

Study of soil pollution with heavy elements in the city of Islah

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Abstract. This study was conducted to estimate the concentrations of some heavy elements (cadmium, lead, nickel, zinc and copper) in the soil, in addition to some physical and chemical properties. Samples were collected from five different sites (residential, commercial, agricultural, adjacent to the river and industrial) in Islah City/Thi-Qar Governorate in order to investigate the possibility of contamination in these areas with these pollutants. The results of laboratory analyzes using a flame atomic absorption spectrophotometer showed an increase in the concentration of the element lead compared to the other elements, as it reached (54.37) mg/kg at the site (E) close to the brick making plant. While the concentrations of zinc, copper and nickel elements were within the normal rates, the concentration of cadmium exceeded the critical limits, as the highest rate reached (1.06) mg/kg at site (B) within the commercial area.

1 Introduction

Researchers have been interested in studying environmental pollution, whether it is air, water, food or soil pollution, due to its seriousness and direct relationship to many diseases that afflict humans as a result of exposure to environmental pollutants. The problem of soil pollution is one of the most important and most dangerous problems of the times that threaten human life and even all living things. This problem has emerged as a result of progress in various industrial, agricultural and technological fields, as well as the result of the large increase in population. Resulting in a change in the natural balance of the environment. Environmental pollution is an unpleasant change in the physical, chemical and biological phenomena of air, water and soil, and it may cause harm or adversely affect living organisms and facilities [1]. As for soil pollution, it is the change in the natural, chemical and biological properties of the soil by adding or removing substances from it [2].

Soil pollution can result from the accumulation and accumulation of pollutants from various sources, some of which are natural, such as volcanoes, earthquakes, hurricanes and floods, and some of them are human, such as the use of pesticides, fertilizers and solid waste, including sewage, urban garbage, factory and laboratory waste, and the products of fuel combustion, as well as the use of poor quality water in irrigation as water Sewage residues and airborne materials [3,4]. Soil pollution with toxic heavy elements is one of the most dangerous types of pollution, although some heavy elements are necessary for life in small quantities and are called (rare) trace elements such as copper, iron and zinc, but they may

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become toxic when there are high concentrations of them in the soil and the soils are classified when they contain concentrations High from heavy elements as polluted soils, which becomes toxic to plants, humans and animals [5] and the danger of heavy elements lies in their high stability, unlimited periods of stay and their transfer to great distances from their areas of origin, and their concentrations can double throughout the food chain, as some animals and plants become and because of their containment of concentrations High in some dangerous elements is a source of toxicity and a great danger to health [6]. Also, these elements cannot be decomposed by bacteria and natural decomposition processes, as the type of the compound can be changed, but the element remains and its concentration gradually increases [7]. Heavy elements amount to 38 elements, and due to sedimentation and absorption processes in the soil, toxicity occurs in three elements, which are zinc, copper and nickel, while toxicity occurs with lead, cobalt, cadmium and arsenic under very special conditions. Cadmium and lead are considered to be absorbable by plants and then enter the food chain, so Much of the research on element toxicity has concerned the elements zinc, copper, nickel, cadmium, and lead [8]. Research has shown that there are many areas in Iraq that suffer from pollution with heavy elements, including the study [9] air and soil pollution with heavy elements in the area near the brick-making factories in Reform City, as they chose seven sampling stations, three of them in the direction of the prevailing winds and three against the direction of the wind While the seventh station was in an area far (3000 m) from the factories and perpendicular to the direction of the winds as a reference station for comparison, and they proved that the air particles and the soil were somewhat polluted with high concentrations of heavy elements in the study area compared to the reference station. [10] also studied the contamination of soil adjacent to the Euphrates River in Nasiriyah with heavy metals, and they found from this study that copper exceeded the critical limits and nickel and zinc exceeded the standard limits. Likewise [11] studied soil pollution in Shatra city with some heavy elements and their results indicated the high percentage of lead, cadmium and zinc in Study area compared to the permissible limits globally. The study carried out by [12] in the city of Baghdad indicated that some soils in the studied areas contain high concentrations of heavy elements (cadmium, lead and zinc). The suspended dust loaded with heavy elements in the atmosphere of the city of Baghdad, which poses a direct threat to the population and the vital system of the city.

