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To cite this article: Bashar Abdulazeez Mahmood and Mahmood Amin Mejbil 2021 *IOP Conf. Ser.: Earth Environ. Sci.* **790** 012017

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## 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 <sup>[1]</sup>. 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 <sup>[2]</sup> .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<sup>[3]</sup> . 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 <sup>[4]</sup> , lead is easily absorbed through the digestive and respiratory system and through healthy and undamaged skin <sup>[5]</sup> . 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 <sup>[6]</sup>. 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 <sup>[7]</sup>. 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 <sup>[8]</sup>.

## 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, markets and parks. Figure (1) shows the study area (Anbar Governorate - Iraq)



**Figure (1) the study area Anbar Governorate – Iraq.**<sup>[9]</sup>

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** <sup>[10]</sup>

Middle	Concentration
Water	10 - 0.005 $\mu\text{g/g}$
Soil	5-25 $\mu\text{g/g}$
Air	0.1 – 0.001 $\mu\text{g/m}^3$
Food	0.1 - 0.01 $\mu\text{g/g}$

**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<sup>[11]</sup>, and it was sifted through a stainless steel sieve size (106  $\mu\text{m}$ ) 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 <sup>[12]</sup> . 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	no	code	Region
1	Q1	Al-Askari District M / Al-Beja Elementary School for Boys	36	R 1	The seven kilo model Al Ittihad gas station
2	Q 2	Al-Qaam Center - The Old Market..	37	R 2	The Five Kilo - Mosque of the Shuhada

3	Q 3	Al-Andalus neighborhood - Hunayn Battle of the Mosque	38	R 3	Al-Tameem - High School for Girls
4	Q 4	Al-Rummana - M / Al Qastas Elementary School for Boys	39	R 4	Al-Haouz - Al-Furqan Mosque
5	Q 5	Al-Rummana - M / Shatt Al-Arab Elementary School for	40	R 5	The Association - Khalid Bin Al Waleed Primary School
6	Q 6	Al-Qaim General Hospital	41	R 6	Sufism - Al-Ghaffar Mosque
7	Q 7	Al-Qaim Sports Stadium	42	R 7	Al-Dhubat Neighborhood - Salah Al-Din Al-Ayoubi Mosque.
8	Q 8	Ali bin Abi Talib Mosque	43	R 8	Al Anbar Province Education - Car Park
9	A 1	Curse - the obituary	44	R 9	Ramadi General Hospital
10	A 2	Anah - Western Anah School	45	R 10	Al Anbar University Gardens of the College of Education for Pure Sciences
11	A 3	Curse - kindergarten curse	46	R 11	Al Sjarya - Al Sijariya Intermediate School for Girls
12	A 4	Entrance Street. Dhu al-Nuran Mosque	47	R 12	A numerical answer, Granada for boys
13	A 5	Anah the Great Mosque.	48	R 13	Hasiba Al Sharqiya - Al Andalus High School for
14	A 6	Anna High School for girls	49	R 14	Al Azizia - Ziyad Restaurant
15	Rw1	Al-Qadisiyah neighborhood. Al-Qadisiyah Health Center	50	R 15	The 35th kilometer - Tourist Corner Restaurant
16	Rw2	Hammurabi Intermediate School for Boys	51	Hb1	Al-Khalidiya - Al-Khalidiya School for Girls.
17	Rw3	New Rawah. Al-Abbas Mosque	52	Hb 2	Workers District - Mosque of Aisha, Mother of the Believers
18	Ha 1	Entrance Haditha - Haqlaniyya	53	Hb 3	Workers neighborhood - Abu Yusef Al-Ansari Mosque
19	Ha 2	Barwana - El Mamoun Elementary School for Boys	54	Hb4	Church of the Virgin Mary.
20	Ha 3	Barawana - Tigris River Intermediate School	55	Hb5	Al-Nibras Elementary Boys School

