A study of lead pollution element in selected samples of soils of some areas of Anbar province, Iraq

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Abstract

This study aims to estimate the levels of lead pollution in soil samples from the selected sites in Anbar Governorate, represented by some schools, mosques, residential neighborhoods, industrial neighborhoods, hospitals, health centers, markets, public parks, etc., where (70) samples were collected and analyzed at different depths, from (10 to 5) cm and from (10 to 15) cm, to measure the concentration of the element of lead, and the results showed that the percentage of lead in most areas was within the permissible ratios globally, except for some areas, the percentage of lead exceeded the permissible limits, and after discussing the results, it was found that the areas in which a significant increase was found in the concentration of lead is a result of human and industrial activities such as transport, factories, and factories, especially the areas close to them, because these causes lead to lead in the air and deposited on the ground, so areas crowded with cars and electric power generators installed inside residential neighborhoods and fueling stations are the main sources of lead in the air and soil of those Regions.

Keywords: lead pollution, soil pollution, Anbar Governorate.

1. Introduction: Lead is considered a heavy and toxic metal, as it is found in the earth's crust in the form of mineral ores and the most important [1]. It is used widely in industries as it is used (40 %) Lead metal, (25 %) Alloys, and (35%) Chemical compounds. It is used in the manufacture of batteries, rubber, dyes, old printing presses, metal welding wires, and in the coating of pipes, tanks and plates used to protect against X-rays and some electrical tools. It is also used in the manufacture of pesticides and phosphate fertilizers. Likewise, in the petroleum industries, it is added in the form of tetraethyl lead to automobile fuel to reduce cracking. And in alloying, mining and smelting of metals [2]. Therefore, waste from factories and means of transport using lead plays a major role in air, water and soil pollution, which paves the way for its transfer to plants and from there to animals, which are an essential source of human food [3]. He indicated that the element of lead is one of the most important environmental and industrial pollutants due to its ability to cause severe damage to the tissues and organs of the human and animal body. Whether after acute or chronic exposure [4], lead is easily absorbed through the digestive and respiratory system and through healthy and undamaged skin [8]. The lead moves into the bloodstream and small amounts of it are associated with plasma proteins such as albumin, while the remaining quantities appear as
free lead in the plasma and then quickly distributed to the tissues, as it accumulates in the soft tissues (such as lung, spleen, liver and kidney tissues), and the liver and kidneys serve as reservoirs. Lead in the body, as it accumulates in the bone with continued exposure and accumulates in the gray matter of the central nervous system [6]. The body can get rid of lead compounds that are insoluble in water in several ways. Including sweating or stool or through the bile, or excretion through the kidneys or breast milk, which is the main food source for newborns [7]. Lead is a bluish gray heavy metal with a low melting point and malleable to lamination. It can easily combine with other metals to form alloys. Uses lead because of this. Properties for thousands of years, it is now widely used in products such as batteries. Dyes, paints, glass making, weights, ammunition, cable coating and protective clothing of radiation. The chemical symbol for lead is Pb, short for the Latin name for lead, Plum bum. The atomic number of lead is 82 and the atomic weight is 207.2, the density of lead is 11.34, and its melting point is 327.46 degrees Celsius, according to the World Health Organization. Raw lead makes up 10 percent of the earth's crust, according to the Organization for Economic Cooperation and Development [8].

2. Study area:

The study was conducted in Anbar governorate and its district extending along the Euphrates River from Fallujah district in the east to Al-Qaim district in the west with the Syrian borders. The study also included some areas such as Kabisa sub-district, Al-Muhammadi sub-district, Al-Baghdadi sub-district and Al-Khalidiya sub-district, and the study focused mostly on populated areas such as residential, traffic and industrial areas, and mosques. Schools, hospitals, health centers, markes and parkes. Figure (1) shows the study area (Anbar Governorate - Iraq)

Figure (1) the study area Anbar Governorate – Iraq [9]
The table below shows the natural and internationally determined ratios of lead in some media.

**Table (1) Normal values for lead concentration in water, soil, air and food**[10]

| Medium  | Concentration       |
|---------|---------------------|
| Water   | 10 - 0.005 µg/g     |
| Soil    | 5-25 µg/g           |
| Air     | 0.1 – 0.001 µg/m³   |
| Food    | 0.1 - 0.01 µg/g     |

**Experimental Part**: The study was conducted in Anbar governorate and its district extending along the Euphrates River from Fallujah district in the east to Al-Qaim district in the west with the Syrian borders. The study also included some areas such as Kabisa sub-district, Al-Muhammadi sub-district, Al-Baghdadi sub-district and Al-Khalidiya sub-district, and the study focused mostly on populated areas such as residential, traffic and industrial areas, and mosques. Schools, hospitals, health centers, markets and parks.

