of millions of world inhabitants suffer health problem related to waste generated from anthropogenic activities. Soil being one of the repositories for anthropogenic waste Biochemical processes mobilize the chemical substances contained in it to pollute water supplies and impact food chain [1] thereby causing great harm to man. The high toxic and persistent nature of heavy metals in the environment have made them priority pollutants [2]. The unchecked industrial and human activities have contributed to toxic trace metals levels in surface and subsurface soils when compared with those contributed from geogenic process [3]. Anthropogenic metal emission into the atmosphere such as Lead(Pb), Mercury(Hg), Zinc (Zn), Cadmium (Cd) Copper(Cu), Chromium(Cr) and Nickel(Ni) are by 1 to 3 order of magnitude higher than natural influx [4]. Heavy metal is a general collective term that applies to a group of metals and metalloids with an atomic density greater than 5g/cm^3 [5]. Examples of heavy metals/metalloids include Mercury (Hg), Lead (Pb), Cadmium (Cd), Arsenic (As), Copper (Cu), Manganese (Mn) etc. According to [6], trace metal levels in soils can be indicators of the concentrations of other pollutants that potentially related.

Heavy metals, unlike organic pollutants, are elements, which occur naturally in the Earth crust. They are therefore found naturally in soils and rocks with a subsequent rage of natural concentration in soils, sediment, waters and organisms [7]. Heavy metals belong to a group of elements whose hydro-geochemical cycles have been greatly accelerated by man. Anthropogenic release has given rise to higher concentrations of these metals relative to the normal background levels.

The impact of pollution in vicinity of over crowded cities and towns and industrial effluents and automobile exhaust has reached a disturbing magnitude, arousing public awareness [8]. According to [9], one of the major sources of increase heavy metal concentration of the ecosystem in Nigeria is automobile mechanic activities. In Nigeria, soil pollution problems associated with heavy metals have been widely reported.

In Nigeria, automobile mechanic workshops are located or concentrated in area known as "Mechanic Villages". These are places officially designated for repairs and servicing of motor vehicles [10]. The sources and mechanism of release of heavy metals into the soil and groundwater of Automobile mechanic sites include engine oil and lubricating oil, engine and gear box recycling, battery charging, welding and soldering, automobile body work and spray painting and combustion processes. [11] Waste emanating from such activities includes spent lubricants hydraulic fluids, worn-out parts, packaging materials, metal scraps, used batteries, discarded cans and stripped oily sludge.

Lead (Pb), Nickel (Ni), Chromium (Cr), Cadmium (Cd), [12] also have adverse effect on human health. Therefore, it becomes imperative to asses whether the levels of heavy metals in Enugu mechanic site is sufficient to affect the health of the inhabitants of the study area.

Statement of the Problem

The unchecked industrial and human activities have contributed to toxic trace metals levels in surface and subsurface soils when compared to those contributed from geogenic process. [13] This has lead to some health hazards of Enugu inhabitants and poor yielding of crops. These effects as a result of trace metals from mechanic workshop may be higher if not mitigated. Therefore, this study seeks to determine the level at which mechanic workshops have polluted the soil through the release of trace metals.

Aims and Objective of the Work

The primary objective of this research is to estimate on the basis of occurrence the level of trace metals in soil samples collected around mechanic workshop in Enugu Metropolis. [14]

Also to ascertain if the results obtained can be compared with World Health Organisation (WHO) standard for soil.

Scope of the Study

This research work is concerned with the determination of trace metal in soil in mechanic workshop at Enugu metropolis, taking Abakpa, Obiagu and Amechi as case study[15].

Significance of the Study

Certain metals and metalloids are essential for plant growth and for animal and human health. With respect to plants, these are referred to as micronutrients and include Boron(B), Cop per(Cu), Iron(Fe), Zinc(Zn),Manganese(Mn) and Molybdenum(Mo). Arsenic(As), Cobalt(Co), Chromium(Cr), Nickel(Ni), Selenium(Se) , and Tin(Sn) are essential in animal nutrition [16]. This metals when in excess results to hazardous effects on plant and animals. This work will produce baseline information/data on metal concentrations in soils of the areas studied. [17] This work will enhance land use planning in the areas as the elemental values or position of any particular area is established.

Limitation of the Study

Due to finance and time factor, this work is limited to trace metals found around mechanic workshops in Enugu Metropolis [18].

MATERIALS AND METHODS

Sample Collection

Soil pits were dug by hand to a depth of 15cm and four (4) samples were collected 20m apart from the various automobile workshop. The samples were pulled together in a polyethylene bag to form a composite. [19] Any non-decomposed organic materials was removed prior to sampling the uppermost horizon. The samples were then taking to the laboratory for analysis.

Soil Sample Digestion

The soil samples were collected from composite sample and air dried in the oven at 105°c and allowed to cool in a desicccator. [20]; [21] The dried samples were pulverized and homogenized with 2mm sieve. 2 grams of each pulverized and dried soil sample were weighed into a 250ml beaker and digested with 20ml of 50% hydrochloric acid on a hot plate until 2/3 of the content were remaining /clear solution. 10ml of deionized water was added to the content to wash the sides of the beaker. [22] The digested sample was filtered into a 100ml volumetric flask and made up to mark with deionized water. A blank was similarly prepared without soil sample. [23] The digested sample was poured into sample bottles for (AAS) analysis (Atomic Absorption Spectrometer).