21	Ha 4	North Oil Company k3	56	Hb6	Al Amal Pharmacy
22	Ha 5	Haqlaniyah fuel filling station	57	F 1	Al-Askari District - Al-Bahjah Primary School for
23	Ha 6	The city center is Al-Mustafa Mosque	58	F 2	Company neighborhood - Yusef Al-Siddiq Mosque
24	Ha 7	Ayoun Hajlan Park	59	F 3	Hay Nazzal - Nursery School for Girls
25	He 1	Industrial district	60	F 4	Al-Golan neighborhood - Al-Raqeeb Mosque
26	He 2	The nursery - the main HIT fuel filling station	61	F 5	Teachers District - Tabarak Primary School
27	He 3	Hit General Hospital	62	F 6	Al-Shorta District - Al-Abed Boys School
28	He 4	Hay al-Ummal - Hay al-Ummal clinic	63	F 7	Al-Joghaifi first neighborhood - Al-Tawfiq Mosque
29	He 5	Teachers District - Hit Junior High School for Girls	64	F 8	Al-Jufayyeh district, the second
30	He 6	Al-Bakr neighborhood - Dar Al-Salam High School for	65	F 9	Haji Hussein Restaurant.
31	He7	Heet Island - Al Hassania Mosque	66	F10	Industry fuel filling station
32	He8	El Maabdiyat - Cairo Elementary School for	67	F11	Eastern Fallujah Park
33	He 9	Al-Muhammadi - El-Tahdheeb Elementary School	68	F12	Fallujah. The public park in Fallujah
34	He10	Kabisa sub-district - Fajr Al Hurriya Intermediate School	69	F13	Collector of Divine Mercy
35	He11	Al-Baghdadi sub-district - Al-Baghdadi High School	70	F14	Mosque of the late Saadoun Al-Aifan

### 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) <sup>[13]</sup>. 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.

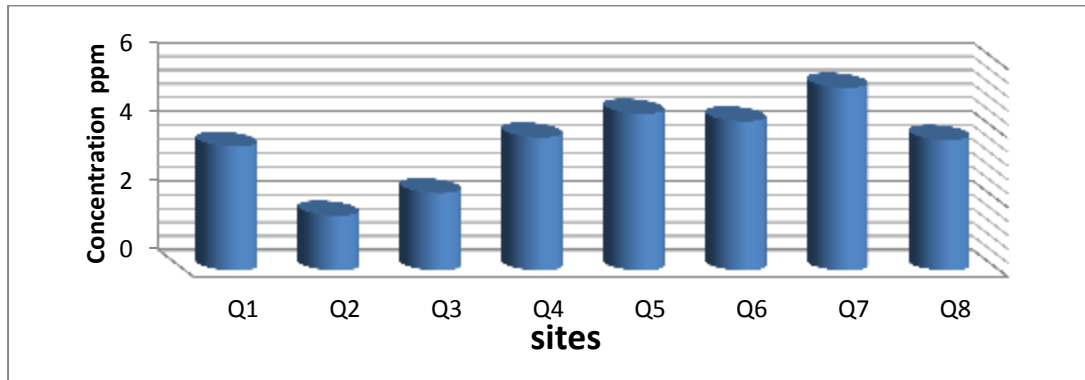
**Table (3) shows the lead concentration in the selected sites**

no	code	Concentration		no	code	Concentration	
		ppm	mg/kg			ppm	mg/kg
1	Q1	3.589	179.45	36	R 1	6.426	321.25
2	Q 2	1.589	73.95	37	R 2	2.206	110.3
3	Q 3	2.243	112.15	38	R 3	2.436	121.8
4	Q 4	3.854	192.7	39	R 4	2.313	115.65
5	Q 5	4.538	226.9	40	R 5	1.945	47.25
6	Q 6	4.320	216	41	R 6	1.773	38.65
7	Q 7	5.290	264.5	42	R 7	4.067	203.35
8	Q 8	3.781	189.05	43	R 8	2.846	142.3
9	A 1	4.414	220.7	44	R 9	4.754	237.7
10	A 2	4.328	216.4	45	R 10	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	Hb 2	3.575	178.75
18	Ha 1	2.115	200.35	53	Hb 3	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	He8	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

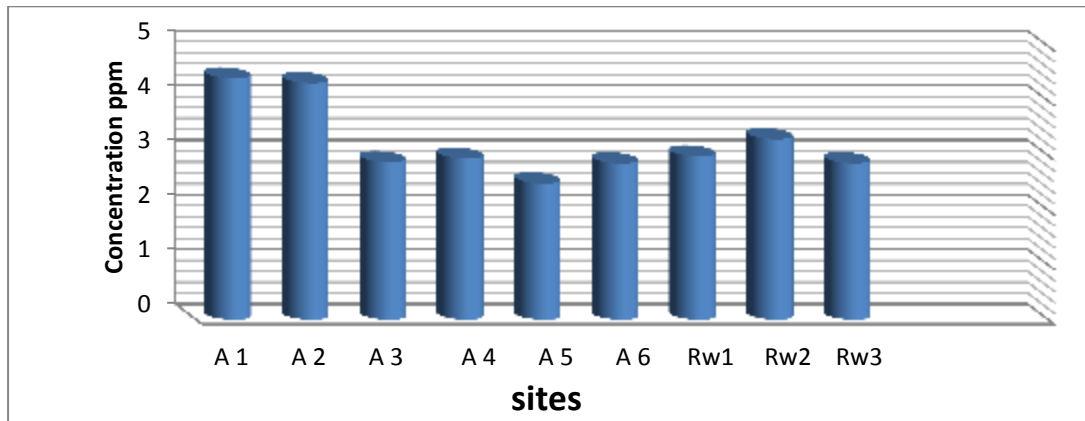
Results are shown in graphs. The Figure (2) shows the percentage of contamination with the element lead in the selected sites in Al-Qaim district.





