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Pollution of Soils by Heavy Metals in East Baghdad in Iraq

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Abstract

The aim of this paper is to study a pollution of soil by heavy metals in Al-Nahrawan city, Baghdad.
A total of 20 samples from the soil,were the samples analyzed for their content of Cd, Cu, Pb, Cr, Ni, Fe, Mn, and Co. A profile foraverage content of these selected metals has been determined by taking averagevalues for different zones. Highestconcentrations for selected heavy metals were observed in the industrial area, 60 brick factories, fossil fuel combustion from traffic emissions, wear of brake liningmaterials, and several industrial processes are considered as major sources of thestudied heavy metals.
Keywords: Heavy metals; Soil contamination.

1. Introduction

Inthe recent years, much concern has been addressed over understanding theurban soils, characteristics and contamination which became considerable greatconcerns due to the rapid industrializations and urbanizations. The upgrading ofindustry and the presence of intensive human activities in urban areas has worsenedthe problems of heavy metal contamination in urban soils [1].
Heavy metals are Pb from leaded gasoline; Cu; Ni; Cr; Fe; Mn; Co andCdfrom car components, tire abrasion, lubricants and industrial plus
incinerator emissions[2].
Their levels in the environment are not stable and vary according to industrialproduction, urbanization, climate changes and many other factors [3]. So, there is anincreasing interest in studies of critical soil constituents of heavy metals to examinetheir spatial distribution and identifying the links with factors such as parent material,land use or other human activities[4].The present investigation aims to assess heavymetal contamination in residential and industrial region in Baghdad city and to studytheir distribution and sources.

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2. Materials and Methods

2.1.Sampling

Sampling was carried out in April 2015. Figure 1 gives anindication of the character of the zones, from which sampleswere taken. Samples were collected from 20 points, were 10 soil samples collected with depth 0-10 cm, and 10 soil samples collected with depth 10-20 cm,using soil core,then all the sampleswere put in plastic bags to measure the concentration of heavy metalsCd, Cu, Pb, Cr, Ni, Fe, Mn, and Co.Thesoil samples were taken on a dry day from various categories of gardens on road sides near factories,children's playgrounds, schools situated in the residential area,tanning leather factoriesand brick factories.

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In the laboratory, samples were sieved in a 2-mm sieve to remove stones, glass and large plant roots and subsequently dried at room temperature for 3 days. Thedried samples were then homogenized with a mortar and a pestle. The proceduredescribed by [5] was followed to digest the samples with some modifications.

Figure 1: The zones of the studying area

2.2. Preparation of Samples

After collecting soil samples from Al-Nahrawancity then all the samples were taken to thelaboratory to preparing these samples for analyzing by (AAS) equipment(Buck Scientific,Model 210 VGP, Atomic Absorption Spectrophotometer).

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3. Mathematical Processing and Analysis

In this section we use interpolation method to compute the concentrations of heavy metals in the study region.Suppose that we want to find the value of the concentrationsof any of heavy metalsat the point in the study regionwithout use the laboratory equipment but depending on the points haveconcentrationsof heavy metals. It is assumed that we know the value of concentrations at the four points $Q_{11} = (x_1, y_1)$, $Q_{12}= (x_1, y_2)$, $Q_{21} = (x_2, y_1)$, and $Q_{22} = (x_2, y_2)$.

The idea is to perform linear interpolation first in one direction, and then again in the other direction. Although each step is linear in the sampled values and in the position, the interpolation as a whole is not linear but rather quadratic in the sample location see Figure 2. In this geometric visualization, the value at the black spot is the sum of the value at each coloured spot multiplied by the area of the rectangle of the same color, divided by the total area of all four rectangles.Alternatively, the interpolant can be written mathematically as:

$$f(x,y) = \sum_{i=0}^{1}\sum_{j=0}^{1} a_{ij}x^i y^j = a_{00} + a_{10}x + a_{01}y + a_{11}xy$$

Where; a_{ij}, i, j =0, 1, is the concentrationsof any of heavy metals of the point (x_i, y_j).

