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Determination of Heavy Elements Concentration and Some Physical and Chemical Properties of the Soil Used in The Local Brick Industry

Ibtihaj A. kadhim

College Of Education For Women, University Of Thi-Qar, Thi-Qar, Iraq.

Abstract:

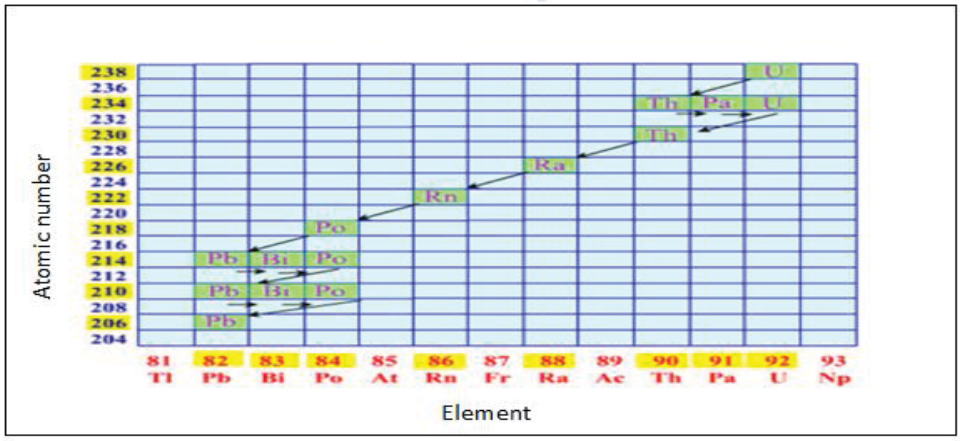
This study was based on the collection of samples of ten sites by five samples from the areas used as quarries for a brick factory and five samples of brick adobe for the same quarry, brick adobe for the same quarry to determine the proportions of heavy elements to determine the extent of radiation contamination of five different elements in the sample of the quarry compared with the same percentages of elements and study their effect on the physical properties of the soil (particle size gradient, organic matter, ph and electrical conductivity) and study its effect on the clay used in the brick industry. Note that the concentration of lead, cadmium and copper is very high [(110.2), pb (8.2), Cd (53.4) Cu] ppm, [(113.6) pb, (9.4) Cd (53.8) Cu] ppm. For each of the quarry and brick blocks samples, respectively. As for the concentrations of [(39) Zn (37.8) Ni] ppm, [(40.2) Zn (39) Ni)] ppm, the rates were below the standard limit of the global average, and the correlation coefficient between the ph and the lead and nickel positive relationship the opposite relationship with cadmium, zinc and copper has been a negative relationship from this we conclude that the pollution is the result of human environmental activities in addition to the natural proportion of elements in the soil.

Keywords: Environmental pollution, Heavy elements, Soil characteristics.

1. Introduction:

Radiation is a natural phenomenon possessed by some elements without the other known as radioactive elements where the nuclei of these elements are unstable and emit particles known as alpha particles or beta particles (positive or negative) or may emit waves electromagnetic known as gamma rays and then become more stable elements Henry Becquerel discovered one of the uranium salts emitted radiation - which was not clear at the time - could penetrate the material, and could copy images placed in the dark. Becquerel proved that the radiation he detected was from all uranium compounds. All radioactive elements belong to one of three chains, each called the radioactivity chain. The first series starts with uranium (U^{238}), the other with uranium (U^{235}) and the third with the thorium (Th^{232}) The following figure (1) [1]

Figure (1) shows the series of uranium decomposition (U^{238}) to lead (Pb^{206})[1].



