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Estimating the Concentration of Cadmium in the Qayyarah and Kasak Sites and its Impact on the Environment

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ABSTRACT

Cadmium recorded a significant superiority in the soil of the Qayyarah site with a peak of (491.744) mg/kg compared to the Kasak site, which showed its highest concentration in the soil of (D1) at (0) metres. The highest value was recorded at (520.217) mg/kg, which indicates high pollution. Compared to the rest of the dimensions, the lowest concentration of cadmium was in the soil (D2) at a distance of (50) meters, amounting to (428,050) mg/kg.

While we note that the Qayyarah site recorded the lowest values of cadmium at the distance (S2D2) (50 metres), with a concentration rate of (450.867) mg/kg. As for cadmium, its highest concentration was at the distance (S2D3) (100 metres) and (S2D5). It reached (521.867) mg/kg.

While the Kasak site recorded the highest value of cadmium at a distance of (S1D1) (0 metres) with a concentration of (527.667) mg/kg, while the lowest concentration of cadmium was at point (S1D2) (50 metres) with a value of (405.233) mg/kg.

Keywords- soil pollution, pollution, heavy elements, cadmium.

I. INTRODUCTION

Heavy elements have a relatively high density and are considered toxic at low concentrations. For example, (Cd, Pb) do not have basic biological functions for living organisms. There are elements such as (Ni, Mn) that have an important role in the functions and systems of enzymes at small concentrations, but they become toxic and dangerous to a large degree. When they exceed the limits of natural concentrations (Hasan et al., 2019). The problem of pollution with heavy metals is one of the most environmental problems that threaten the ecosystem because they accumulate in the human body, causing organ failure or cancer, in addition to poisoning animals and plants, so it has environmental and health effects. Long due to their inability to biodegrade, plants that have the ability to decompose these elements must be evaluated, including phytoremediation technology to treat soil sites contaminated with heavy metals to reduce.

From their toxicity to the ecosystem (Huang et al., 2020), where the results of (Thongyuan et al., 2021) showed variation in the concentration of heavy metals as follows: Mn (41.05-501.80 mg/kg), pb (20.97-72.76 mg). /kg), Ni (1.59-53.74 mg/kg), and Cd (0.16-1.67 mg/kg), while (Gishini et al., 2020) reported that exposure of plants to cadmium led to a decrease in its growth, to increase the concentration of cadmium in the shoots and roots, Then the weight of the leaves and roots decreased linearly with increasing cadmium content in the roots and leaves, and this led to a linear decrease in the water content of the shoots and roots with increasing levels of heavy metals, and that the carob plant was more able to transfer cadmium from the roots to the shoots, and the natural accumulation of cadmium was under A gradual increase in the levels of these elements in the soil. The aim of the study was to estimate the concentration of cadmium and its impact on the environment.

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II. MATERIALS AND METHODS

Sample collection
Soil samples:

Soil samples contaminated with oil were collected at specific distances (0), (50), (100), (150), (200) and (300) meters, from sites contaminated with crude oil and oil spills from the Kasak refinery located west of Nineveh Governorate, about (40) kilometers from the center of the city of Mosul, and the Qayyarah refinery, which is located in the south of Nineveh Governorate, and which is about (60) kilometers from the center of the city of Mosul in the Nineveh Governorate. To estimate the heavy metals in it, the samples were placed in sterile poly bags with the required information written (sample number, Date, weight) on it and then transport it to the laboratory and store it at a temperature of (4 C°) in the refrigerator until use.

Heavy element experiments
Soil sample digestion

The soil digestion process was carried out in the Department of Soil and Water Resources, College of Agriculture, Tikrit University, and (5) grams were weighed of air-dried soil, place it in a clean glass beaker with a capacity of (250 ml), and then add a solution of 250 ml. (1:1:3) of each of concentrated sulfuric acid, concentrated nitric acid, and perchloric acid, and is covered.