Methods For The Heavy Metal Analysis Of Soil Samples

Heavy metal analysis was conducted using Varian AA 240 Atomic Absorption Spectrophotometer according to the method of APHA 1995 (American public health Association).

Working principle: Atomic absorption spectrophotometer's working principle is based on the samples being aspirated into the flame and atomized [24]. When the AAS's light beam is directed through the flame into the monochromator, and onto the detector that measures the amount of light absorbed by the atomized element in the flame. Since metals have their own characteristic absorption wavelength, a source lamp (Hollow cathode lamp) composed of the element is used, making the method relatively free from spectral or radiational interference [25]. The amount of energy of the characteristic wavelength absorbed in the flame is proportional to the concentration of the element in the sample.

Determination Of The Metal Content

The instructions given by the manufacturers of the spectrophotometer was followed in order to reduce interference and background noise [26]. Three paralles extractions were carried out. The concentration of each element were determined by means of the calibration graph.

RESULTS

Results for Heavy Metal Analysis on Soil

Table 1

Sample name	Lead (Ld) mg/L	Chromium (Cr) mg/L	Nickle (Ni) mg/L	Cadmium (Cd) mg/L
Abakpa	1.46	1.56	0.74	0.14
Onuato	0.91	0.31	0.08	0.05
Amechi road	6.67	2.34	1.26	0.60
WHO standard	0.05	0.05	0.05	0.05

DISCUSSION

Many studies have shown that urban soils receive loads of contaminants that are usually greater than in surrounding sub-urban or rural areas due to the higher anthropogenic activities of urban settlement. The concentration of the metals, however, were relatively low in nearby control area with same geology as the mechanic site. In humans, heavy metal poisoning is generally treated by the administration of chelating agents. [27] These are chemical compounds, such as CaNa2 EDTA (calcium disodium ethylenediaminetetetra acetate) that convert heavy metals to chemically inert forms that can be excreted without further interaction with the body. Vitamin and mineral supplements are sometimes co-administered for this reason.

Lead (Pb)

The value of lead (Pb) present in all the soil samples were 1.46 mg/L, 0.91 m/1 respectively 6.67 mg/1, for Abakpa, Onuato and Amechi road respectively and was found to be above the WHO standard for lead in the soil which is 0.05 mg/L.

The value of lead obtained from Amechi road i.e 6.67 mg/L was the highest among the area. [28] This high level of lead may be attributed to the amount of waste oil, presence of automobile emissions and expired motor batteries indiscriminately dumped by battery chargers and auto mechanics around their shops.

Chromium (Cr)

Chromium was present in all the soil samples investigated in concentration of 1.56mg/L, 0.31mg/L and 2.34mg/L for Abakpa, Onuato and Amechi road respectively and were found to be above the WHO standard for Chromium in the soil (0.05mg/L). [29] The value in Amechi road 2.34mg/L was found higher than that of other sites while it was found that there is low distribution of cadmium in this study areas could be attributed to the chromate-based primer paint that had been applied to cars bodies and have contributed to the contamination of the soil.

Nickel (Ni)

The concentration of Nickel (Ni) in the soils investigated showed a distribution concentration of 0.74 mg/L, 0.08 mg/L and 1.26mg/L for Abakpa, Onuato and Amechi road respectively. The results are slightly above the WHO (0.05mg/L) standard for Nickel presence in agricultural soil. [30] The anthropogenic distribution of nickel in this study area could be attributed to the disposal of spent automobile bacteries from nearby auto-battery charger and various paint wastes and pigments, which have contributed to the contamination of the soil.

Cadmium (Cd)

The concentration of cadmium (Cd) examined in these areas were 0.14mg/L , 0.05mg/L and 0.60mg/L for Abakpa, Onuato and Amechi road respectively. The values of cadmium in Abakpa and Amechi road were found to be above the WHO standard while that of Onuato is the same with the WHO standard. [31] The concentration of cadmium in the soil may be attributed to large quantities of battery dumped at the study areas since batteries are good sources of several elements including lead, cadmium and nickel. The presence of heavy metals in the study areas could have deleterious impacts on the health of human beings and animals.

CONCLUSION

The present study investigated the effects of mechanic workshops on the levels of heavy metals (lead, Chromium, Nickel and cadmium in soil, can be concluded that automobile wastes from mechanic workshops accumulated in soils. The study also revealed significant variations in heavy metal levels in the soil. In order to have a comparative idea about the levels of contamination, data from this work was compared with those from the control (WHO standard). The background value of an element is the maximum level of the element in an environment beyond which the environment is said to be polluted by the element.

The average level of these metals in the soil, around the auto mechanic site indicates that they are not derived from the natural geology of the area as evident from the low level of metals in control sample. Large variations imply great heterogeneity of metals in soils while low variations showed more or less homogenous distribution of metals in the soil and this could be traced to different levels of pollution caused by varying degree of automobile wastes and other anthropological activities. The improper disposal of these wastes now demands attention in order to protect the soil as they render farmlands unfit for agriculture as well as pollute the ground and surface water system.

RECOMMENDATION

It is therefore recommended that, mechanic villages should be sited far from residential and farmland areas to avoid the transfer of these heavy metals into the food chain and ground and surface water systems.

Government should state an act of using bioremediation to clean up the already polluted soil to avoid further transfer of these heavy metals in the wells, surface water and groundwater.

I addition, the study recommended that the waste effluents from mechanic workshops should be treated and more importantly, environmental education should be encouraged.

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