Nat. Volatiles & Essent. Oils, 2021; 8(4): 7048-7057

Determination Of Levels Of Hg And Pb In Soils And Some Leaf Plantsfrom Polluted Area By Crude Oil

Sama Hassan Ali Rahmatullah , Dr. Reyam Naji Ajmi

Department of Biology Science, Mustansaryah University, POX 46079, Iraq-Baghdad

reyam80a@uomustansiriyah.edu.iq, reyam80a@yahoo.com

sama.hassan993@gmail.com

Abstract: A high content of heavy metals in the soil and plants accumulated by a crude oil might causeserious damage to the environment and can be a threat to the health of the surrounding population This paper presents the results of research that focused on analyzing the heavy metal(mercury and lead) content insoil and plants in oil company ,The analysis focused on the content of heavy metals in soil and plant(Atomic absorption spectrometry and DMA80). In the soil sample the concentration of mercury higher than lead 6.423 ,1.261ppm respectively and withinWorld Health Organization (WHO) allowable limits and the concentration of mercury in plant The arrangement was as follows: Alhagigraecorum> Eucalyptus camaldulensis>Phragmitesaustralis>Phoenix dactylifera , Ziziphusspina-christi>Tamarixarticulata>Typhadomingensis .And in lead arrangement was as follows, Alhagigraecorum> Eucalyptus camaldulensis>Phragmitesaustralis>Ziziphusspina-christi>Phoenix dactylifera>Typhadomingensis>Tamarixarticulata.

Keywords : Pollution, Mercury and Lead , Crude Oil , Plants

1-INTRODUCTION :

The soil contamination with elements is a serious environmental threat and one of the most pressing environmental problems in the world (Foleyet al; 2011).The anthropic activities contribute to soil contamination and pollution with heavy metals including mining (Ok et al., 2010) therefore, the environmental pollution with heavy metals has become a serious environmental problem. These heavy metals are not biodegradable and many of them are toxic (Abbas and Abdelhafez, 2013). Lead (Pb) is one of the most pervasive contaminants in aqueous environments and soils. It is used as a raw material for several industries, storage battery manufacturing, printing, pigments, fuels, photographic material and explosive manufacturing (Nagajyotiet al., 2010). Soil is the major reservoir for Pb in the environment and forms the initial link of the food chain through which the lead is transferred to man. Lead discharges from humans' activities enter the soil from the depositions of polluted atmospheric or aquatic system or through land-based disposal of contaminated wastes. Pb occurs naturally in soil in low concentration, and transfers to the food chain from soil to plants and then to the animals and human. However, when the concentration increases it will become toxic and hazardous for the health and the balance of the environment itself (Geoffrey K. Kinuthia , etal ; 2020). The uncontrolled release of Petroleum and its products into soils and groundwater has become a significant problem (Foley J.Ramankutty, etal ; 2011) . Spilled oil endangers public health devastate natural resources and makes soils to be less useful for agricultural activities with soil dependent organisms being adversely affected (Njokuet al; 2008). Human activity is a primary source of Hg contamination and with drastic health consequences resulting from its uptake through the food chain. It has been documented that zinc smelting plants result in some of the greatest anthropogenic contributors to Hg emission (Nriagu and Pacyna, 1988), have also been used to minimize variations associated with soil logical differences in the samples when the primary goal is to document variations in the contaminant concentrations for the purpose of source damage identification.

2 -MATERIALS AND METHODS:

2-1: Description and samples collection of the study area:

The samples were collected from the study site during January 2021 in central oil company as a contamination site with petroluem hydrocarbons in Baghdad city .

2-2: Sampling:

•Plant samples: Seven (contaminated) leaf plants samples were collected with 3 replicates of each samples, then dried outdoors at room temperature for 3-5 days, then grinded with a mill and sifted with a 1 mm diameter sieve to be ready for analysis.

• Soil Samples one soil samples were collected from contamination sites with 3 replicate of sample by using cleaned polyethylene bags from 30 cm in depth.

2-3 : Mechanical working of Milestone's Direct Mercury Analyzer (DMA-80):

Directly analysisinto metal boat or quartz and then transfer sample from DMA-80 to the analytical balance need five minutes for one sample, no need acid digestion. The sample boats loaded on to instrument auto sampler, first dried then thermally decomposed in furnace oxygen. Mercury, Nitrogen, Hydrogen, Carbon and combustion products released from the sample and carried to the catalyst section furnace, where sulfur oxides and nitrogen. Mercury (Hg) is flown by the transferor gas into path of the spectrophotometer where it is quantitatively measured. All systems of information a kept on a windows-based computer and software, providing simple and intuitive, Sample parameters including method profile, furnace temperatures, absorbance signals according to (USEPA, 2006).

