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Determination of Lead Levels in Soil for Some Areas at East Gezira and Khartoum - Sudan, Africa

A Comparative Study between the Rural Areas and Urban Areas

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Abstract- Lead is a chemical element with an atomic number 82 and symbol Pb and nowadays recognized as a heavy-metal poisonous, it affects every system of the body. Acute exposure to a high level of Lead can result in death or significant damage to the brain or other organs. The study aimed to determine the concentration of Lead in Soil of some areas in Khartoum and East of Gezira (Banat, Rufa'a, and Tambol) Specifically. Also, to make a comparison between the rural areas and the urban areas. Eighteen samples of soil havebeen collected from the bus stations, batteries repairing Market in Souk Sha'bi and specific distances away from them. Atomic Absorption Spectrometer method was used to do the analytical work. The concentration of Lead in samples of soil in this Investigation was ranged 0.78 ppm (Banat) – 10.58 ppm (Batteries Market Souk Sha'bi). We found a positive correlation between Urbanization and lead mean concentration of 1.22 ppm in Khartoum and 0.40 ppm in East of Gezira. A positive relationship was additionally found between the concentrations of lead as being closer to the Centre of each one of the transport station and Batteries repairing places and the Main road. So this study recommended that all Lead-related industries and markets should be far enough from human living to avoid environmental lead pollution.

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Determination of Lead Levels in Soil for Some Areas at East Gezira and Khartoum-Sudan, Africa

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I. Introduction

Heavy metal is an Individual from a badly characterized subset of the chemical elements that show metallic properties. Many different descriptions of the term Heavy metal have been proposed, in light of either Density, Atomic number, Atomic weight, Chemical properties, or Toxicity (Cacar, 2003).The term heavy metal alludes to any metallic chemical element that has a comparatively high density and is poisonous at low concentrations (Cacar, 2003). Instances of Heavy Metals incorporate Mercury (Hg), Cadmium (Cd), Arsenic (As), Chromium (Cr), Thallium (Tl), and Lead (Pb) "Our focus element in this Examination"

Heavy metals are natural constituents of the Earth's crust. They are steady and can't be debased or devastated, and along these lines, they will result in general aggregate in soils and dregs. However, human activities have drastically altered the biochemical and geochemical cycles and balance of some heavy metals.

The vital man-made wellsprings of Heavy Metals are mechanical point sources, e.g., mines, foundries and smelters, and diffuse sources, such as ignition side-effects, traffic, and so on. Moderately unstable Heavy metals and those that become connected to air-borne particles (particulates) can be broadly scattered all through the climate, regularly being saved a great many miles from the site of introductory discharge. As a rule, the littler and lighter a molecule is, the more it will remain noticeable all around. In general bigger particles (greater than 10 micrometers (μm) in diameter) will settle to the ground by gravity in matter of hours whereas the littlest particles (under 1μm in diameter) can remain in the environment for a considerable length of time and are for the most part expelled by precipitation.

The main anthropogenic wellsprings of heavy metals are different industrial procedures, mining, foundries, and smelters, burning of non-renewable energy source and gasoline, and waste incinerators. The significant Heavy Metals of worry to EMEP are Hg, Cd, and Pb, since they are the most dangerous and have known actual impacts on, for example, human health. Environmental exposure to high concentrations of heavy metals has connected with, e.g., different diseases, cancers, and kidney harm. There are significantly more estimations information on Hg, Cd, and Pb in Europe than for other metals. (Ilyan et al. 2002)

Heavy metal contamination in wastewater and Soil are one of the issues confronting Individuals, Heavy Metal can be toxic or poisonous to life, as shown in [Table 1].

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Table 1: Classification of Elements According to Toxicity and Availability (Wood, 1974).

Non-critical Accessible	Toxic but rare	Very toxic
Al	Ba	Ag
Br	Cs	As
C	Ga	Au
Ca	Hf	Be
Cl	Ir	Bi
Li	La	Cd
Mg	Nb	Co
N	Re	Cu
Na	Rh	Hg
Rb	Ru	Ni
Sr	Ta	**Pb**
Si	Ti	Pd
F	Zr	Pt
Fe	W	Sb
Hg		Se
K		Ti
O		Te
P		Zn
S		

II. The Objective of the Examination

The propose of this Investigation was to determine and examine the level of lead in soil by using atomic absorption spectrometer Method and makes a comparison between the rural and the urban areas.

III. The Experiment

a) Materials

Eighteen Samples of soil were collected from several random places from East of Gezira and Khartoum (Sudan), including three rural areas Rufa'a, Banat and Tambol (East of Gezira) and three urban areas Souk Arabi, Souk Sha'abi, and Mina Al-Barri (Khartoum) and preserved for a later laboratory test.

b) Chemical reagents

The grade of chemical reagents used in soil analysis for *Pb* element estimation was Analytical reagent (AR) with high purity (99.9%); which includes HCl and H_2SO_4.

c) Atomic Absorption Spectrometer

Atomic absorption Spectrometer (210/211 VGP Buck Scientific) double beam manufactured by The United States of America was used in a measuring the concentration of Pb in soil Samples (AAS, 1994). It's usually used for the determination of metal elements. This technique features high accuracy and precision of trace element determination on condition that analyze is adequately prepared.