Studying and estimating the concentrations of heavy elements in the soil in different areas of Islah city, thus knowing the percentage of pollution for each component, as these elements have a direct impact on the health of the population and come up with recommendations that would contribute to reducing pollution levels of the city's environment.

2 Study area

The city of Islah is located on one of the two branches of the Gharraf River sloping from the Tigris River in southern Iraq, about 320 km southwest of the capital, Baghdad, at latitude ($31^{\circ} 10' 1.10''$ N) and longitude ($46^{\circ} 36' 0.42''$ E) Figure (1). Its population density is 79,000 people, according to 2014 statistics, and administratively and geographically, it is affiliated to Dhi Qar Governorate, with an area of (1054) km.

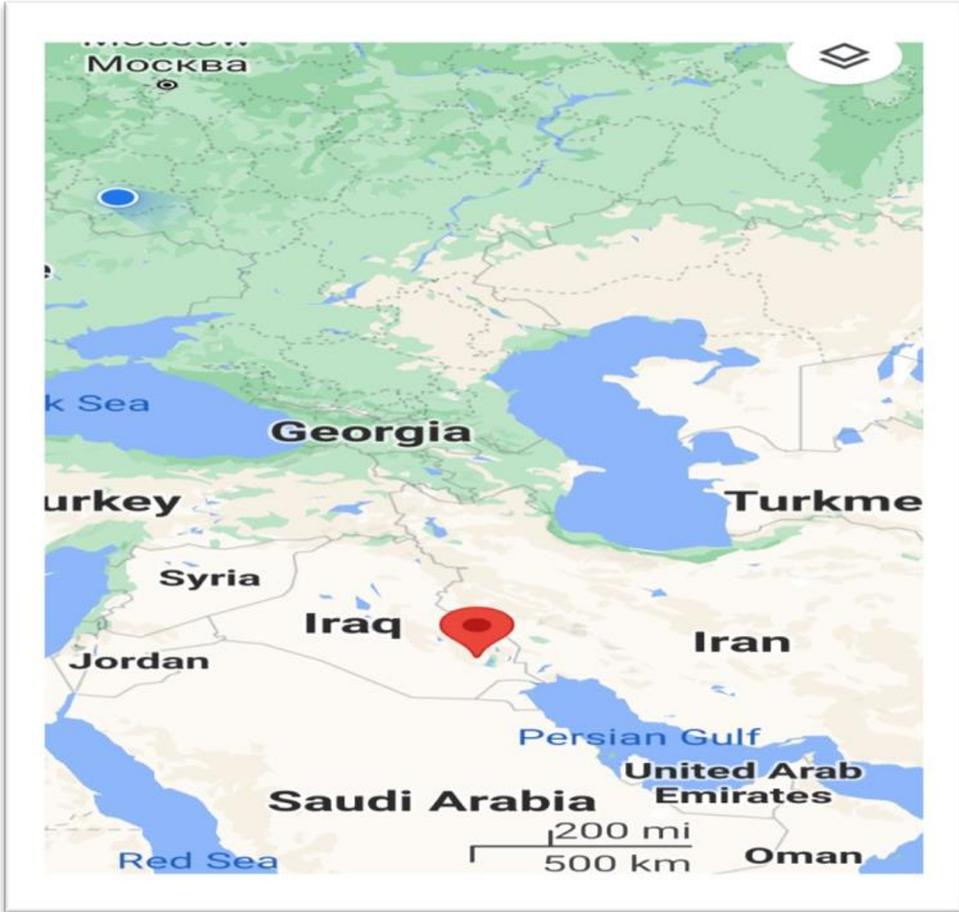


Fig. 1. Study area (Google Maps).