**Soil sample collection**

Soil samples were collected randomly from all districts and (70) sites to a depth ranging between (5-15 cm) using a shovel made of stainless steel, and the soil sample consisted of 4 subsamples. Sampling sites were recorded using GPS. For each site, the four samples were taken, then a composite sample was made by mixing the four sub-samples. Soil samples were preserved in special plastic bags equipped with a special modeling form for each area, including the sample number, the name of the area, information about the nature of the area and its contents of the factories, factories, car garages and population density. Her preoccupations for laboratory work.

The soil preserved in plastic bags was taken and dried in the laboratory by the oven at a temperature of 105 °C for 12 hours[11], and it was sifted through a stainless steel sieve size (106 µm) to remove large particles, gravel, plant roots and residues. Other wastes were homogenized with ceramic mortar. The samples were stored in a polyethylene container ready for digestion and analysis for further measurements. Lindsay protocol adopted and Martens 1990 for, preparing soil samples and analyzing them during work[12]. Table (2) shows the sample collection sites. The table below shows the selected sites from which soil samples were taken from all districts in Anbar Governorate.

**Table (2) shows the sample collection sites**

| no | code | Region                                      | Region                                      |
|----|------|---------------------------------------------|---------------------------------------------|
| 1  | Q1   | Al-Askari District M / Al-Beja Elementary School for Boys | The seven kilo model Al Ittihad gas station |
| 2  | Q2   | Al-Qaam Center - The Old Market..             | The Five Kilo - Mosque of the Shuhada       |
| 36 | R1   |                                             |                                             |
| 37 | R2   |                                             |                                             |
| No | Area | Building/Location |
|----|------|------------------|
| 3  | Q 3  | Al-Andalus neighborhood - Hunayn Battle of the Mosque |
| 4  | Q 4  | Al-Rummanan - M / Al Qastas Elementary School for Boys |
| 5  | Q 5  | Al-Rummanan - M / Shatt Al-Arab Elementary School for Girls |
| 6  | Q 6  | Al-Qaim General Hospital |
| 7  | Q 7  | Al-Qaim Sports Stadium |
| 8  | Q 8  | Ali bin Abi Talib Mosque |
| 9  | A 1  | Curse - the obituary |
| 10 | A 2  | Anah - Western Anah School |
| 11 | A 3  | Curse - kindergarten curse |
| 12 | A 4  | Entrance Street. Dhu al-Nuran Mosque |
| 13 | A 5  | Anah the Great Mosque. |
| 14 | A 6  | Anna High School for girls |
| 15 | Rw1  | Al-Qadisiyah neighborhood. Al-Qadisiyah Health Center |
| 16 | Rw2  | Hammurabi Intermediate School for Boys |
| 17 | Rw3  | New Rawah. Al-Abbas Mosque |
| 18 | Ha 1 | Entrance Haditha - Haqlaniyya |
| 19 | Ha 2 | Barwana - El Mamoun Elementary School for Boys |
| 20 | Ha 3 | Barawana - Tigris River Intermediate School |

- **Q 3**: Al-Tameem - High School for Girls
- **Q 4**: Al-Haouz - Al-Furqan Mosque
- **Q 5**: The Association - Khalid Bin Al Waleed Primary School
- **Q 6**: Sufism - Al-Ghaffar Mosque
- **Q 7**: Al-Dhubat Neighborhood - Salah Al-Din Al-Ayoubi Mosque.
- **Q 8**: Al Anbar Province Education - Car Park
- **A 1**: Ramadi General Hospital
- **A 2**: Al Anbar University Gardens of the College of Education for Pure Sciences
- **A 3**: Al Sjarya - Al Sijariya Intermediate School for Girls
- **A 4**: A numerical answer, Granada for boys
- **A 5**: Hasiba Al Sharqiya - Al Andalus High School for boys
- **A 6**: Al Azizia - Ziyad Restaurant
- **A 7**: The 35th kilometer - Tourist Corner Restaurant
- **A 8**: Al-Khalidiya - Al-Khalidiya School for Girls.
- **A 9**: Workers District - Mosque of Aisha, Mother of the Believers
- **A 10**: Workers neighborhood - Abu Yusef Al-Ansari Mosque
- **A 11**: Church of the Virgin Mary.
| No. | Area          | Location                          | Address                                      |
|-----|---------------|-----------------------------------|----------------------------------------------|
| 21  | Ha 4          | North Oil Company k3              | Al Amal Pharmacy                              |
| 22  | Ha 5          | Haqlaniyah fuel filling station   | Al-Askari District - Al-Bahjah Primary School for |
| 23  | Ha 6          | The city center is Al-Mustafa     | Company neighborhood - Yusef Al-Siddiq Mosque |
| 24  | Ha 7          | Ayoun Hajlan Park                 | Hay Nazzal - Nursery School for Girls         |
| 25  | He 1          | Industrial district              | Al-Golan neighborhood - Al-Raqeeb Mosque      |
| 26  | He 2          | The nursery - the main HIT fuel  | Teachers District - Tabarak Primary School    |
| 27  | He 3          | Hit General Hospital             | Al-Shorta District - Al-Abed Boys School      |
| 28  | He 4          | Hay al-Ummal - Hay al-Ummal      | Al-Joghaifi first neighborhood - Al-Tawfiq Mosque |
| 29  | He 5          | Teachers District - Hit Junior    | Al-Jufayyeh district, the second             |
|     |               | High School for Girls            |                                              |
| 30  | He 6          | Al-Bakr neighborhood - Dar Al-    |                                              |
|     |               | Salam High School for            |                                              |
| 31  | He 7          | Heet Island - Al Hassania         | Haji Hussein Restaurant.                     |
|     |               | Mosque                           |                                              |
| 32  | He 8          | El Maabdiyat - Cairo Elementary  | Eastern Fallujah Park                        |
|     |               | School for                       |                                              |
| 33  | He 9          | Al-Muhammadi - El-Tahdheeb        | Fallujah. The public park in Fallujah        |
|     |               | Elementary School                |                                              |
| 34  | He 10         | Kabisa sub-district - Fajr Al    | Collector of Divine Mercy                    |
|     |               | Hurriya Intermediate School      |                                              |
| 35  | He 11         | Al-Baghdadi sub-district - Al-    | Mosque of the late Saadoun Al-Aifan           |
|     |               | Baghdadi High School             |                                              |