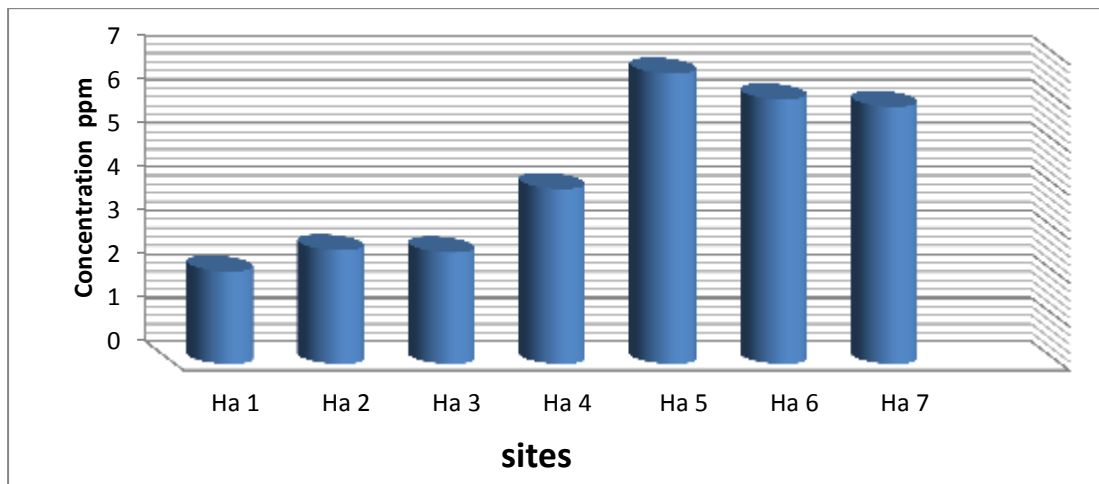
**Figure (2) shows the percentage of pollution in Al-Qaim district**

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



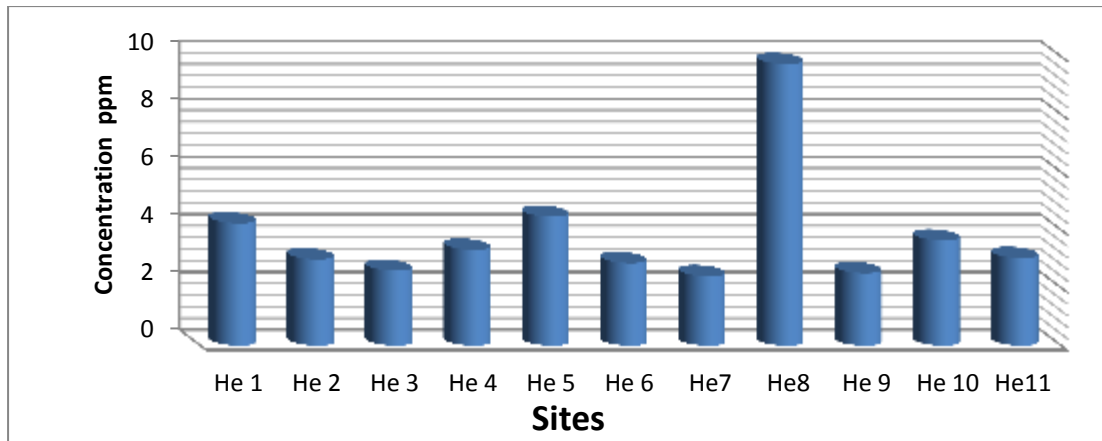
**Figure (3) shows the percentage of pollution in the Anah and Rawa districts**