The beaker is covered with a watch glass to prevent evaporation of the concentrated acids. The samples are then heated on the surface of a heat plate at A temperature of 105 degrees Celsius for an hour and a half or until it evaporates and we get dry soil by placing it on (Electric heating plate) Then add 20ml of nitric acid to the dry soil sample, and then we transfer Flask contents of a 100 ml volumetric flask after filtering the liquid with filter paper to prevent clogging of the tube

Capillary atomic absorption spectrometer (A.A.S), and we carry out the dilution process by adding distilled water to (50 ml) according to (Jackson, 1958).

Determination of cadmium in soil

The heavy metals of soil samples were estimated in the central laboratory at the College of Agriculture/University of Mosul, which included soil digestion and after dilution with distilled water, the absorption of each of the heavy metals in the soil samples was estimated using an A.A.S atomic absorption device, of the Perkin Elmer type. The length was determined The waveform and current used for each heavy element, and the absorbance was converted to concentration units by referring to the regression equations for the standard curves for the heavy elements under study, and the results were expressed in units of micrograms of metal and per gram of dry weight of the soil according to what was stated in the method of Jackson (1958).

Statistical analysis

The data were analyzed according to a factorial experiment system with a completely randomized block design, and comparison was made between...

Averages of coefficients using range multiple s'Duncan method using least test

A significant difference in terms of (LSD≤0.05), where the different coefficients were significantly distinguished by different alphabetical letters. Using SPSS (Perscott et al., 2005).

III. RESULTS AND DISCUSSION

Cadmium concentrations in the soil of the Al-Kasak and Qayyarah sites

We note from Table (1) and Figure (1) that the average concentration of cadmium was significantly higher at the Qayyarah site (491.744) mg/kg compared to the Kasak site, where its concentration reached (470.678) mg/kg. The reason may be attributed to the proximity of the study site to the source of pollution. And in a study conducted by (Kubier et al., 2019) it was revealed that cadmium enters the soil through combustion emissions, sewage sludge, industry and mining, and due to the possibility of differences in the components and quality of crude oil for the two study sites and a difference in the quality of oil pollutants released for each site, and these results are consistent with (Kadhim et al., 2017) and (Aziz et al.,2020) and (Dong et al., 2023).

Table (1) Average concentrations of cadmium in the Al-Kasak and Qayyarah sites

Sites	Cd
S1	470.678
S2	491.744
LSD(0.05)	4.568

*S1 represents the site of Al-Kasak *S2 represents the site of Al-Qayyarah

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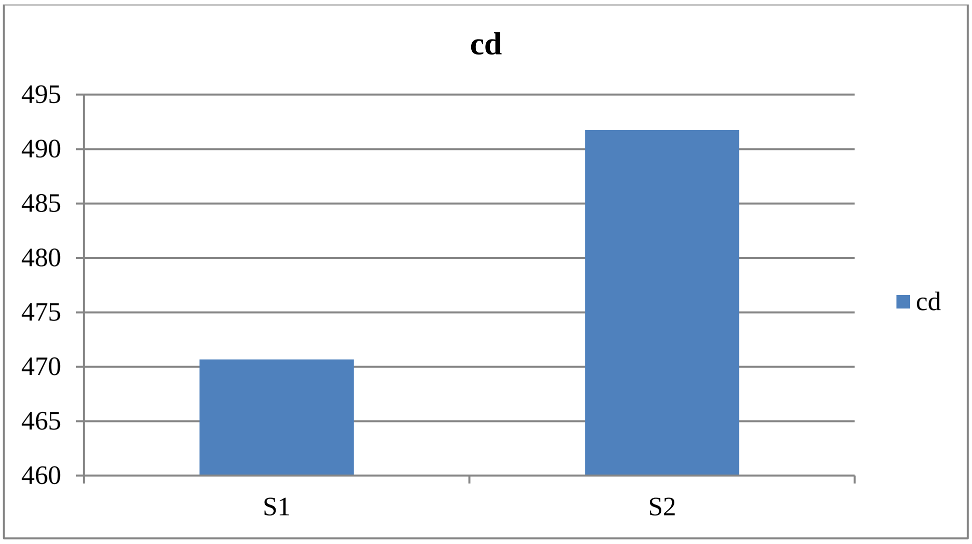