As a result of industrial development, most countries of the world have faced many environmental problems, the most important problem is the contamination of the e soil by heavy element, in addition to the pollution of heavier elements, which is considered the most dangerous of these species, although some elements are necessary for life but in small concentration ,they become toxic their concentrations become higher in soils [2].The brick making process is one of the important construction industries because of its strategic role in this process of economic development on the negative side, the brick industry is considered to be one of the industries that produce toxins and pollutes the environment through its use of contaminated water and black oil [3]. . Contaminants from the brick industry are dangerous contaminants that lead to air, water, soil pollution. The gases and fumes rising from the stacks of the brick factories cause serious pollution that adversely affects the environment and human health [4]. Soil factors are relatively important factors in addition to the climate factors. These factors include soil pH, organic matter and high salinity in some soils used in the brick industry due to lack of rain and high level of evaporation due to recent high temperature in the southern and central regions because of the phenomenon of global warming and this leads to the blooming of bricks (the high proportion of salt on the block's surface, which weakens the resistance to climatic conditions) [5]

2- Research problem:

The present study aims to Measurement of environmental pollution with heavy elements because of the great danger to the environment in general and to the residential areas close to the sources of pollution in particular, where classified when the soil contains high proportions of heavy elements as soil polluted and toxic to plant, animal and human and this in turn changes the physical properties of soil As it was necessary to shed light on the causes of pollution and try to develop some solutions to ensure a balance between the exploitation of wealth and conservation of the environment and the first to maintain the health of the population of diseases caused by the accumulation of elements To him.

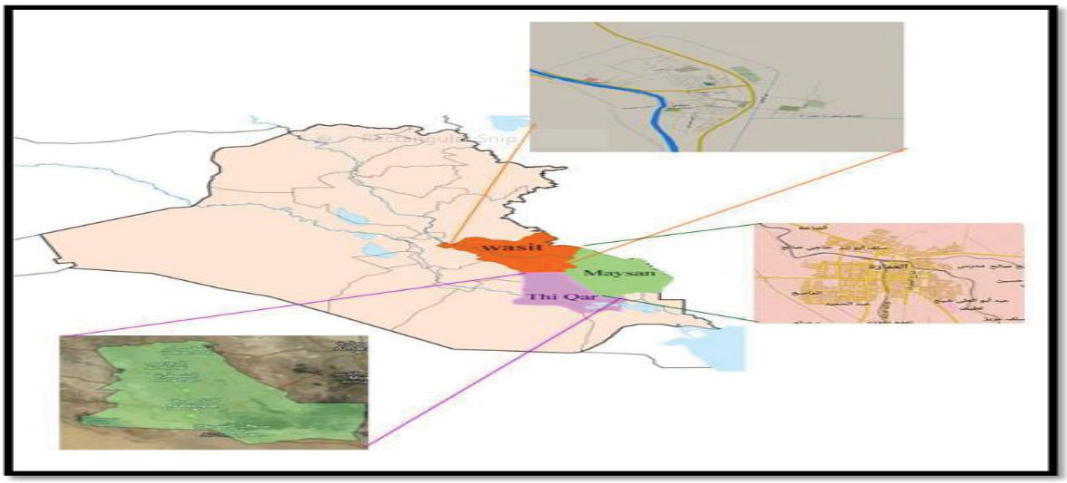
3. Search goal:

The first objective: To determine the ratios of heavy elements in the soil of the study areas and to identify their negative impact on human health and the quality of the bricks.
The second objective: To find the relationship between the concentration of heavy elements in soil and some physical and chemical properties. The third objective: Study the effect after or near the coefficient of bricks on the role of housing and its role in soil pollution by heavy elements.

4. Study area:

Sampling areas are characterized by muddy green soil, according to the results of Table (3), showing the percentages of sand, clay, and sands found in the quarry soils of the factories producing the blocks bricks. These areas are preferred because they have clay green soil. Figure (2) shows samples were collected samples from five different regions of each of the provinces (Thi Qar, Wasit and Maysan) where the neighborhood district is located in the city of Kut, which is located on the Tigris River and the branches of which are collapsed: Dujaili, Gharraf, Shatrah Shat, Al Bid'ah Shat, It is a coastal region with a climate of transition between the Mediterranean climate and the hot and dry desert climate, with low rainfall and high temperature, and the temperature begins to rise from March, culminating in July and August. The city of Amara is located in the province of Maysan, in the east of Iraq on the Iranian border, its biggest city Amara is on the Tigris River. Al-Islah, Al-Rifa'i and Al-Qal'a are located in the Thi- Qar governorate

Figure (2) A map showing the study areas.