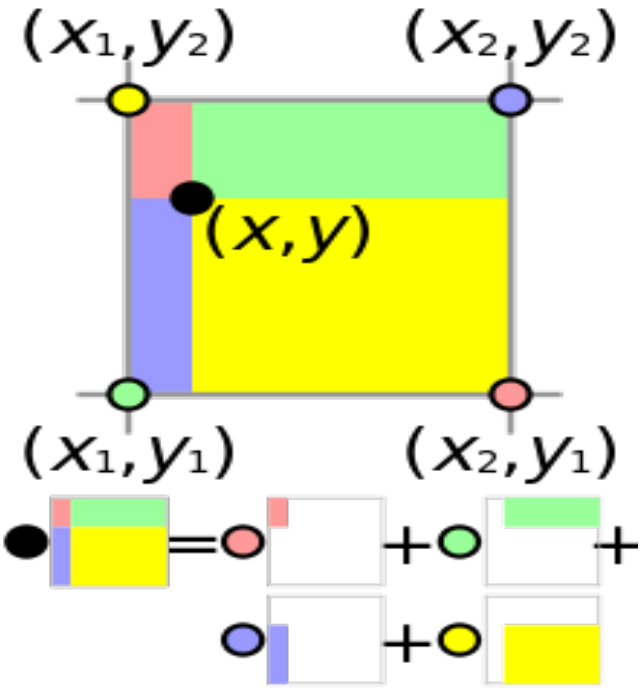

Figure 2: illustration of suggest method to compute theconcentrations

We applied the method on study region and the results gave in Figure 3, which illustrates the distribution of heavy metal in study region in Baghdad city for (0-10 cm) depth and Figure 4,illustrates the distribution of heavy metal in study region in Baghdad city for (10-20 cm) depth.

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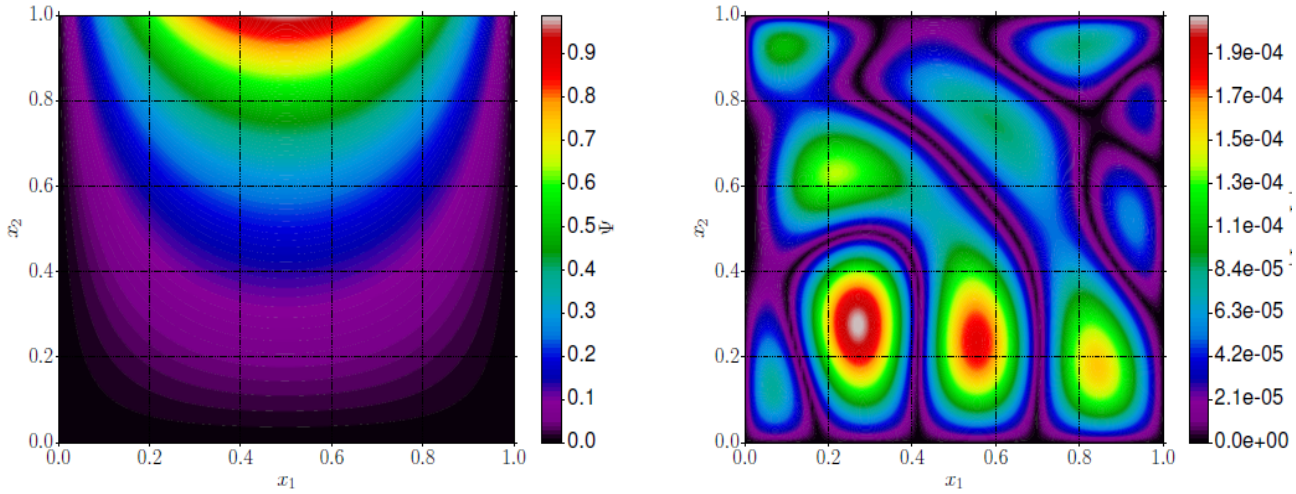
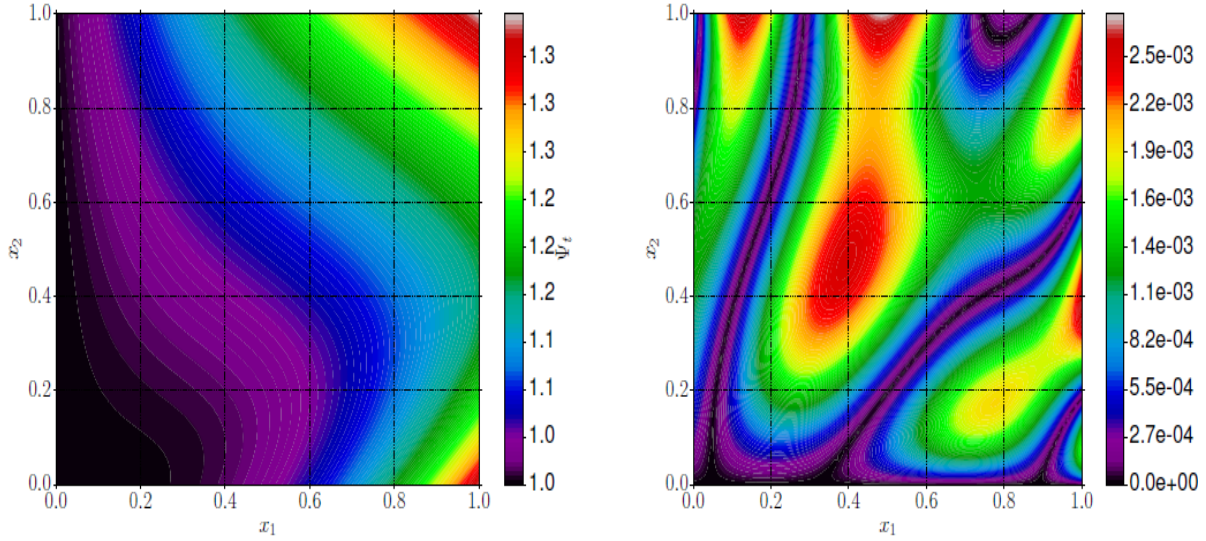