Figure (1) A graph showing the difference between cadmium concentrations between the Al-Kasak and Al-Qayyarah sites

The results of Table (2) and Figure (2) showed a variation in the concentration of heavy elements on different dimensions. We find that the average concentration of cadmium in soil (D1) over (0) meters recorded the highest value of (520.217) mg/kg, which indicates high pollution. Compared to the rest of the dimensions, because the cadmium concentration was high in the oil pond and the close distance from the oil pond led to a high concentration of cadmium, and the lowest concentration of cadmium was in the (D2) soil at a distance of (50) meters and amounted to (428,050) mg/kg. This is due to the presence of plants that absorb heavy elements through the root system. The soil in the Al-Kasak and Qayyarah sites showed high values of cadmium outside the permissible limits. The reason for this may be contamination of the soil with crude oil, and these results are consistent with (Thongyuan et al. .,2021) and (Bridget et al.,2023).

Table (2) Cadmium concentration on different dimensions

Distance	Cd
D1	520.217a
D2	428.050d
D3	503.300b
D4	482.933c
D5	474.267c
D6	478.500c

*Similar letters mean there are no significant differences
*(D1, D2, D3, D4, D5, D6) represents the soil for dimensions (0, 50, 100, 150, 200, 300) meters for the Kasak and Qayyarah sites.

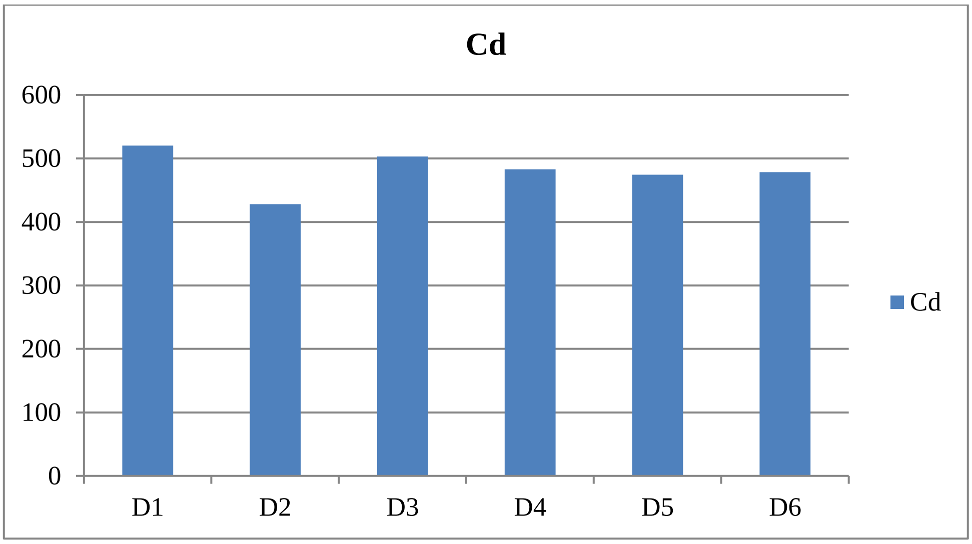

Figure (2): A graph showing the concentration of cadmium according to different soil dimensions

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We notice from the results of Table (3) and Figure (3) that the Qayyarah site recorded the lowest values for the elements cadmium on the dimensions (S2D2) (50 metres) with a concentration rate of (450.867) mg/kg. The reason may be attributed to the presence of the reed plant Typha domingesis in the site that works On the absorption of cadmium by the roots, biological processes allow the removal of heavy elements by microorganisms, as biological agents respond to pollution through their own defense mechanisms, such as the secretion of enzymes and cellular morphological changes, and then they accumulate, stabilize, or bind in the form of volatile substances. It is less toxic, and bacteria can encourage the degradation of metal pollutants (Cui et al., 2017). As for cadmium, its concentration was higher in dimensions (S2D3) (100 metres), amounting to (521.867) mg/kg, due to the possibility of the absence of the plant or near the site. About the source of pollution, these results are consistent with (Thongyuan et al., 2021) (Dong et al., 2023).

