International Journal of Discrete Mathematics
2017; 2(3): 59-63
http://www.sciencepublishinggroup.com/j/dmath
doi: 10.11648/j.dmath.20170203.11

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Heavy Metals Pollution in Soil and Its Influence in South of Iraq

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To cite this article:
Luma Naji Mohammed Tawfiq, Farah Feasal Ghazi. Heavy Metals Pollution in Soil and Its Influence in South of Iraq. *International Journal of Discrete Mathematics.* Vol. 2, No. 3, 2017, pp. 59-63. doi: 10.11648/j.dmath.20170203.11

Received: January 27, 2017; **Accepted**: February 18, 2017; **Published**: March 9, 2017

Abstract: The aim of this paper is to determine the significant levels of some heavy metals such: lead, chromium, nickel and cadmium, were determined. Sources of pollution and their distribution according to presence of elements in the soils over the whole zone of the province of Maysan in southern of Iraq were investigated 36 soil samples from different zones: residential, industrial, commercial, agricultural and main roads, were collected from the soil surface and a depth of 30 cm and analyzed measuring of concentrations for heavy metals by a device ICP-MS technique. The results were compared with global standard levels of these elements in the soil.

Keywords: Mathematical Modeling, Pollution, Heavy Metals, Plants, Accumulation, Hyperaccumulator Plant

1. Introduction

Mining, manufacturing, and the use of synthetic products, e. g., pesticides, paints, batteries, industrial waste, and land application of industrial or domestic sludge, can generated heavy metal contamination for urban and agricultural soils. Heavy metals also occur naturally, but rarely at toxic levels. Potentially contaminated soils may occur at old landfill sites (particularly those that accepted industrial wastes), old orchards that used insecticides containing arsenic as an active ingredient, fields that had past applications of waste water or municipal sludge ,areas in or around mining waste piles and tailings, industrial areas where chemicals may have been dumped on the ground, or in areas downwind from industrial sites [1]. When using the contaminated soil to produce food by various crop plants, as the easy entry of these elements in the food chain, which increases the risk to human health [2].

The most important elements must disappeared from the soil are lead and cadmium, as they are very significant impact on human health where the cadmium is very toxic elements for humans, the inhalation (0.04) mg / kg lead to symptoms of headache, cough, chest pain may lead to death, as the ingestion of 1 g of cadmium produces vomiting and pain in the head, but for the lead must follow it continuously high for the threat to the environment for entering in many industries the most important of the battery industry and motor gasoline, pesticides and lead an impact on physiological processes in the human body to children and has the effect of risk the emergence of embryonic as it leads to the accumulation causes mental retardation or toppling when pregnant [3-7].

2. Materials and Methods

Soil samples were collected from 36 area of soils for Maysan city divided by 22 a sample of residential zones and 2 a sample of industrial zones and 4 distributed on both commercial and agricultural zones and main roads sample in a row and at a sample rate for each area in depth (0-30) cm. Preserved specimens within the nylon bag and then transported to the laboratory models for the purpose configured to measure the content of heavy elements in the approved study: Cr, Ni, Pb and Cd, and read by its focus device ICP-MS technique.

3. Factors Controlling the Distribution of Heavy Metals in the Soil

Many factors and variables govern trace metal behavior in soils and sediments in complex ways. These factors are: Organic matters (O. M.), Clay minerals, Iron oxides and pH [8].

4. Results and Discussion

Heavy metals concentrations levels were measured in soil samples which were taken from the testing locations at different depths (0 and 30 cm from soil surface).

The total results of heavy metals concentration are listed in Tables 1b, 2, 3, 4 and 5 there show variation in the concentrations of heavy. The average concentration of nickel in the soil of Maysan city: residential, industrial, commercial, main roads and agricultural is 47.3, 80.9, 56.9, 76.1 and 28.5 mg/kg respectively, higher than the global average in natural soils, which amounted to 40 mg/kg as shown in Table 1a. It also was demonstrated that the highest concentration of nickel in the zone (Qatea 28) of the residential regions the amount of focus 90.1 mg/kg was the amount of the increase over the normal average by 50.1mg/kg and also shown in Table 1b. The rate of lead in the soil of Maysan: residential, industrial, commercial, main roads and agricultural, were as follows: 44.3, 79.7, 47.4, 71.4 and 25.2 mg/kg respectively higher than the natural rates by about a 10 mg/kg. The highest concentration was in the zone (Hue Nahawand) of industrial zones, it was 81.4 mg/kg the rate of increasing was 71.4 mg/ kg. Chromium rate was in the zones mentioned above soil Maysan as follows: 65.1, 75.6, 60.7, 69.5 and 22.5 mg/kg which was less than the normal rate for the concentrations of chromium in the soil Chrome 100 in the soil and the highest concentration of chromium in the zone (Al Mokea) of the residential zones, the concentration of chromium was 86.8 mg/ kg. For cadmium average concentrations in the areas mentioned above soil Maysan were 0.054, 1.93, 0.294, 1.37 and 0.011mg/kg which was higher than the normal rate in some areas where the global rate of cadmium in the soil is 0.06 mg/kg and his concentration was higher in the zone (Hue Al Sinaae) of the industrial zones displaying concentration of 2.01 mg/ kg while the average of increasing over the natural global average was 1.95 mg/kg.