(a) (b)

Figure3:(a) Distribution of heavy metal in zones in Baghdad city with (0-10cm) depth (b)Comparison between standard and computed concentrations of heavy metals for zones in (a)



(a) (b)

Figure4:(a) Distribution of heavy metal in zones in Baghdad city with (10-20cm) depth (b)Comparison between standard and computed concentrations of heavy metals for zones in (a).

4. Results and Discussion

In Table (1), the concentrations of heavy metals Cd, Cu, Pb, Cr, Ni, Fe, Co and Mn of samples in depth (0-10cm) and in depth (10-20cm) are given. We see that the mean concentration of Pb in depth (0-10cm) is 70.5 PPm and in depth (10-20cm) is 66 PPm which is higher than Pb concentration in Shale which is 20 PPm depending on [6] also, higher than the standard universal [7] that attains 50 PPm (see Table 2). Also, we see that the concentration of Pb in depth (0-10cm) is higher than depth (10-20cm).

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The mean concentration of Cr in depth (0-10cm) is 77.5 PPm and in depth (10-20cm) is 70.25 PPm, the reason of increasing Cr concentration in soil is relating to the projectiles from chimneys of brick factories which contain high concentration of Cr when reaching soil after falling from air, and remnants of burning fuel, in addition to leather tanning factories where Cr is a basic element used in tanning leathers.

The mean of concentration of Ni in depth (0-10cm) is 190.8 PPm and in depth (10-20cm) is 167.2 PPm, and both cases are higher than its concentration in Shale which is 95 PPm or 68 PPm depending on [6], also, higher than the standard universal [7] were attain 100PPm (see Table 2).

The mean of concentration of Cd in depth (0-10cm) is 13.1 PPm and in depth (10-20 cm) is 11.7 PPm which are much more than Shale concentration which is 0.3 PPm depending on [6].