While the Al-Kasak site recorded the highest value for the element cadmium at a distance of (S1D1) (0 metres) with a concentration of (527.667) mg/kg. The reason for this increase in the values of cadmium concentrations may be due to the proximity of the studied site to sources of oil pollution and its receipt of large and successive quantities of oil pollutants. It accumulates over time as a result of the continuous release of oil pollutants resulting from the refining of crude oil, as well as the continuous combustion of oil and its derivatives. As for the elements cadmium, its concentration was lowest at point (S1D2) (50 metres) with a value of (405.233) mg/kg, and the reason for this is the presence of the reed plant. Typha domingesis, which works to pull heavy elements from the soil from the root system to the roots, and these results are consistent with the findings of (Abbas, 2020), (Shi et al., 2023), and (Bridget et al., 2023).

Table (3) The interaction between location and distance and its effect on the concentration of cadmium

Combination	Cd
S1D1	527.667a
S1D2	405.233h
S1D3	484.733de
S1D4	463.433g
S1D5	477.833def
S1D6	465.167fg
S2D1	512.767ab
S2D2	450.867gh
S2D3	521.867a
S2D4	502.433bc
S2D5	470.700ef
S2D6	491.833bcd

*Similar letters mean there are no significant differences
*(S1D1, S1D2, S1D3, S1D4, S1D5, S1D6) represents the soil for dimensions (0, 50, 100, 1500, 200, 300) meters at the Kasak site
*(S2D1, S2D2, S2D3, S2D4, S2D5, S2D6) represents the soil for dimensions (0, 50, 100, 150, 200, 300) meters at the Qayyarah site

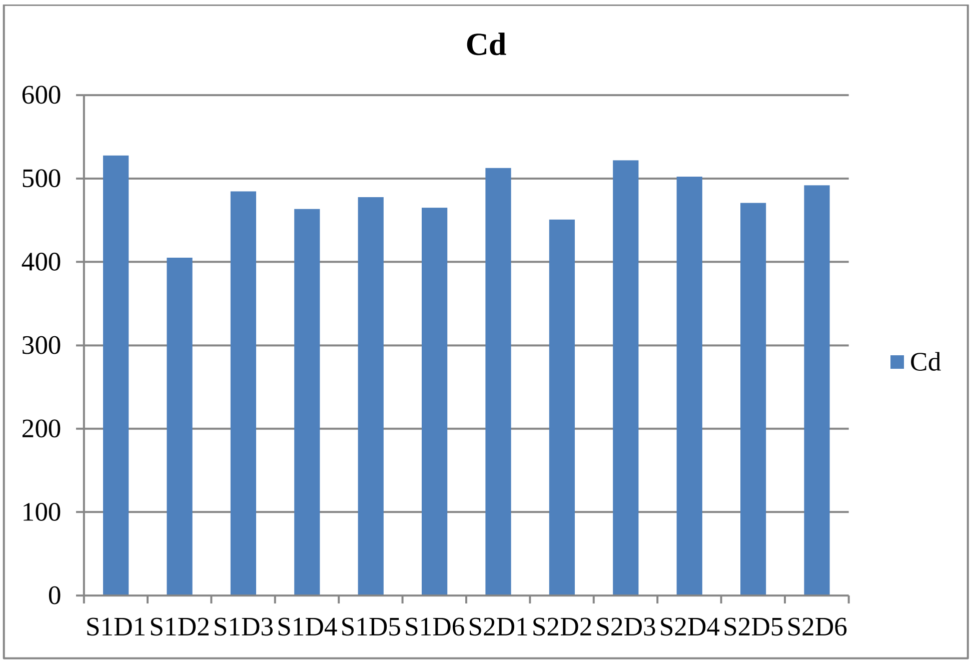

Figure (3): A graph of the concentration of cadmium according to the interaction between location and distance from the source of pollution

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IV. CONCLUSIONS

The cadmium element showed a difference between the two study sites, with the Qayyarah site being superior at a rate of (491.678) mg/kg compared to the Kasak site. The cadmium concentration in the D1 S1 dimension was the highest value at a rate of (527.667) mg/kg and the lowest value in the S1D2 dimension at a rate of (402.233) mg/kg. kg at the Al-Kasak site, while at the Qayyarah site, the cadmium value was highest at the S2D2 dimension with a concentration of (521.867) mg/kg, while the lowest concentration was at the S2D3 dimension with a concentration of (450.867) mg/kg.