In order to compare zones with each other (residential zones, industrial zones, commercial zones, main roads and agricultural zones) the conclusion are demonstrated as follows:

Soils agricultural zones < soils residential zones < soils commercial zones < soils main roads < soils industrial zones. Figure 2. illustrates that the agricultural zones are the lowest while industrial zones are the highest.

5. The Suggestion Treatment

There are many ways to reclaim the most important soil contaminated including:

i) to abate the toxicity of heavy metals in soil by using bacteria;

ii) to add bonds in soil to solidify and stabilize heavy metals;

iii) to remove heavy metals from soil by utilization of electricity dynamics;

iv) to remove heavy metals from soil by thermic absorption;

v) to remove heavy metals from soil by extraction and washing;

vi) to remove heavy metals from soil by phytoremediation [9].

Table 1a. *Standard means concentrations of heave metals in soil [13].*

	Pb	Ni	Cr	Cu	Cd
Standard mean in soil given by Lindsay, 1979	10	40	100	30	0.06

Table 1b. *The concentrations of the studied heavy metals in the soil of Maysan to some residential areas in 30 cm depth.*

No.	Site	Pb	Difference with standard	Ni	Difference with standard	Cr	Difference with standard	Cd	Difference with standard
1	Owasha	29.5	19.5	37.0	-3.0	77.5	-22.5	nil	-
2	Hue Al Hseean	48.6	38.6	52.3	12.3	82.6	-17.4	nil	-
3	Al Qadria	35.7	25.7	35.2	-4.8	75.9	-24.1	nil	-
4	Al Srea	51.9	41.9	44.6	4.6	64.4	-35.6	nil	-
5	Al Sray	49.1	39.1	40.9	0.9	61.5	-38.5	nil	-
6	Qatea 28	78.7	68.7	90.1	50.1	73.7	-26.3	nil	-
7	Qatea 30	44.5	34.5	43.8	3.8	61.2	-38.8	nil	-
8	Hue Al moalemen Al Chaded (Mkrba)	28.2	18.2	30.0	-10.0	45.8	-54.2	nil	-
9	Al Askan	39.3	29.3	38.4	-1.6	58.1	-41.9	nil	-
10	Hue Al Resala	61.4	51.4	70.2	30.2	66.0	-34.0	nil	-
11	Al qahera	49.6	39.6	52.5	12.5	64.9	-35.1	nil	-
12	Al mahmodea	45.1	35.1	50.7	10.7	70.3	-29.7	nil	-
13	Al Majdea	36.2	26.2	39.6	-0.4	48.8	-51.2	nil	-
14	Al Dababes	64.4	54.4	70.3	30.3	72.0	-28.0	nil	-
15	Hue Al Escary	37.6	27.6	41.4	1.4	69.2	-30.8	nil	-
16	Hue Al moalemen Al qadem	29.5	19.5	31.6	-8.4	51.7	-48.3	nil	-
17	Al Emarat Al Saknia	61.3	51.3	67.3	27.3	65.5	-34.5	0.095	0.035
18	Hue Al Amel	31.4	21.4	33.7	-6.3	59.4	-40.6	nil	-
19	Al Jadeda	25.0	15.0	30.8	-9.2	52.6	-47.4	nil	-
20	Hue Al Mehnean	29.0	19.0	33.0	-7.0	51.2	-48.8	nil	-
21	Abu Rmana	35.1	25.1	40.0	0	72.7	-27.3	nil	-
22	Al Mokea	64.2	54.2	66.2	26.2	86.8	13.2	1.10	1.04
	Average	44.3	47.3	65.1	0.054				

