Heavy Metals Concentration in Different Soil Samples in Najaf City, Iraq

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***Abstract*— In this study, the concentration of selected heavy metals including Co, Cd, Pb, and Cr in soils was assessed in Najaf city, Iraq using a Flame Atomic Absorption Spectrophotometer. Soil samples are collected from 12 different locations in Najaf city. The results revealed that the mean concentrations were in the order Pb > Co > Cr > Cd, in all the sites. The highest Pb (3.35 ppm) was found in sample S4 (Kufa river (surface)). All soil samples had lower values of total heavy metal concentrations than those recommended by the U.S. Environmental Protection Agency.**

***Keywords*— Heavy metals, soil, Najaf city, EPA**

I. Introduction

Soils are dynamic natural resources for the survival of people life and because its complex matrix is the prime receiver of the relentless pollutants such as heavy metals [1, 2]. Every soil contains natural amounts of heavy metals, at concentration called a metal background. The magnitude of a metal's background depends on the composition of the parent rock material from which the soils were derived [3]. Due to their abundance and the consequential environmental hazards, the group of metals (Co, Cd, Pb, and Cr) is the most frequently reported heavy metals in the context of contaminated urban soils. The present study assesses the heavy metals in soil. The total land area of Iraq is 437, 072 km^2. Iraq, officially the Republic of Iraq, is a country in Western Asia that borders Turkey to the north, Iran to the east, Kuwait to the southeast, Saudi Arabia to the south, Jordan to the southwest, and Syria to the west. The capital, Baghdad, is in the centre of the country. Najaf Governorate is a governorate in southern Iraq. The capital is the city of Najaf. The other major city is Kufa. Najaf is geographically located at 31 ° 59′ 54″ N and 44 ° 20′ 23″ E.

II. Methods and Materials

A total number of 12 soil samples were collected from different location in Najaf city as shown in Fig. 1. The heavy metals in soil were determined using a Flame Atomic Absorption Spectrophotometer-6300 AA, Shimadzu, Japan. The random sampling method was adopted at each site. The soil samples were transferred to air-tight polythene bags, labeled, and taken to the laboratory for further analysis. Samples were dried, manually ground by mortar and pestle and passed through a steel sieve of 75 µm. About 0.5 g of each of the sieved sample was digested at 180 oC for a 3 h. Then 7 ml added of aqua regia, heated the mixture to dry, add 5 ml of aqua regia, and 1 mL of 40% of the acid HF. Then heated the mixture again for two hours, then add 5 ml of 65% HNO_3, and heated the mixture to dry. Then add 50 ml of distilled water to remnants of the beaker and then filtered the solution for the purpose of separation of solid waste to become a sample ready for the measurement of Co, Cd, Pb, and Cr using atomic absorption spectrophotometer.

III. Results and Discussion

The heavy metal concentrations (ppm) in soil samples are found as shown in Table 1. Fig. 2 show that the highest Pb (3.35 ppm) was found in sample S4 (Kufa river (surface)), whereas the lowest (0.15 ppm) was found in sample S12 (near Kufa bridge (200 m from Kufa river)). The highest Cr (1.37 ppm) was found in sample S5 (Zargah (30 cm)), whereas the lowest (0.27 ppm) was found in sample S1 (Hyra). The highest Cd (0.88 ppm) was found in sample S10 (Meshkhab (surface agricultural soil)), whereas the lowest (0.06 ppm) was found in sample S2 (Kufa river (5 km from streams)). The highest Co (1.31 ppm) was found in sample S9 (Meshkhab (depth agricultural soil)), whereas the lowest (0.62 ppm) was found in sample S2 (Kufa river (5 km from sewerage)). The results showed that the mean

concentrations were in the order Pb > Co > Cr > Cd, in all the sites as shown in Fig. 3.

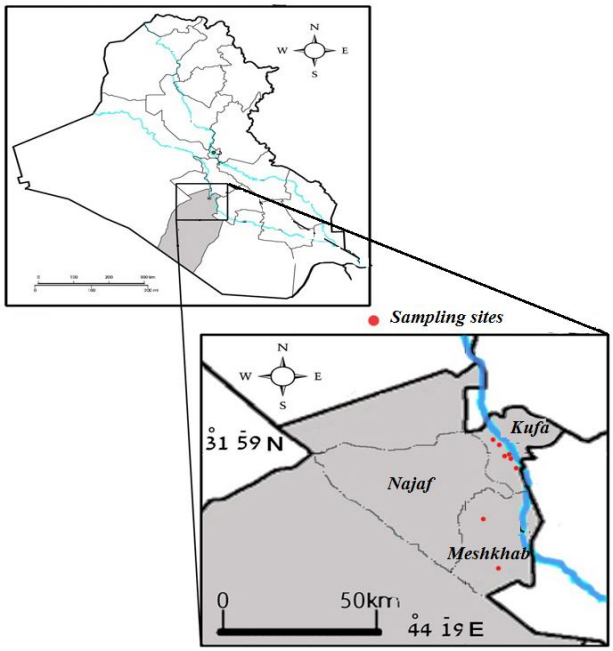

Fig. 1 The administrative Iraq and Najaf maps

TABLE I

The selected metal content of soil samples (ppm)