REFERENCES

[1] Hasan, M. M., Uddin, M. N., Ara-Sharmeen, I., F. Alharby, H., Alzahrani, Y., Hakeem, K. R., & Zhang, L. (2019). Assisting phytoremediation of heavy metals using chemical amendments. *Plants*, *8*(9), 295.

[2] Huang, L., Rad, S., Xu, L., Gui, L., Song, X., Li, Y., Wu, Z., Chen, Z., 2020. Heavy metal distribution, sourcesand ecological risk assessment in Huixian wetland. South China. Water 12, 431. https://doi.org/10.3390/w12020431

[3] Thongyuan, S., Khantamoon, T., Aendo, P., Binot, A., & Tulayakul, P. (2021). Ecological and health risk assessment, carcinogenic and non-carcinogenic effects of heavy metals contamination in the soil from municipal solid waste landfill in Central, Thailand. *Human and Ecological Risk Assessment: An International Journal*, *27*(4), 876-897.

[4] Gishini, M. F. S., Azizian, A., Alemzadeh, A., Shabani, M., Amin, S., & Hildebrand, D. (2020). Response of Prosopis farcta to copper and cadmium stress and potential for accumulation and translocation of these heavy metals. bioRxiv, 2020-11. https://doi.org/10.1101/2020.11.02.365619

[5] Jackson, M. L (1958). Soil chemical analysis (ed.). Prentice Hall. Inc.

[6] Prescott, L.M.; Harley, J.P.; Klein, D.A. Microbiology, Sixth edition, McGraw Hill International edition, New York. (2005).

[7] Kubier A, RT Wilkin and T Pichler (2019). Cadmium in soils and groundwater: A review. Applied Geochemistry, 108, 1-16. https:// doi.org/10.1016/j.apgeochem.2019.104388.

[8] Azizi, A., Krika, A., & Krika, F. (2020). Heavy metal bioaccumulation and distribution in Typha latifolia and Arundo donax: implication for phytoremediation. *Caspian Journal of Environmental Sciences*, *18*(1), 21-29.

[9] Kadhim, S., Zarraq, G. A., & F Abed, M. (2017). Calculating pollution indices and health risks of heavy metals in surface soil at Tikrit City. *Kirkuk University Journal-Scientific Studies*, *12*(3), 391-413.

[10] Dong, Q., Song, C., Yang, D., Zhao, Y., & Yan, M. (2023). Spatial Distribution, Contamination Assessment and Origin of Soil Heavy Metals in the Danjiangkou Reservoir, China. International Journal of Environmental Research and Public Health, 20(4), 3443. https://doi.org/10.3390/ijerph20043443

[11] Bridget, D. E., Okorondu, J. N., Susan, I. A., Edokpa, D. O., Acholonu, C., & Edeh, S. (2023). Assessment of Heavy Metal Contamination of Soil in Mechanic Workshops at Nekede and Orji, Owerri Zone, Imo State, Nigeria. Journal of Scientific Research and Reports, 29(7), 8-16.

[12] Cui, Z.; Zhang, X.; Yang, H.; Sun, L. Bioremediation of heavy metal pollution utilizing composite microbial agent of Mucor circinelloides, Actinomucor sp. and Mortierella sp. J. Environ. Chem. Eng. 2017, 5, 3616–3621. https://doi.org/10.1016/j.jece.2017.07.021

[13] Shi, J., Qian, W., Jin, Z., Zhou, Z., Wang, X., & Yang, X. (2023). Evaluation of soil heavy metals pollution and the phytoremediation potential of copper-nickel mine tailings ponds. *Plos one*, *18*(3), e0277159.

[14] Abbas, J. A. A. (2020). Spatial Distribution of some of Heavy Metals Pollution Parameters for Soils surrounding Al-Dora Power Plant, South Baghdad, Iraq. Plant Archives, 20(2).