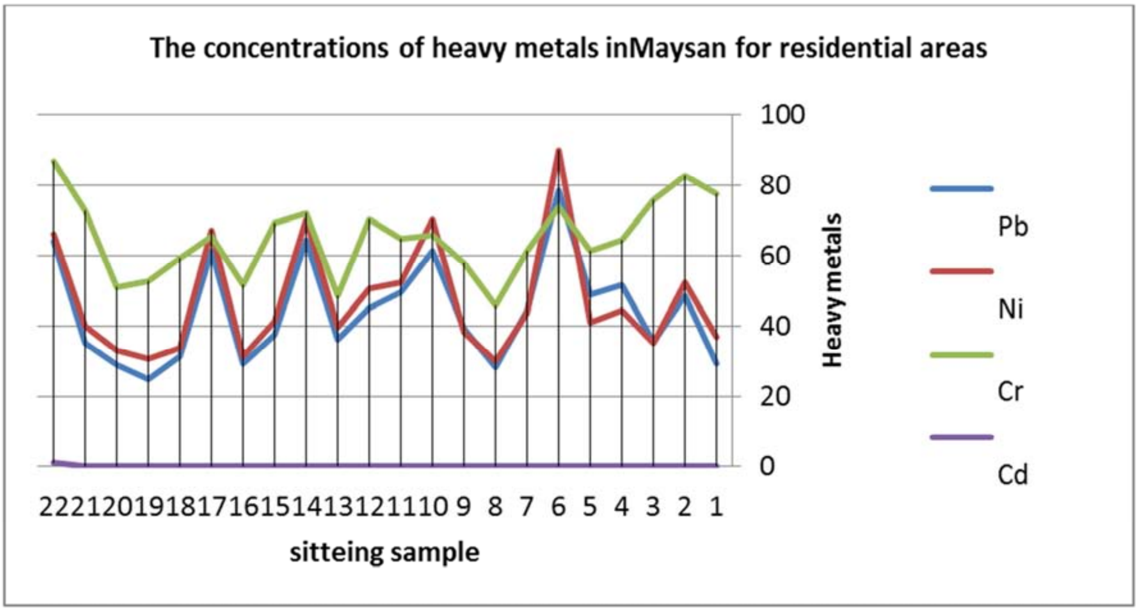

Figure 1. *The concentrations of heavy metals in Maysan for residential areas.*

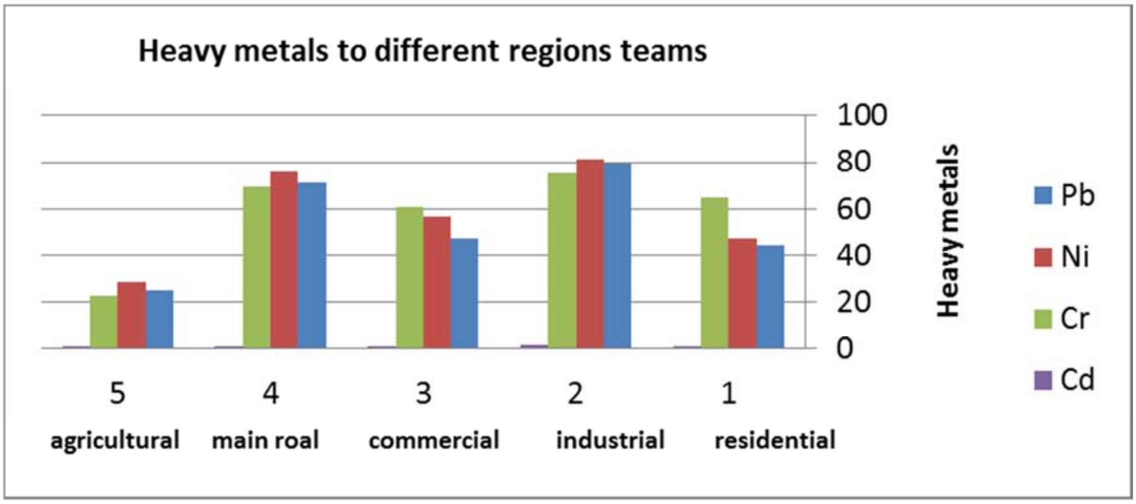

Figure 2. *Heavy metals to different regions teams for Maysan city.*

6. Phytoremediation

Phytoremediation is the process of growing plants in metal contaminated soil. Plant roots translocate the metals into aboveground portions of the plant. After plants have grown for some time, they are harvested and incinerated or composted to recycle the metals. Several crop growth cycles may be needed to decrease contaminant levels to allowable limits. If the plants are incinerated, the ash must be disposed of in a hazardous waste landfill, but the volume of the ash is much smaller than the volume of contaminated soil if dug out and removed for treatment [1-2].

The phenomenon of accumulation of heavy metals in the plants has received a significant attention of researchers because of its important applications in vegetable processors. Phytoremediation can exploit these plants and used it to extract contaminants (heavy metals) from the soil, because these plants have valuable absorption toward these elements from the soil solution and then transiting them to the total vegetative. Also some plants may be use as technology to transfer some heavy metals to the volatile materials which can easy disposal into atmosphere. Studies to indicate that there are many plants that can capture and accumulate heavy metals from contaminated zones, however, that the ideal plant for this process must have some characteristics such as faster growth, roots dense, deep large, easy harvesting, cutting and accumulation, using for a wide range of elements and live mass, eventually the plants should withstand high levels of elements [10-11].