Sample name	SC	Pb	Cr	Cd	Co
Hyra (Surface)	S1	0.99	0.27	0.22	0.77
Kufa river (5 km from sewerage)	S2	2.11	0.48	0.06	0.62
Hyra (Depth)	S3	1.54	1.24	0.10	0.87
Kufa river (Surface soil)	S4	3.35	0.81	0.46	0.83
Zargah (30 cm)	S5	1.20	1.37	0.27	0.93
Kufa river (50 m from sewerage)	S6	0.41	1.33	0.21	0.64
Meshkhab (Surface soil)	S7	0.61	0.36	0.27	1.06
Zargah (Surface)	S8	0.50	0.48	0.66	1.25
Meshkhab (Depth agricultural soil)	S9	1.92	0.84	0.10	1.31
Meshkhab (Surface agricultural soil)	S10	0.46	0.90	0.88	1.10
Zargah (20 cm)	S11	0.87	0.53	0.49	1.08
Near Kufa bridge (200 m from Kufa river)	S12	0.15	0.96	0.26	1.23

Fig. 2 Mean heavy metal concentrations vs. measurement site

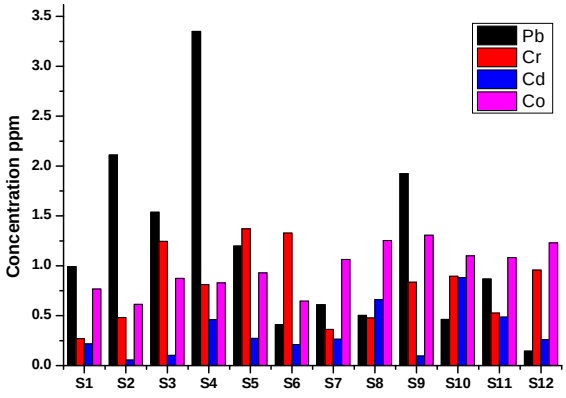

Fig. 3 Mean heavy metal concentrations in the studies soil samples.

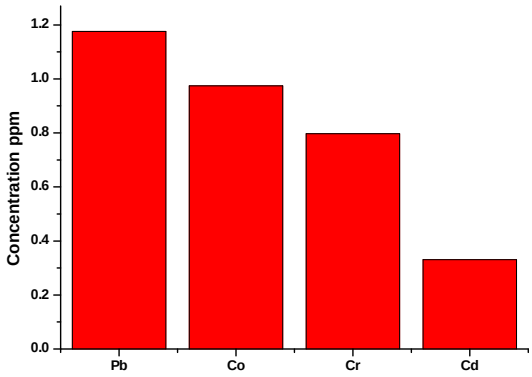

Table 2 summarizes the heavy metal concentrations in soils obtained in some world regions as well as this study. The concentrations of Pb, Cr, Cd, and Co in the present study were within the concentration range of heavy metal in other listed regions.

TABLE II

Comparison of heavy metal concentrations in soil (ppm) at different sites with those in other countries

Country	Pb	Cr	Cd	Co
USA [4]	10.1	24.1	0.16	7.0
Brazil [5]	50	100	3	ND
Hungary [6]	18	30	ND	9
Pakistan [7]	66.37	9.93	….	….
World [8]	10	100	0.06	8
Present study	**1.18**	**0.80**	**0.33**	**0.97**

ND: Not detected

IV. Conclusions

The highest Pb, Cr, Cd, and Co concentrations were found in samples S4 (Kufa river (surface soil)), S5 (Zargah (30 cm)), S10 (Meshkhab (surface agricultural soil)), S9 (Meshkhab (depth agricultural soil)), respectively. All soil samples had lower values of total heavy metals concentrations (Aqua Regia method) than those recommended by the U.S. Environmental Protection Agency [9]. The spatial variation in the concentrations of Pb, Cr, Cd, and Co metals may be the result of increased atmospheric deposition from road traffic in the soil and the contribution of meteorological factor, anthropogenic activity, and the land use on the variation of heavy metals in soil.

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