Field and laboratory work:

5. Samples Collection:

To know the ratios of heavy elements before the introduction of the laboratory and after production and determine the quality of the bricks and the extent of its usefulness for use.The samples were collected for ten different models of quarry quarries by two models for each city (five cities) from the southern cities of Dhi Qar, Wasit, and Missan governorates for the quarries of the most productive factories and consumption of the bricks and comparing the results with the results of the grinding of the blocks produced for each of the five laboratories.

6. Laboratory Procedures

6.1- Analysis of elements (lead pb, cadmium Cd, zinc Zn and copper Cu and Nicle Ni)

To determine the concentrations of heavy elements in the selected soil samples, Jackson method was used. After the modeling process was completed, samples were fragmented and approximately 1 g of each sample was taken in a manner that ensures the sample is well represented. The sample then passes through a series of stages for geochemical analysis and sample preparation for final analysis using an Atomic Absorption The final analysis was conducted at the laboratory of the Biology Department of College of Science / University of Baghdad. The most important stages of processing samples and preparing them for final analysis [6]:

1-The sample was sampled using a ceramic mortar after drying in an oven (100 ℃) for two hours.

.2-Sieving using a sieve with a diameter of (0.07 mm) for the ground model

3-(1 g) of dried sample was taken and place in a clean beaker (250 ml) using a sensitive balance

4-The sample was digested by adding (15 ml) of HCl with (5 ml) of concentrated nitric acid (HNO_3)

5-A sand bath was used for (45-60 minutes)

6-The beaker is cooled to laboratory heat and added (5ml) of HCl acid and heated in a sandy bath until dryness and this step takes about (5-10 minutes)

7-After cooling the bicritum (5 mL) of HCl and (50 ml) of hot distilled water were added to wash the beaker in sides of the affected sample.

8- The mixture was kept in boiling for (2-3 minutes)

9- A filter paper (No. 42) was used to filter the sample and the leachate is placed in a volume bottle with a capacity of (100 ml).

10-Finally, the insoluble precipitant was washed with distilled water and the washing water was added to the filter and the volume is completed to (100 ml) then sent for analysis by Atomic Absorption.

6.2-Measure pH of Soil Samples.

Ten soil samples were used for the southern regions pH was measured by weight of (1g) from the dried sample at (100C°) and added to (100 ml) of distilled water and mixed well for half an hour. And measurement of the hydrogen function of the filter

6.3-Granular Gradient Analysis of soil Samples

The previously mentioned samples were prepared to measure the ratio of sand, silt and clay for these samples using the Hydrometer method, depending on the working contexts of the General Company for Geological Survey and Mining [7]. The stages of analysis of the gradient in the selected soils were carried out according to the following:

1-Taking (50 g) of the sample and wash it with a (0.063 mm) sieve to separate the clay from sand.
2-The sand is placed in the beaker and placed in an oven at a temperature of (150C°).
3-To disassemble the particles, put the clay in a vibrator for (15 minutes).
4-A small sample of stagnant samples was taken after 24 hours and barium chloride was added to ensure that it is free of salts. If there is an interaction with barium chloride, this means salts are present in the sample.
5-The clay is dried in a container inside the oven at a temperature of (45-50 C°) to prevent the disintegration of the particles.
6- Weighting of clay and sand after drying with a sensitive balance and the difference in weight represents the amount of salts.
7-The clay was taken and a solution (125 ml) was added from the calcon (sodium hexamethaphosphate) which is prepared by using (40 g) of sodium hexametaphosphate and melted with 100 ml of distilled water.
8-The mixture was put in a graduated cylinder. Distilled water was added. The sample was taken another listed cylinder and add distilled water only.
9- Thermometer was used to measure the water temperature
10-The capacitor is placed in the inserted cylinder and the readings were taken according to certain times (1/4 minutes, 1/2 minute, 1 minute, 2 minutes, 3 minutes, 15 minutes, 30 minutes, 60 minutes, 240 minutes, and the next day). On the particle diameter of both silt and clay.