3 Materials and methods

3.1 Study stations

Four sections were identified in the current study area, as well as a fifth station outside the city close to the brick factories. according to Table No. (1).

3.2 Sample collection

Soil samples were collected from a depth of (0-20) cm from the five stations, with three replicates for each station. The samples were placed in nylon bags with data written on them. The samples were transported to the laboratory for the purpose of physical and chemical tests.

Table 1. Description of the study stations for the sites in the city of Islah.

The description	Site	Station symbol
Residential area	31°09'52.7"N 46°35'47.5"E	A
commercial area	31°10'01.1"N 46°35'56.9"E	B
agricultural area	31°12'02.8"N 46°38'10.8"E	C
along the river	31°10'06.0"N 46°36'09.9"E	D
industrial area (brick factories)	31°08'27.9"N 46°30'22.0"E	E

3.3 Physical and chemical analysis

Soil texture was estimated according to the method [14] and the degree of electrical conductivity EC according to the methods mentioned by [15] and the pH according to the method that was mentioned by [16] and the heavy elements (lead, cadmium, nickel, copper, zinc) were estimated by following the method of digestion [11]. As follows:

- Each sample was homogenized and crumbled, then about (5) gm was taken to represent the total sample.

The sample was ground very finely using a ceramic mortar.

-The sample was placed in a washed beaker with distilled water and dried, then placed in the oven at a temperature of (100) C for two hours.

-A sifting process was carried out for the dried sample through a sieve (0.63).

-One gram of the dried sample was weighed and placed in a clean (250) mL beaker.

-The sample was digested by adding (15) ml of concentrated HCL acid with (5) ml of concentrated HNO₃ acid.

-The sample was heated in a hot sand bath until the vapors stopped appearing and the sample was dried for approximately 45-60 minutes.

-The beaker was cooled to the laboratory temperature and (5) ml of concentrated HCL acid was added and heated in a sand bath until the sample dried for approximately (5-10) minutes.

-The beaker was cooled to the laboratory temperature and (5) ml of concentrated HCL acid and (50) ml of hot distilled water were

added to wash the sides of the beaker from the traces of the dissolved sample.

The mixture was heated to a boiling point (2-3) minutes.

-The mixture was filtered with filter paper No. (42), then the filtrate was placed in a volume bottle of (100) ml.

-The insoluble sediment was washed with distilled water, wash water was added to the filtrate, and the volume was completed to (100) ml. Then the samples were estimated using an atomic absorption spectrometer.

4 Results and discussion

The pH results showed that all soils are alkaline, as most of the values were more than 7 for all sites, as they ranged between (7.86 - 7.26) Table (2), which was expected from the pH value of Iraqi soils close to (8.0) since most of the Iraqi soils are soils. Calcareous. Table No. (2) showed that the electrical conductivity value was high in some locations, and this means that the soil in this area is salty. The high values of electrical conductivity are affected by the high evaporation values at the study sites.

Table 2. pH values and electrical conductivity.

mean	stationE	stationD	Station C	Station B	Station A	The studied adjective
7.61	7.31	7.26	7.68	7.91	7.86	pH
7.80	11.34	7.02	6.82	9.46	4.36	Electrical conductivity dS.cm ⁻¹

Table 3. Soil texture in the studied sites.

Station E	Station D	Station C	Station B	Station A	Soil texture
50.75	46.42	49.66	50.47	53.76	Clay%
31.82	27.75	22.18	34.36	32.73	silt%
17.43	25.83	28.16	15.17	13.51	sand%
Clay	Clay	Clay	Clay	Clay	Texture