There are many plants with high capacity to absorb dangerous substances released by the label Plants hyper accumulation Some examples [12]

1- Sunflower (Helianthus annuus): Featuring sunflower large radial flowers, which revolve with the sun wherever it took place; therefore called so, and cultured Sofa Accessories, and eaten the seeds of this plant have the ability to absorb heavy metals and radioactive materials, and its concentration in the leaves, so used in cleaning the soil of Uranium in Chernobyl

Figure 3a. *Sunflower plant.*

2- Indian mustard / Brassica juncea: It has the ability to absorb bullets

Figure 3b. *Indian mustard.*

3- Amaranthus

This vegetarian follow platoon Brocades and Brocade is a genus of flowers, also known as "love die" bleeding.

It was used in medieval times to stop the bleeding. The leaves are characterized by shades of purple, red and gold. They have the ability to store extremely high amounts of radioactive elements in the leaves.

Figure 3c. *Love die flowers.*

4- Sorghum bicolor

It can absorb some heavy metals.

Figure 3d. *Sorghum bicolor plant.*

The benefits of phytoremediation: inexpensive, can be controlled in the plant, which absorbed pollutants such as burning of passivity that it takes a long time sometimes.

Table 2. *The concentrations of the heavy metals in the soil of Maysan to some industrial areas in 30 cm depth.*

No.	Site	Pb	Difference with standard	Ni	Difference with standard	Cr	Difference with standard	Cd	Difference with standard
1	Hue Al Sinaae	78.0	68.0	86.5	46.5	65.6	-34.4	2.01	1.95
2	Hue Nahawand	81.4	71.4	75.2	35.2	85.6	-14.4	1.85	1.79
	Average	79.7		80.9		75.6		1.93	

Table 3. *The concentrations of the heavy metals in the soil of Maysan to some commercial areas in 30 cm depth.*

No.	Site	Pb	Difference with standard	Ni	Difference with standard	Cr	The difference	Cd	The difference
1	Tareq Omara-Kowt	72.3	62.3	77.2	37.2	69.1	-30.9	1.25	1.19
2	Tareq Omara-Basra	69.8	59.8	83.0	43.0	78.9	-21.1	1.77	1.71
3	Tareq Omara-Naseraa	80.1	70.1	77.9	37.9	71.0	-29.0	1.40	1.34
4	Tareq Omara- Mashrah	63.3	53.3	66.1	26.1	59.0	-41.0	1.08	1.02
	Average	47.4		56.9		60.7		0.294	

Table 4. *The concentrations of the heavy metals in the soil of Maysan to Main roads in 30 cm depth.*

No.	Site	Pb	Difference with standard	Ni	Difference with standard	Cr	Difference with standard	Cd	Difference with standard
1	St. dejla	46.2	36.2	59.6	19.6	67.4	-32.6	1.08	1.02
2	St. Al Tarbea	45.7	35.7	55.5	15.5	65.9	-34.1	0.095	0.035
3	St. Baghdad	47.7	37.7	61.1	21.1	60.6	-39.4	nil	-
4	St. Al Moror	50.0	10.0	51.7	11.7	48.8	-51.2	nil	-
	Average	71.4		76.1		69.5		1.37	

Table 5. *The concentrations of the heavy metals in the soil of Maysan to some agricultural areas in 30 cm depth.*

No.	Site	Pb	Difference with standard	Ni	Difference with standard	Cr	Difference with standard	Cd	Difference with standard
1	Naher Sead	25.5	15.5	30.7	-9.3	19.6	-80.4	nil	-
2	Al Shbana	30.0	20.0	36.2	-3.8	23.3	-76.7	0.044	-0.016
3	Al Tlaiaa	18.4	8.4	23.5	-16.5	21.6	-78.4	nil	-
4	Al Mjer	26.7	16.7	37.3	-2.7	25.5	-74.5	nil	-
	Average	25.2		28.5		22.5		0.011	

7. Conclusions

The results which obtained from the present work show that soil of Maysan city in southern of Iraq were found to be significantly contaminated with metals like Cr, Ni, Pb and Zn at levels above the background concentration in the international soils, which may give rise to various health hazards, while the concentrations of Cd and Co were under the background concentration in soil. Also, we see that the rate of contamination in soil for different zone is as follow:

Soils agricultural zones < soils residential zones < soils commercial zones < soils main roads < soils industrial zones. Figure 2. illustrates that the agricultural zones are the lowest while industrial zones are the highest. Finally suggest some ways to treatment the contamination in soil.

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