6.4-Measure the Amount of Organic Matter

The selected samples were previously taken to measure the proportion of organic matter found in them according to Al-Janabi. The procdure of measuring the amount of organic matter in the selected soils was carried as follows [8]:

1- (3g) of the dried sample was taken to an oven (100° C) in beaker capacity (250 ml)
2-Add 10 (ml) of K_2 Cr_2 O_7 (1N) and (200 ml) of H_2SO_4
3- Sample were left for (20 minute). The sample was diluted with distilled water to (200 ml). Addition (10 ml) of H_3PO_4.
4-The sample was corrected with H_2O-O_2H_7 (0.5) N $FeSO_4$ using aminosulfhenyl diphonyl barium as an indicator of the endpoint as the color changes from yellow to green.

6.5-Electrical conductivity

Check electrical conductivity using an electrical conductivity meter and gives the device direct reading (mm / cm obaldismymns / M -1) and follow the following steps:
1-The 5 mL pipette was drawn by leachate and placed in a flask conical flask
2-For the purpose of dilution 20 mL distilled water was added to the locate.
3-To increase the pH of the leachate to about 12, to make the base medium, add five drops of NaOH solution. This results in the deposition of element ions (copper, nitric, iron, manganese, tin) and prevents its reaction.
4-(50) mg of the Myroxide Guide was added
5-The mixture shall be shaken and corrected against EDTA (0.01N) solution until the color changes from pink to purple. Then, record the user's EDTA size.
6-Calculation of the value of calcium in mg / l.

Practical part:

Table (1): shows the concentration of heavy elements and the physical properties of quarry soil samples (study areas)

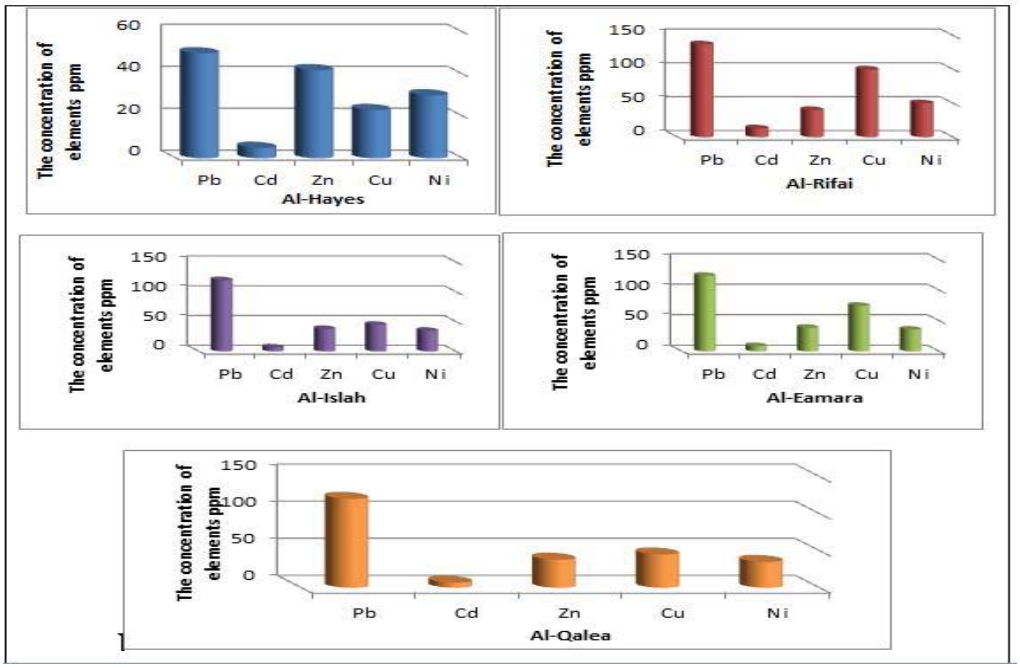
No.	Study Aria	% The gluten		% Clay		% Sand	
		Brick soil	Toothed soil	Brick soil	Toothed soil	Brick soil	Toothed soil
1	Al- Haye	59.4	57.1	40	42	0.6	0.9
2	Al- Rifia	54.4	53.2	45	46	0.6	0.8
3	Al- Eamara	52.2	52.2	47	48	0.8	0.65
4	Al- Islah	53.8	51.35	43	44	3.2	3.1
5	Al- Qalea	60.4	60.6	37	38	2.6	2.4
Rate		56.04	54.38	42.4	43.6	1.56	1.57
Standard Deviation		3.248	3.498	3.555	3.440	1.112	0.991
Correlation coefficient		0.060	0.060	-0.318	-0.411	0.838	0.755