As for the concentrations of heavy elements, the results shown in Table (4) and Figures (2,3,4,5,6) indicated a high concentration of lead compared to the other elements. The results indicated that there were significant differences in the concentrations of this component in the study sites below the ($p < 0.05$) probability level. The reason for the high concentration may be attributed to the effect of discarded bricks coefficient (plankton) and thus its transfer to the adjacent soils (site E). When compared with global determinants, zinc, copper and nickel were within the standard limits, while cadmium exceeded the critical limits at site (B). The concentration of cadmium in the soil is the burning of plastic materials, as these combustion products increase the concentration of cadmium in the atmosphere and then deposit it on the soil [13]. He also explained [14] that the combustion products of fuel in transport media contain high concentrations of heavy elements. Cadmium concentrations in the soil as a result of industrial activities and the use of pesticides [11]. The study recommends continuing to monitor the environment for sources of pollution, establishing strict environmental controls, and conducting a comprehensive assessment and thorough review of the environmental reality, in addition to using modern methods of irrigation through awareness and material and moral support, which will preserve the environment.

Table 4. Concentrations of heavy elements in soil samples for the study sites.

Mean	Conc.(ppm) for element in stations					Element
	E	D	C	B	A	
34,7	54,4	17,4	28,1	33,2	40,5	Pb
0,80	2,6	0,21	0,19	1,06	0,15	Cd
13,2	15,8	9,8	12,6	11,4	16,2	Ni
49,7	12,8	31,3	42,6	22,3	139,7	Zn
13,1	11,8	9,6	13,2	18,7	12,4	Cu

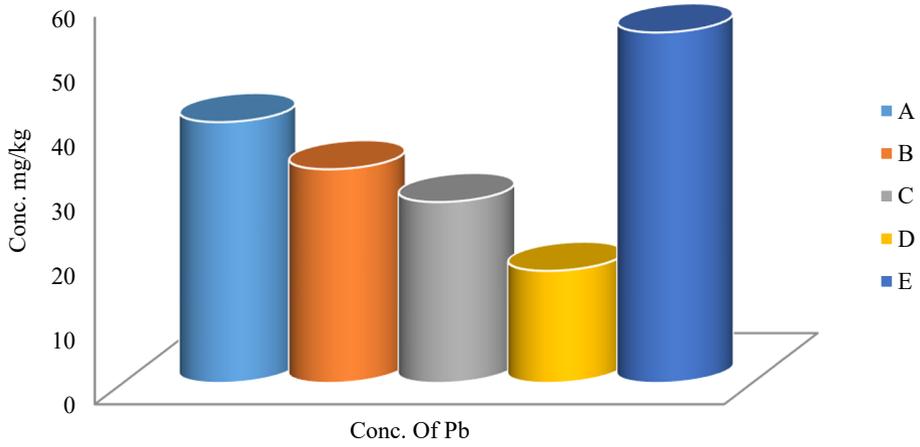


Fig. 2. Lead concentrations in the studied sites.

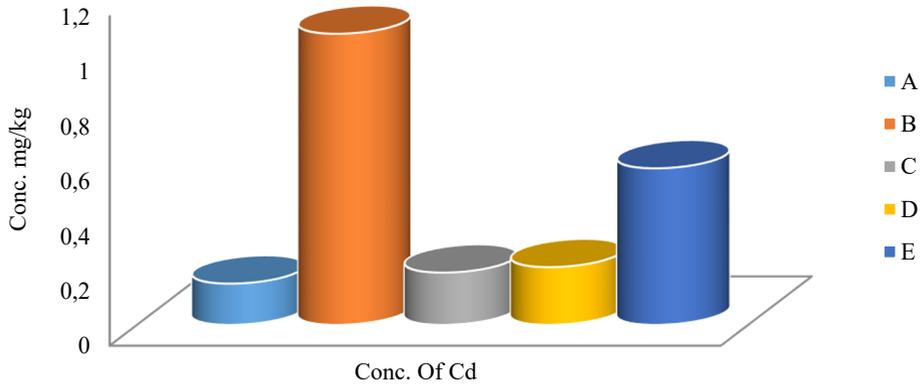


Fig. 3. Cadmium concentration in the studied sites.