The mean of concentration of Fe in depth (0-10cm) is 31900 PPm and in depth (10-20cm) is 30100 PPm and both values are less than the concentration of Fe in Shale which is 47000 PPm depending on [6] that is the concentration of Fe in soil region is little more than the existing normal Geochemistry, also its concentration in depth (0-10cm) is higher than the concentration in depth (10-20cm) and the agricultural lands consist high concentration of Fe.

The mean of concentration of Mn in depth (0-10cm) is 187 PPm and in depth (10-20cm) is 185.5 PPm, but the mean of concentration of Mn in clay is (200-1200 PPm) and in sand is (20-500 PPm). The Eh and PH have important spell for determining their removing [8].

The mean concentration of Cu in depth (0-10cm) is 30.95 PPm and in depth (10-20cm) is 28.15 PPm and both values are less than the concentration of Cu in Shale which is 57 PPm depending on [6]. But the mean of concentration of Co in depth (0-10cm) is 12.9PPm and in depth (10-20cm) is 12.15 PPm and both values are exceeding the standard universal which is 10 PPm see Table 2, generally the mean of concentration of Co in soil is 0.05-300.

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Table 1: The concentration ofheavy metals in study regions with measure units PPm

Zone	Depth(cm)	Pb	Cr	Ni	Cd	Fe	Mn	Cu	Co
1	0-10	60	85	180	12	31500	200	36.5	13.5
2	0-10	55	80	173	12	31000	195	32	13
3	0-10	75	70	210	11	30500	195	27	13.5
4	0-10	75	75	203	13.5	31500	195	32	12
5	0-10	70	80	173	15	28000	185	27	12.5
6	0-10	70	90	180	14.5	36500	190	31.5	13
7	0-10	75	85	203	15	35000	180	29.5	13.5
8	0-10	70	80	188	12.5	29500	170	31.5	13
9	0-10	75	55	195	12	33000	190	31	12.5
10	0-10	80	75	203	13.5	32500	170	31.5	12.5
11	10-20	55	50	172.5	10	31000	195	32.5	13
12	10-20	60	75	165	11.5	29500	195	31	14
13	10-20	70	70	180	10	30000	185	26	12.5
14	10-20	60	72.5	180	12	30500	195	31	12
15	10-20	70	82.5	165	13	27000	185	26	11
16	10-20	65	87.5	150	12.5	35500	190	25.5	11.5
17	10-20	75	80	172.5	12.5	34500	180	27.5	12
18	10-20	60	80	150	12	26000	170	29	12.5
19	10-20	70	35	165	11.5	26500	190	22.5	11
20	10-20	75	70	175.5	12	30500	170	30.5	12
Mean	0-10	70.5	77.5	190.8	13.1	31900	187	30.95	12.9
	10-20	66	70.25	167.25	11.7	30100	185.5	28.15	12.15

Table 2: Standard Universalfor concentration ofheavy metals in soil [7]

Element	Standard Soils (mg/kg)	Critical Bound (mg/kg)	Pollution Soils (mg/kg)
Pb	50	150	600
Cd	1	5	20
Ni	50	100	500
Cr	100	250	800
Co	1	10	800
Zn	70	300	800
Cu	20	20	800

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5. Conclusions

The study present from the chemical analysis of soil. This soil's region containing high concentrations of heavy metals because of projectiles falling of brick factories on that zone where clay metals and organic materials in that soil adsorbs these metals and increase their concentrations.

Also, we see that the concentration of the heavy metals in depth (0-10cm) is higher than the concentration in depth (10-20cm), since it has a direct contact with the projectiles of brick factories, increasing the organic materials in it and existence of clay metals which adsorb these studied heavy metals.

6. Recommendations

To avoid the above problem we suggest to use the natural gas and electric ovens instead of the heavy fuel used in burning furnaces, we also suggest to make an engineering geological study about soil mechanics to know what extracting this soil causes when using it in brick industry in the environmental side and protecting the agricultural areas from sabotage.

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