No.	Study Aria	The concentration of heavy elements (ppm)					PH	O.M%	E.C
		Pb	Cd	Zn	Cu	Ni			
1	Al- Haye	50	5	42	23	30	7.3	0.35	2.3
2	Al- Rifia	137	13	40	100	50	7.4	3.2	4.9
3	Al- Eamara	124	9	39	75	36	7.2	1.9	3.1
4	Al- Islah	120	7	38	45	35	7.1	0.4	2.7
5	Al- Qalea	120	7	36	24	33	7.3	3	2.1
Rate		110.2	8.2	39	53.4	36.8	7.26	1.77	3.02
Standard Deviation		30.742	2.7129	2	29.990	6.910	0.1019	1.222	1.0008
Correlation coefficient		0.5658	-0.3127	-0.707	-0.759	0.470	-0.554	0.937	0.2543

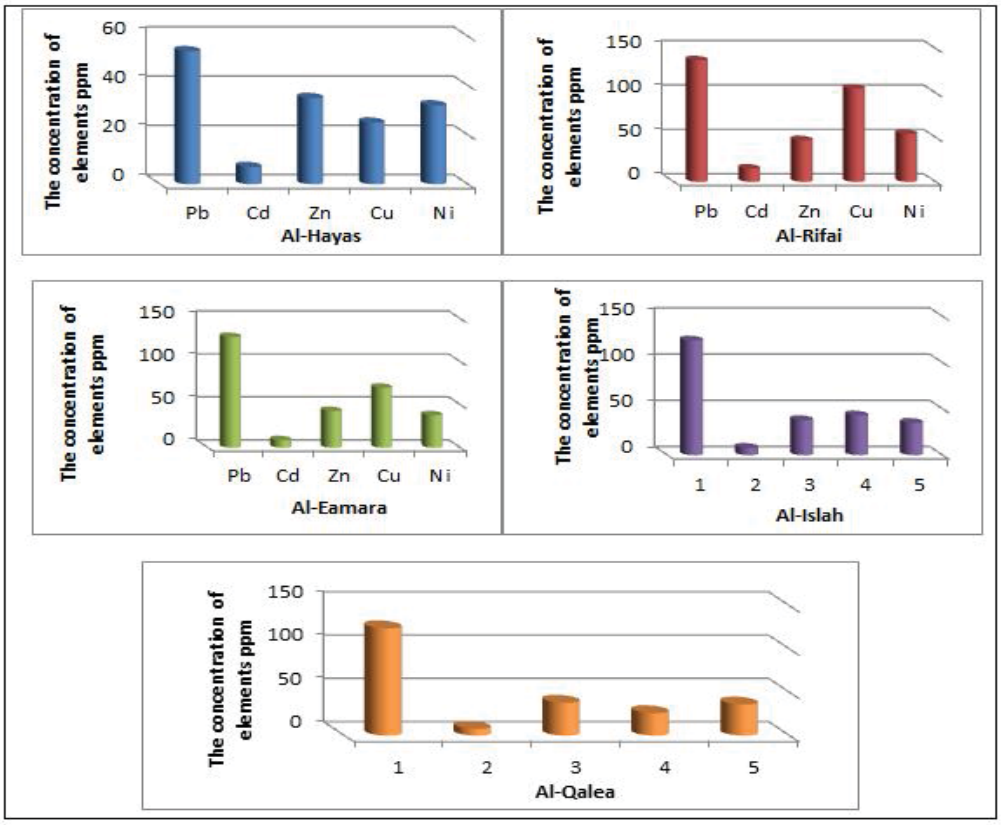
Table (2): shows the concentration of heavy elements and the physical properties of brick soil samples (study areas)

Table (3) shows the relationship between the size gradient of the quarry and the adobe of the bricks in study areas.