Method validation was used as certificate reference material CRM as in Table (1) (Gaithersburg, 2017) was utilized to assess the accuracy of the method. Developed spike recoveries were performed on this material as well as samples according to Ataroet al., (2008) and Nascimentoet al., (2008). This principle was used for all sample analysis. This typically contains an automatic sampler, quartz furnace, cobalt-manganese oxide catalyst, gold-coated sand amalgamator and an atomic absorption detection cell with three different path lengths (120,165 and 4mm). The method for solid sample analysis consists of placing a known amount of milled sample in a nickel or quartz boat (Sample holder). The sample is introduced in the quartz furnace, where it is heated up to 200 °C (drying temperature) for 600-1000 C, Maximum temperature allowed by the software of equipment about 105 which set a limit mercury volatilization and reduction of Oxygen O2 (99.99%) (MDE. 2014b).

Table (1): Method validation was used as certificate reference material CRM

Wavelength	Step	Time	CRM and SRM	Type
Gas Flow (L min-1)	150	12 min	IAEA-140TM	Plants
Plasma 15	170	16 min	TORT-2	Soil
Auxiliary 0.2	100	15 min	DORM-2	Blank
Nebulizer 0.8	100	10 min	0	Blank
Read delay (s) 75	200	25 min	NIST 2709	Plants
Replicates 3	175-200	One time to each	SRM-1974b	Soil
Probe in sample (n)	100	10	0	Blank

2-4: Sample Preparation for Analysis by Top Wave:

Determination the presence of Pb Element by using Atomic spectrometer contra 700 type and has been examined in the Ministry of Commerce/General Company for Foodstuff Trading / quality control division. This method identifies the concentration of Pb in samples used, before that all samples must be converted to liquid.

In soil samples weigh 3.5g of the samples to the digestion vessel. The amount of organic material should not exceed 250mg. Then add 2.5ml of HNO_3 %65 and 7.5ml of HCl37% to the samples.(APHA, 2005) .

In plants samples weight 0.3g of samples and place them in the digestion vessels and add 7.5 ml of nitric acid HNO_3 %65 ,after that shake the mixture carefully or stir with clean glass bar. necessary wait at least 2min before the vessel is closed, Heat in the Microwave oven with the following program to avoid foaming and splashing wait until the vessels have cooled the same room temperature about (20 min).The digestion vessel is carefully opened in fume hood wearing hand Eye and body protection since a large amount of gas would be produced during the digestion process, then they were quantitatively transferred to Falcon tubes and diluted to 15 ml with deionized water to examined by the Atomic spectrometer (APHA, 2005).

3- Results and Discussion:

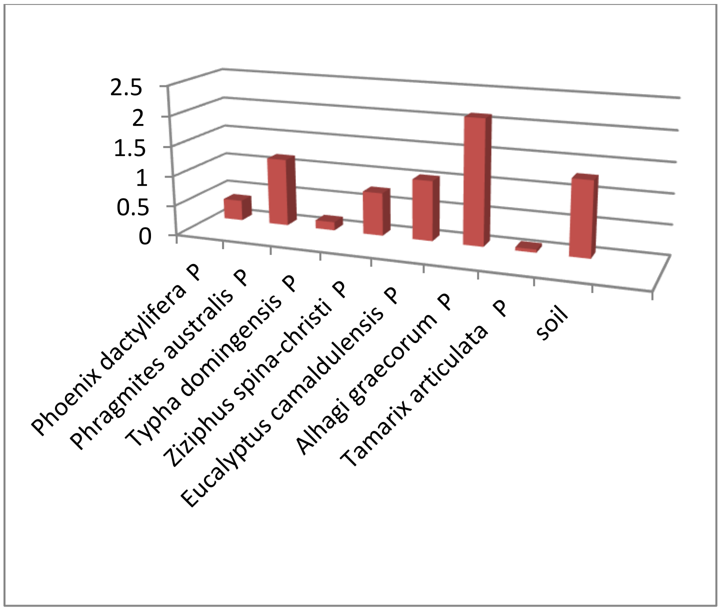
3-1 : Elements concentrations:

The elements were measured of dry leaf plant and soil samples to monitor the quantity cumulative ratios which are:

A-Concentration Lead between plants and soil :

Results of lead element showed the presence of concentration in plants was differing from types depending on the ability to absorb this element. Through statistical analysis scored a significance between element and plants in a percentage of the corresponding the highest correlation coefficient between plant and soil was recorded R^2 value [(51% in Phoenix dactylifera), (47% in Typhadomingensis) and 47% in Alhagigraecorum] , this is consistent with some of the researchers in local studies (Ajmi, 2010) found (Pb element in Typhadomengensis between (14.1-17.5)ppm .