**Measure the sample by flame atomic absorption**

1-Installing the optimum conditions for the operation of the atomic absorption device to determine the detection limits of the device and the type of flame used with each element.

2-Prepare a series of standard solutions from the standard solution at a concentration of 1000 mg / L for the element to be measured, and this series whose concentrations are lower and higher than the element to be evaluated in the sample.
3-The pH of the sample solutions is acidic, with a pH of between (6.5). This affects the flow rate of the solution in the atomizer, and for this reason, the standard solutions must be acidified by adding (5 – 4) Drops of concentrated nitric acid.

4-We start with the measurement process with an atomic absorber after performing the above steps

3. Results and Calculations:

The results obtained from the atomic absorption apparatus showed that there is pollution in some areas of the study, because it exceeded the internationally permitted limit for the concentration of lead, which is (5 ppm) \(^{133}\) Or close to industrial areas, where the highest concentration of lead was observed in industrial areas, fuel stations and main streets. As for the areas close to or slightly less than the permissible limit, such as some schools and residential neighborhoods, the reason is due to the lack of transportation means in these areas and the presence of some trees (green cover), which in turn work somewhat to purify the air that transmits pollutants. As for the areas where there is no pollution with lead, according to the results They are agricultural areas or far from external roads, factories, and electric power generators. Thus, we can say that some of the lead in the soil comes from fuel burning operations and through the air is transported to nearby areas

Test results for lead concentration of soil samples in some areas of Al Anbar Governorate

In mg / kg, in ppm. The table below shows the percentage of contamination with the element of lead in the selected sites in Anbar Governorate.