No.	Study Aria	The concentration of heavy elements (ppm)					PH	O.M%	E.C
		Pb	Cd	Zn	Cu	Ni			
1	Al- Haye	54	7	35	25	32	7.3	0. 5	2.5
2	Al- Rifia	137	15	47	105	54	7.4	3.1	5.2
3	Al- Eamara	129	9	43	70	38	7.3	2.1	3
4	Al- Islah	124	8	38	43	35	7.2	0.6	2.6
5	Al- Qalea	124	8	38	26	36	7.2	2.9	2.2
Rate		113.6	9.4	40.2	53.8	39	7.28	1.84	3.1
Standard Deviation		29.083	2.870	4.261	30.34	7.74	0. 074	1.10	1.080
Correlation coefficient		0. 6	-0.640	0.06	0.783	0.783	0.377	0.93	0.261



Figure(3) Show the concentration of heavy elements in study areas in quarry soils



Figure(4) Show the Concentration of heavy metals in the study areas in the bricks of bricks

7. Results and discussion:

Some calculations were made to determine the concentration of some heavy metals (lead, cadmium, zinc, copper and nickel) in the soil of the areas under study and discuss the natural factors that control the concentrations of these elements such as hydrogenation, organic matter and particle size gradient in soil samples in the study areas.

We measured the content of heavy metals (Pb, Cd, Zn, Cu & Ni) in soil samples using atomic absorption spectrometry after conducting geochemical analysis of all samples. Some calculations and statistical equations were performed within the values and concentration obtained for heavy elements. (Correlation Coefficient) was calculated between the concentrations of lead, cadmium, zinc and copper, on the one hand, and the natural factors that control the concentration of these elements on the other, and three samples with high concentrations and three samples with low concentrations of heavy elements if the value of (r) is equal to (0), it means that there is no correlation between them. if the value of (r) is equal to (+1), this indicates the state of absolute correlation, While the value (-1) indicates the state of full reverse correlation according to the equation:

$$r = \frac{\frac{1}{N}\sum (Xi - \bar{X})(Yi - \bar{Y})}{(S.D_X) \times (S.D_Y)}$$

r = Pearson's linear correlation coefficient

Xi = The first variable
Yi = the second variable

S. DY, S.DX The standard deviation of the first and second variables, respectively $\bar{X}$: The average values in the first variable, $\bar{Y}$: The The average values the second variable, N: Numbervariable The Excel program was used to perform calculations and extract values
It can see from Table (1) that the percentage of lead> cadmium> zinc> copper> nickel in the soil samples of the product before the introduction of the oven by a small percentage of the models of the soil of the quarry confirms that the external factors (water used, climate factors, soil characteristics, the age of the plant, the quality of the fuel) each of these factors have a role in changing the concentrations of heavy elements more than the normal limit, [9]. Note from Table (2) The rate of lead ratios recorded a value higher than the normal limit of (11) times. The relationship between the concentration of cadmium and the variables (pH, O.M%, E.C) has also shown an inverse relation between the chemical properties of these variables, which will lead to a decrease in the concentration of cadmium concentration in the extracted soil samples shown in table (1), there is a positive relationship between the lead and nickel components with the variables (O.M%, E.C) where the values were 0.5658 for the lead while the nickel component was 0.470. This indicates that each increase in the values of these variables leads to an increase in the values of both elements The reason for the increase in the concentration of lead in the dust by smoke from industrial processes as well as the products of fuel combustion in gasoline-powered vehicles as well as generators and the wind is one of the most important elements that help to transport dust flying by dust storms Lead is a toxic element that must be monitored for its high risk to humans and the environment and increase its rate leads to behavior and learning problems. In addition, continuous and systematic exposure leads to mental retardation. This element can be transmitted with blood stream. It is dissolved with breast milk and prolonged exposure to the ingredient or one of its compounds leads to low levels of intelligence, low fertility, miscarriage, hormonal changes, menstrual disorders and delayed puberty, People are exposed to natural radiation every day. Natural radiation comes from many sources, including more than 60 naturally occurring radioactive materials found in soil, water and air. Radon is a natural gas that originates from rocks and soil, the main source of natural radiation. Every day, people are exposed to radionuclides by inhalation and ingestion of air, food and water, People are exposed to natural radiation also by cosmic rays, especially at high altitudes. About 80% of the radiation dose receive per year - on average - comes from natural and earthly radiation. Levels of exposure to background radiation vary due to geological differences. In some areas exposure may be more than 200 times higher than the global average [10].