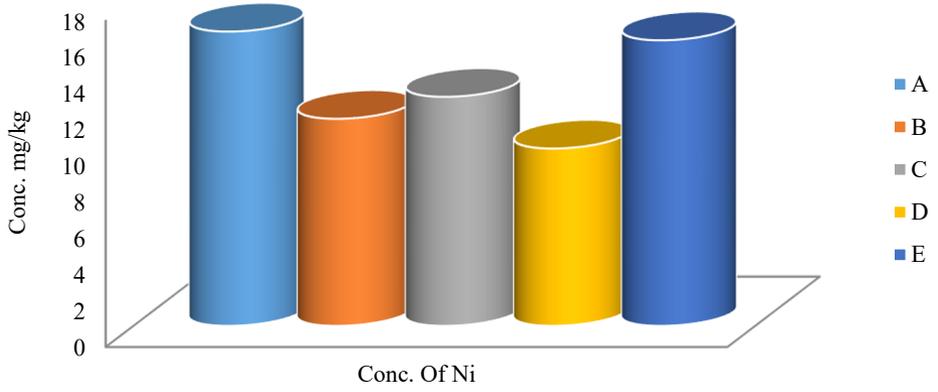


Fig. 4. Nickel concentrations in the studied sites.

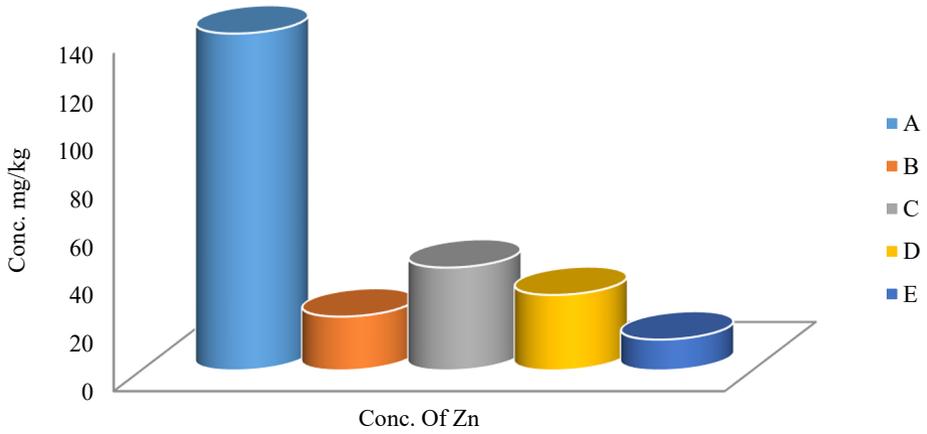


Fig. 5. Zinc concentration in the studied sites.

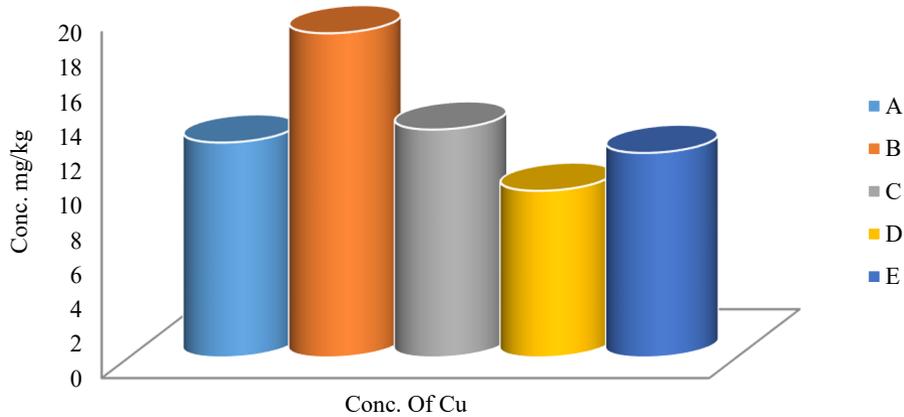


Fig. 6. Copper concentrations in the studied sites.

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