IV. Methods

a) Sample preparation

5.0 g of an air-dried ground and sieved sample was placed in an Erlenmeyer flask. 20 ml of extracting solution was added; (0.05N HCl + 0.025N H2SO4). Then Placed in a mechanical shaker for 15 minutes. After that filtrated through Whatman #42 filter paper into a 50-ml volumetric flask and diluted to 50 ml with extracting solution.

b) Analytical methods for Atomic Absorption

The analysis of soil samples for measuring Pb was done by Calibrated Atomic Absorption Spectrometer Instrument with known stock standard solutions prepared in ratio 1:3:6 mg/l to perform the linear curves within the linear ranges for the mentioned element, beside the reference sample materials (Certified Samples for the same elements) according to certain condition.

The techniques of instrument operation performed in steps, the desired lamp in the upper most position of the lamp turret was installed. This is an operating position to align the wavelength. {Library} key button was pressed to enter the library. {Sel} key button pressed until the lamp number (Top of the screen) matches the turret position. Either {Up/down} key arrow was pressed until the desired metal and method were shown in the library window.

c) Statistical Analysis

Data were analyzed as a completed randomized design. Analysis of variance (ANOVA) was performed According to the procedure described by Gomez (1984). Means were separated by using Duncan multiple ranges tests (DMRT). The results were used to compare between the two sample Areas.

d) Sample Coding

After taking the samples from their different areas what the researcher needed was making codes to deal with the different items and samples, the codes were assembled by taking the Urban Area as (A) and the rural area as (B). The below table gives more detail about the codes.

Table 2: Sample Codes and their Distribution

Urban Areas (Khartoum)		
Sample Code	mg/l	mg/kg
A1a	0.198	1.98
A1b	0.129	1.29
A1c	0.135	1.35
Mean of A1 area = 1.54		
A2a	0.192	1.92
A2b	0.157	1.57
A2c	0.277	2.77
Mean of A2 area = 2.09		
A3a	0.623	6.23
A3b	1.058	10.58
A3c	0.833	8.33
Mean of A3 area = 8.38		

V. Results

The Experimental work was done in *Environmental and natural resource and desertification research Institute* (Khartoum – Sudan) under supervision of *Dr. Magdi Hashim Ahmed* (Central lab. Supervisor), and *Dr. Omer Mohamed Dafalla* (Chief of the chemical analysis Dep.) and this was the result.

Table 3: Lead Level in the Urban Areas

Urban Area (Khartoum)	Rural area (East of Gezira state)
A1a Bus Station (Mina al barri)	B1a Banat
A1b 50 meter away	B1b 50 meter away
A1c 100 meter away	B1c 100 meter away
A2a Bus station (Souk Arabi)	B2a Tambol – Veterinary medicine college
A2b Around the liberty bridge	B2b 50 meter away
A2c Sahafa shareg buses	B2c 100 meter away
A3a Souk sha'bi	B3a Rufa'a
A3b 50 meter away	B3b 50 meter away
A3c 100 meter away	B3c 100 meter away

Note: Uncontaminated soil contains lead concentrations less than 50 ppm, but soil lead levels in many urban areas exceed 200 ppm.

Calculation Formula:

[Mg/Kg = Reading (g/l) x Volume (ml) / Weight (g)]

Example: 0.198 x 50 / 5 = 1.98 mg/kg

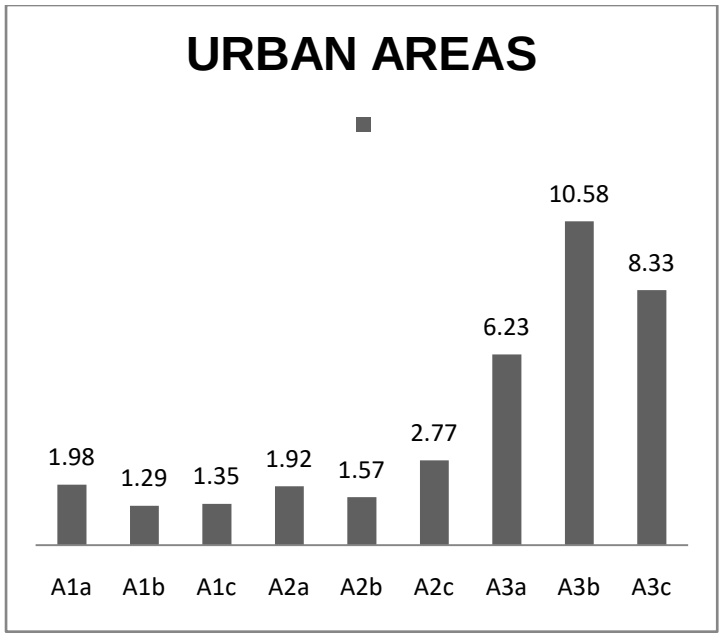

Figure 1: Level of Lead Concentration in Urban Areas

Note:

- Since the P value in the urban area is greater than 0.05, the null hypothesis is accepted which indicates that the lead level is higher in the urban area than the rural area.
- Values with different characters are significantly different using of DUNCANS Test ($p<0.05$).