There are also anthropogenic sources of radiation ranging in their variety from nuclear power plants to medical uses of radiation in diagnosing diseases or treating patients. The most commonly used human ionizing radiation sources today are x-ray machines and other medical devices.

A change was observed between the concentration of the elements between the samples of the bricks and the soil samples of some of the elements, for example the increase in the concentration of the study elements in the area (1) due to the quality of water used in industry, fuel quality, high temperature, and to the characteristics of soil used in the industry in addition to the different characteristics of soils in the study areas from one area to another according to Table (3). We note that lower rates of sand in the samples of the soil were lower than of bricks than the samples of soils and the reason might be due to the washing of

soil samples before the introduction of the industry to wash of sodium chloride and the difference is the basis of the soil content of sand, clay and silt for weathering operations and biogeogenic processes in soils and this came in line with the results of [11] [12] [13] geochemical study of heavy metals confirmed the high concentration of lead and copper in the clay fraction, and attributed this to the adsorption of these elements to clay minerals.

Table (1,2) shows the height of all studied elements, but the concentration of copper in Rifa'i of architecture when the concentration of heavy elements in the study sites was compared with the global average concentration in the global soil [9].This is due to the increase in the ratio of heavy elements to the natural proportions of the elements in soils, the use of excess irrigation water and the penetration of groundwater wells in the area, as well as the use of chemical fertilizers and the role of organic matter and hydrogen function, which had the role of adsorption of heavy elements and pollution from wind and water used in drying samples In addition, Is considered one of the most important factors that directly or indirectly assist in increasing the phenomenon of desertification and land degradation in the central and southern regions [14]. That the soil of Iraq suffers from a high risk of wind erosion of the arid and semi-arid regions of the system is very fragile, which makes it quick to impact any change of the elements of the climate known, which in turn increase the frequency and the occurrence of dust storms, which have an influential role in the expansion and scope of sand dunes, which is one of the most dangerous manifestations that lead to soil degradation [15] The percentage of elements varies depending on the parent material if the soil content of the heavy elements depends mainly on the parent material -derived rock. Soil content of the igneous rocks of the heavy elements is richer than the sedimentary rocks as well as the weathering of the crust and the quantity, quality and proportion of clay minerals Rare or ionic exchange based on PH where the heavy kinetic mobility increases with the increase of pH [4] As the difference of soil in its content of heavy elements according to their regional and climatic conditions. Cold sinks due to changing climatic conditions and their geochemical properties [17] [18] [7]. There is a weak correlation between the two variables, but the elements nickel and lead have strong relations with each other. This relationship may be attributed to their emission from the stacks and their fall on the soil of the region and their absorption of clay minerals (1,2). In addition to the bond of copper and nickel due to the existence of industrial processes represented by the movement of heavy equipment used in the extraction and loading and transport of soil and bricks to and from the laboratories, Heavy equipment used in the extraction and loading and transport of soil and brick to and from the laboratories, where often used these vehicles fuel oil gas as well as to corrode engine parts. In addition, combustion is irregular and causes a clear variation in the intensity of fumes from chimneys over time. This condition is frequently repeated due to continuous and emergency changes in the load of electrical power to the power transmission and distribution network [19].

Conclusions:

We conclude from the study that the availability of heavy elements in the soil naturally and with a specific concentration can increase the impact of climate factors as the wind and high temperatures and rain play a large role in increasing pollutants in the soil, especially near the brick factories as the wind to transport the smoke rising from the plants loaded with contaminated gases To the environment to hundreds of meters depending on the speed and direction of the wind, in addition to the role of rain through the interaction of rain with gases and dust particles in the air and turned into acid rain, which in turn interact with the soil compounds, which leads to the rise of heavy elements in the soil.