These indicate that plants are known in accumulating elements from around its environment according to (Al-Haidary, 2009 and Ajmi, 2010).The rate of absorption of carbon was a high , its being the most plants play an important role in circulating nutrients and trace metals in ecosystems according to (Pip and Stepaniuk,2020) and due to their high capacity in uptake of nutrients and other pollutants from treatment (Brancovicet al .,2010). Figure (1) Showed the concentration



Lead between plants and soil.

Fig (1): The concentration Lead between plants and Soil

A-Concentration Mercury between plants and soil :

Results of mercury element showed the presence of concentration in plants was differing from types depending on the ability to absorb this element . Through statistical analysis scored a significance between element and plants in a percentage of the corresponding the highest correlation coefficient between plant and soil was recorded R2 value [(51% in Phoenix dactylifera), (47% in Typhadomingensis) and 47% in Alhagigraecorum] , this is consistent with some of the researchers in local studies (Ati, 2017) found Hg in Phragmitesaustralis between (2.3- 1.9 ppm),Also in local studies (Ajmi, 2012) found Typhadomengensis between (14.1-17.5 ppm) and Phragmitesaustralis between (8.6-13.8 ppm)

These indicate that plants are known in accumulating elements from around its environment according to (Al-Haidary, 2009 and Ajmi, 2010).The rate of absorption of carbon was a high , its being the most plants play an important role in circulating nutrients and trace metals in ecosystems according to (Pip and Stepaniuk,2020) and due to their high capacity in uptake of nutrients and other pollutants from treatment (Brancovicet al .,2010). Figure (2) Showed the concentration Mercury between plants and Soil.

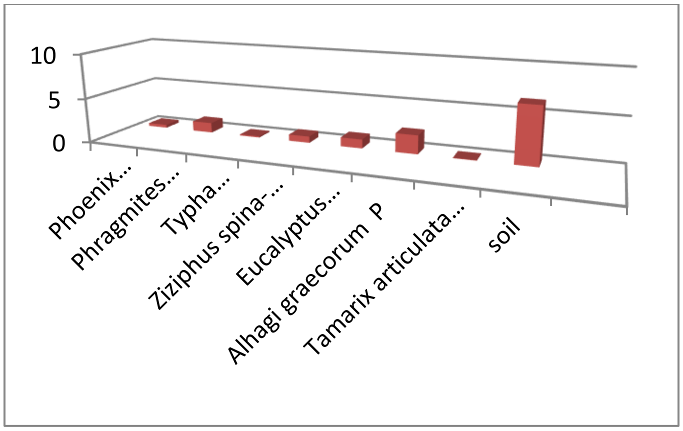


Fig (2): The concentration Mercury between plants and Soil

Table (2) The concentration of elemental in leaf plants and soil in polluted area .

Types of Plants	Mercury	Lead
Phoenix dactylifera	0.19	0.317
Phoenix dactylifera	1.53	0.371
Phoenix dactylifera	2.55	0.345
Mean ± SD	1.42±1,23	0.34±1.01
Phragmitesaustralis	3.11	2.7
Phragmitesaustralis	1.53	0.371
Phragmitesaustralis	2.55	0.345
Mean ± SD	2.37±0.92	1.17±1.22

Table (3) The concentration of elemental in leaf plants and soil in polluted area .

Types of Plants	Mercury	Lead
Typhadomingensis	0.11	0.32
Typhadomingensis	1.03	0.09
Typhadomingensis	1.83	0.01
Mean ± SD	0.99±0.11	0.14±0.02
Ziziphusspina-christi	1.81	1.9
Ziziphusspina-christi	0.93	0.12
Ziziphusspina-christi	1.35	0.15
Mean ± SD	1.36±1.12	0.72±0.04
Eucalyptus camaldulensis	2.41	1.2
Eucalyptus camaldulensis	1.93	0.99
Eucalyptus camaldulensis	2.35	0.84
Mean ± SD	2.23±1.21	1.01±0.98
Alhagigraecorum	2.54	1.339
Alhagigraecorum	3.11	2.97
Alhagigraecorum	2.54	1.99
Mean ± SD	2.73±1.29	2.09±1.39
Tamarixarticulata	1.92	1.7
Tamarixarticulata	0.99	0.11
Tamarixarticulata	1.03	0.15
Mean ± SD	1.33±0.99	0.65±0.03

Table (2) The concentration of elemental in soil of polluted area .