| Table (3) shows the lead concentration in the selected sites |
|-----------------|-----------------|-----------------|-----------------|
| no | code | Concentration | no | code | Concentration |
|-----|------|----------------|-----|------|----------------|
|     |      | ppm | mg/kg |      |      | ppm | mg/kg |
| 1   | Q1   | 3.589 | 179.45 | 36   | R1   | 6.426 | 321.25 |
| 2   | Q2   | 1.589 | 73.95 | 37   | R2   | 2.206 | 110.3 |
| 3   | Q3   | 2.243 | 112.15 | 38   | R3   | 2.436 | 121.8 |
| 4   | Q4   | 3.854 | 192.7 | 39   | R4   | 2.313 | 115.65 |
| 5   | Q5   | 4.538 | 226.9 | 40   | R5   | 1.945 | 47.25 |
| 6   | Q6   | 4.320 | 216 | 41   | R6   | 1.773 | 38.65 |
| 7   | Q7   | 5.290 | 264.5 | 42   | R7   | 4.067 | 203.35 |
| 8   | Q8   | 3.781 | 189.05 | 43   | R8   | 2.846 | 142.3 |
| 9   | A1   | 4.414 | 220.7 | 44   | R9   | 4.754 | 237.7 |
| 10  | A2   | 4.328 | 216.4 | 45   | R10  | 1.839 | 41.95 |
|   |   |   |   |   |   |
|---|---|---|---|---|---|
| 11 | A 3 | 2.880 | 144.00 | 46 | R 11 | 2.127 | 106.35 |
| 12 | A 4 | 2.947 | 147.35 | 47 | R 12 | 5.899 | 294.95 |
| 13 | A 5 | 2.493 | 124.65 | 48 | R 13 | 3.364 | 168.2 |
| 14 | A 6 | 2.859 | 142.95 | 49 | R 14 | 1.993 | 49.65 |
| 15 | Rw1 | 2.987 | 149.35 | 50 | R 15 | 3.434 | 171.7 |
| 16 | Rw2 | 3.302 | 165.1 | 51 | Hb1 | 2.371 | 118.55 |
| 17 | Rw3 | 2.862 | 143.1 | 52 | Hb2 | 3.575 | 178.75 |
| 18 | Ha 1 | 2.115 | 200.35 | 53 | Hb3 | 2.066 | 103.3 |
| 19 | Ha 2 | 2.598 | 2.598 | 54 | Hb4 | 3.227 | 161.35 |
| 20 | Ha 3 | 2.549 | 2.549 | 55 | Hb5 | 2.572 | 128.6 |
| 21 | Ha 4 | 4.007 | 4.007 | 56 | Hb6 | 2.664 | 133.2 |
| 22 | Ha 5 | 6.645 | 332.25 | 57 | F 1 | 3.214 | 160.7 |
| 23 | Ha 6 | 6.055 | 302.75 | 58 | F 2 | 3.931 | 196.55 |
| 24 | Ha 7 | 5.885 | 294.25 | 59 | F 3 | 2.316 | 115.8 |
| 25 | He 1 | 4.232 | 211.6 | 60 | F 4 | 2.292 | 114.6 |
| 26 | He 2 | 3.985 | 199.25 | 61 | F 5 | 2.215 | 110.75 |
| 27 | He 3 | 2.591 | 129.55 | 62 | F 6 | 2.179 | 108.95 |
| 28 | He 4 | 3.313 | 165.65 | 63 | F 7 | 2.852 | 142.6 |
| 29 | He 5 | 4.462 | 223.1 | 64 | F 8 | 3.385 | 169.25 |
| 30 | He 6 | 2.855 | 142.75 | 65 | F 9 | 3.150 | 157.5 |
| 31 | He7 | 2.397 | 119.85 | 66 | F10 | 3.730 | 186.5 |
| 32 | He 8 | 9.741 | 487.05 | 67 | F11 | 2.441 | 122.05 |
| 33 | He 9 | 2.508 | 125.4 | 68 | F12 | 5.777 | 288.85 |
| 34 | He 10 | 3.637 | 181.85 | 69 | F13 | 7.090 | 354.5 |
| 35 | He11 | 3.028 | 151.4 | 70 | F14 | 4.994 | 249.7 |

Results are shown in graphs. The Figure (2) shows the percentage of contamination with the element lead in the selected sites in Al-Qaim district.
Figure (2) shows the percentage of pollution in Al-Qaim district

The Figure (3) shows the percentage of lead contamination in the Anah and Rawa districts.

Figure (3) shows the percentage of pollution in the Anah and Rawa districts

The Figure (4) shows the percentage of lead pollution in Haditha district.

Figure (4) shows the percentage of pollution in Haditha district

The Figure (5) shows the percentage of lead contamination in Heet district.
Figure (5) shows the percentage of pollution in Heet district.

The Figure (6) shows the percentage of pollution with lead in the district of Ramadi.

Figure (6) shows the percentage of pollution in the Ramadi district.

The Figure (7) shows the percentage of contamination with elemental lead in the Habbaniyah district.

Figure (7) shows the percentage of pollution in the Habbaniyah district.
The Figure (8) shows the percentage of lead contamination in Fallujah district

![Bar graph showing concentration of lead in different sites in Fallujah district.](image)

**Figure (8) shows the percentage of pollution in Fallujah district**

**Conclusions**

The results showed that the percentage of lead in most areas was within the permissible rates globally, except for some areas, the percentage of lead exceeded the permissible limits, and after discussing the results, it was found that the areas in which there was a significant increase in the concentration of lead resulting from human and industrial activities such as means of transport, factories and factories. Especially the areas close to it, because these causes lead to leaving the air in the air and depositing on the ground, so the areas crowded with cars and electric power generators installed inside residential neighborhoods and refueling stations are among the main sources of lead in the air and soil of these areas.

**4. Recommendations**

1- Transferring petrol filling stations outside residential neighborhoods.

2- Deportation of industrial neighborhoods outside the city center.

3- Emphasis on the use of fuel without lead additives.

4- Establishing the private printing presses outside the city center and in the industrial neighborhoods.

5- Treating the situation of old cars in some way by the governorate.

6- Deportation of car showrooms outside residential neighborhoods.

7- It is necessary to wash the sidewalks, streets and floors of stores daily to get rid of the accumulation of an element Lead.

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