Recommendations:

The establishment of a green belt around the plant, which in turn reduce the spread of dust and gases to the atmosphere through the planting of some trees (trees, friendly environment), which helps to absorb heavy elements from the soil as well as its role in the stabilization of soil and not moving from one place to another by the impact of wind. The use of water with a few concentrations of heavy elements and use in the washing of soil samples used in the manufacture of bricks, trying to maintain the machines inside the laboratory and the use of electric plants and try to move away from the machines that use fuel because of the fuel of a large role of environmental pollution by smoke and gas Rising from the stacks filled with lead compounds, which is considered one of the most toxic elements of the environment

Reference:

[1] Koedrith P, Kim H, Weon JI, Seo YR. 'Texilogenomic approaches for understanding molecular mechanisms of heavy metal mutagenicity and carcinogencity, Int J Hyg Environ Health. 2013 Aug;216(5) :587-98. Epub 2013 Mar 13

[2] Alloway, B.J..Heavy Metals in Soils.John wilely and sons, Inc.new york (1990)

[3] Renato N. M; Paulo R. M. L; Ederio D. B,"Screening the Toxicity and Biodegradability of Petroleum Hydrocarbon by a Rapid Colorimetric Method", Archives of Environmental Contamination and Toxicology, Vol 68, Issue 2, pp 342–353(2015).

[4] Pul B; Tchoun W; Clement G. Y.; Anita and Dwayne K, Heavy Metals Toxicity and the Environment, HHS, (2012), PP133-167.

[5] Ibtihaj A.K, Calculate the Ratios of Some Heavy Metals and the Physical Properties of the Soil Used in the Local Brick Industry, American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS), Vol 42, No 1, pp 242-254, (2018)

[6]. D.R; Jackson, And A.P; Watson,"Distribution on nutrient pools and transport of heavy metals in watershed near a lead", Vol (6), No (4), (1997), pp (331-332).

[7]. Al-Sultani, Ahmed Rahim, "Air Pollution and Soil of the Nahrawan Region- East Baghdad with Heavy Metals Resulting from the Brick Factories", Master Thesis (unpublished), Faculty of Science, Baghdad University, (2006), pp118

[8]. Al-Janabi, A.Y., Al-Saade, N.A., Zani nl Y.M., Al-Bassam., S, and Al Delaimy M.R., Work Procedures of the S.E OF Geological survey and mining, state establishment of geological survey and mining (geosurv), part (21), No (2002B), (1992), PP59-65

[9] Bieby V. T; Siti R. S. Abdullah; Hassan B.; Mushrifah I; Nurina A, and Muhammad Mukhlisin, "A Review on Heavy Metals (As, Pb, and Hg) Uptake by Plants through Phytoremediation," International Journal of Chemical Engineering, Vol 2011, Article ID 939161, pp31.

[10] WHO, Media Center, Fact Sheets "Ionizing Radiation, Health Effects and Prevention Measures, 2016.

[11] R.J., Schaetzl, L.R. Mikesell, and M. A. Babel, Soil characteristics related to weather and pathogenesis across a geomorphic surface of uniform age in Michigan. 2006, Physical Geography 27: pp170-188.

[12] Saleh, Adel Mouloud and Al-Khafaji, Qahtan Darwish, Study of variability in the weathering levels of some soils under various climatic conditions of northern Iraq, 2014, Mesopotamia Journal - Vol 42, Issue 3.

[13]. K. Banat, "Geochemical study of heavy metals and major ions from the Tigris river between Baghdad and Mosul." Jour. Geol. Soc. Iraq, Special Issue, 1977, pp47-56.

[14] John Oswald, Sarah Harris, Biological and Environmental Hazards, Risks, and Disasters, 2016.

[15] Ali D. B; Hossein A. B and Abdol M. H; "Investigation of Factors of Dust Storms and Solutions for Combating (With Emphasis on West Asia Region)", University of Tehran-Geoinformatics Research Institute (UT- GRI),2016

[17]. Aubert, H.; Pinta, M., "Trace Elements in Soil". Developments in Soil Science 7, Wlsevier Scientific publis hing Company, Amsterdam, 1977, p. 395.

[18] C., Molina, Introduction: Soil Pollution, agriculture & Public Health. Bull -Acad-Natal-Med.1997: 181 (L): pp9-17.

[19] Lefta. Ali Jaber," power stations between reality and ambition", Baghdad Newspaper, 2014, Issue 2983.