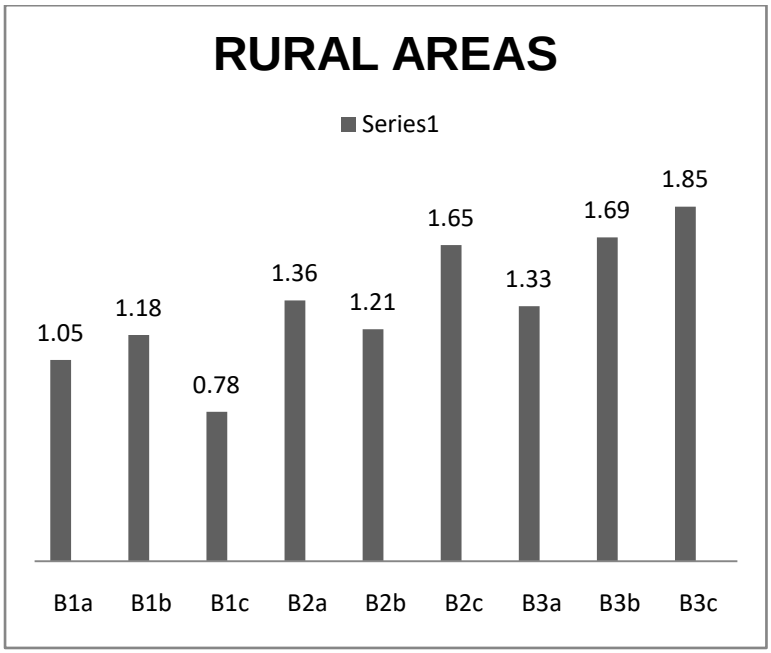

Figure 2: Level of Lead Concentration in Rural Areas

Table 2: Lead Level in the Rural Areas

Rural Areas		
Sample Code	mg/l	mg/kg
B1a	0.105	1.05
B1b	0.118	1.18
B1c	0.078	0.78
Mean of B1 area = 1.003		
B2a	0.136	1.36
B2b	0.121	1.21
B2c	0.165	1.65
Mean of B2 area = 1.41		
B3a	0.133	1.33
B3b	0.169	1.69
B3c	0.185	1.85
Mean of B3 area = 1.62		

VI. Discussion

The highest point of Lead Pollution was found in souk sha'bi (A3b) which was 10.58mgkg^{-1} as expected because of the high level of lead pollution in this area, and the lowest point of Lead pollution was in the rural area as expected and was 0.78 mgkg^{-1} in Banat (B1c) area because of its flexible and rural maintained stability of purity (there is no source of pollution).

So we notice that there is a significant difference (sig. = 0.02) in the two sample areas because of their pollution's source. Among all the things, in general, the urban areas have highly a pollution source that doesn't exist in the rural area.

Mohamed Elmubarek, 2012 "Ph.D." *(Environmental Levels of Lead in Soil and Drinking water in some areas in Khartoum and Gezira State, University of Gezira*), did the same analysis on the soil in Khartoum area and get ranging about 11.24 ppm, by using the same method.

As well as Wafaa Sahib Abbood Alawsy College of Agriculture-University of Qadisia and Eman Abdul Mahdi Oleiwi College of Agriculture-University of Baghdad, 2014 "MSc" *(Study the Pollution of some Calcareous Soils with Cadmium and Lead and Its Relationship with the Accumulative Effect of Used Engines Oils on Mineralogical Soil Separates)* were done work on lead pollution in Soil of some areas in Iraq and their ranging was high between 12.8 – 13.6 ppm.

VII. Conclusion

7.1 A Soil with Contamination of *LeadPb* may expose a risk by direct ingestion, Smelling, take-up in vegetable ranches and Soil.

7.2 Uncontaminated soil contains lead fixations under 50 ppm; however, soil lead levels in numerous urban territories surpass 200 ppm.

7.3 The EPA's standard for lead in uncovered soil in play zones is 400 ppm by weight and 1200 ppm for non-play territories.

7.4 The results of this study were significant eligible by the meaning of this command.

VIII. Recommendation

This investigation suggests that:

8.1 All lead-related ventures and Batteries Market ought to be sufficiently far from human living to evade environmental lead contamination.

8.2 To accomplish more work on this contamination field (Heavy metal poisonous).

8.3 More research must be completed for another Heavy metal.

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