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



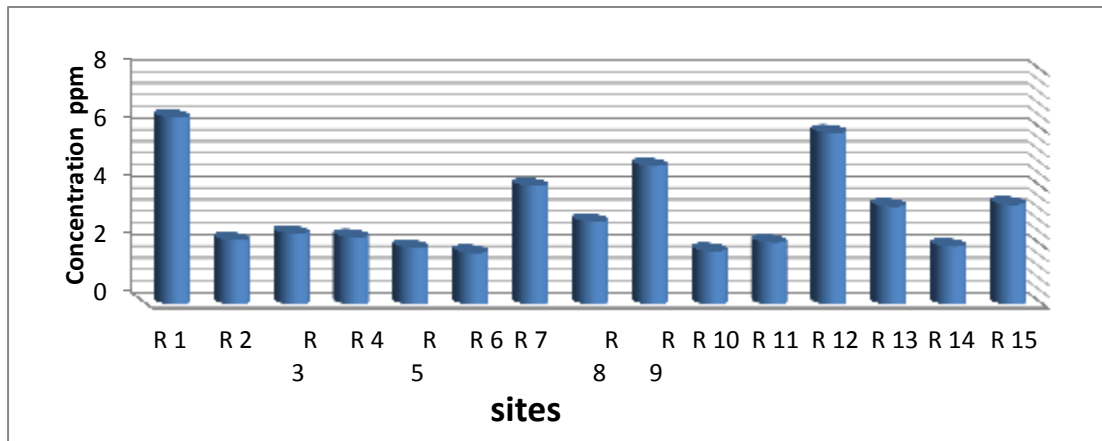
**Figure (4) shows the percentage of pollution in Haditha district**

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



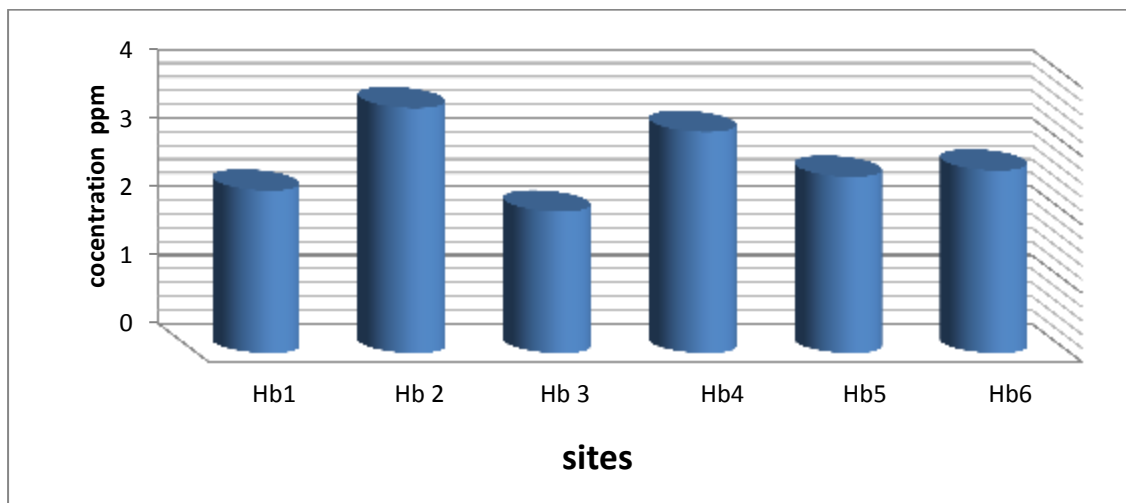
**Figure (5) shows the percentage of pollution in Heet district**

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



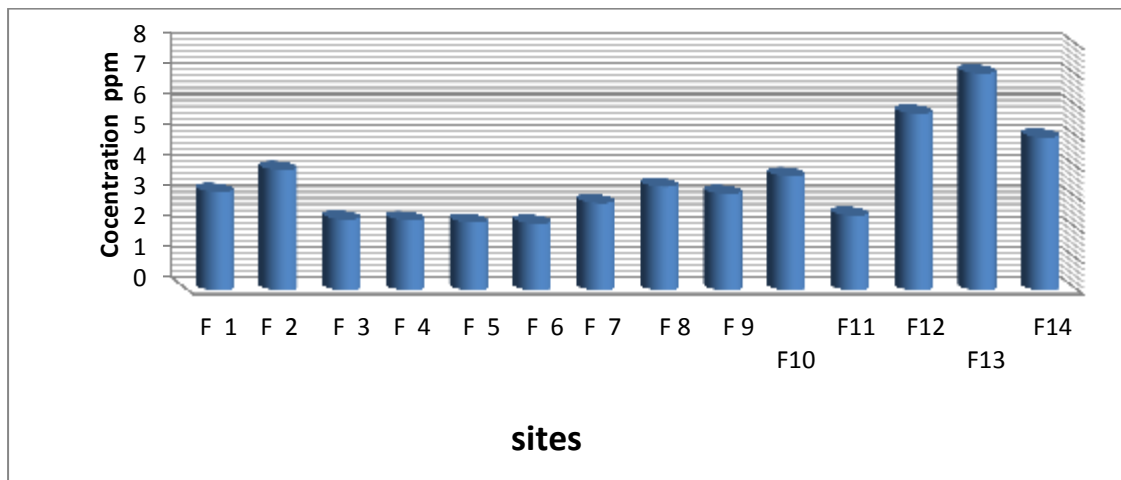
**Figure (6) shows the percentage of pollution in the Ramadi district**

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



**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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