Soil Samples	Mercury	Lead
Soil	5.19	1.117
Soil	6.53	1.521
Soil	7.55	1.145
Mean ± SD	6.43±2.23	1.26±1.53

According to the tables (2,3,4) we note the high percentage of concentrations of the two elements lead and mercury in the soil and plants and this indicates the strength of the plant in biological treatment and its ability to withstand pollution in absorbing pollutants from soil contaminated with oil residues on the side of the central oil company.

4- **Conclusion** :

The high concentration of elements in leaf plant refers to uptake of inorganic complexes because of their higher surface area compared to their volume according to (MDE. 2014a, MDE. 2014b). Therefore,it may be considered one of the most harmful minerals and the extent the influence of the surrounding environment used it as a result of events and damage to plants .The normal level of lead element in the leaf tissues of mature plant growing on uncontaminated soil ranges from (0.01-0.1ppm).It is toxic to the plant if (3ppm) (UNEP, 2012). In studied conducted in a mining area in Hamidan Province in the western part of Iran, the amount of lead in leaf plant Typhadomengensis of the studied site was (2.33 ppm) (MDE. 2017). The amount as mining site in our study produces large amounts of lead pollutants.

5-REFERENCES:

- **Abbas, M. H., &Abdelhafez, A. A.**(2013). Role of EDTA in arsenic mobilization and its uptake by maize grown on an As-polluted soil. Chemosphere, 90(2), 588-594.
- **Ajmi, R. N.** (2010).Biogeochemical Assessment of some heavy metals in Al-Hammar marsh by using GIS. PhD Thesis to college of science/ University of Baghdad,170pp.
- **Ajmi, R. N.** (2012). An investigation of elements (mercury) status in marshes in south of Iraq. Journal of Environmental Science and Engineering. A, 1(10A), 1211.

- **Al-Haidarey, M. J. S**. (2009). Assessment and sources of some heavy metals in Mesopotamian marshes (Doctoral dissertation, Ph. D. thesis, College of Science for Women, University of Baghdad, 275pp.
- **APHA, A.** (2005). WEF, 2005. Standard methods for the examination of water and wastewater, 21, 258-259.
- **Ataro, A., McCrindle, R. I., Botha, B. M., McCrindle, C. M. E. &Ndibewu, P. P.** (2008).Quantification of trace elements in raw cow‟s milk by inductively coupled plasma mass spectrometry (ICP-MS). Food Chem., 111(1):243-248.
- **Ati, E. M.** (2017). Bioindicator of Mercury and Isotope Stable Radioactive Elements in Missan Marshlands by Geographic Information Systems (GIS).Msc. Thesis, boil. Dep. Coll. of science, MustansiriyahUniversity.page 47-54.
- **Brancovic, S., PavlovicMuratspahic, D., Topuzovic, M., Glisic, R., Stankovic, M.** (2010).Concentration of some heavy metals in aquatic macrophytes in reservoir near city Kragujevac (Serbia).Secend Balkan Conference on Biology, Plodiv :21-23
- **Foley, J. A., Ramankutty, N., Brauman, K. A., Cassidy, E. S., Gerber, J. S., Johnston, M., ... &Zaks, D. P.** (2011). Solutions for a cultivated planet. Nature, 478(7369), 337-342.
- **Gaithersburg K** ,(2017) c. Preliminary Background Report- Amended SDP-7362-2016: Kentland Apartments. http://www.gaithersburgmd.gov/~/media/city/documents/government/city_projects/kentlands_apartments/preliminary_staff_analysis.pdf. Accessed 18 December 2017.
- **Geoffrey K. Kinuthia , Veronica Ngure, DunstoneBeti, Reuben Lugalia, Agnes Wangila and Luna Kamau** (2020) . Levels of heavy metals in wastewater and soil samples from open drainage channels in Nairobi, Kenya: community health implication,Scientific Reports, 10:8434.
- **MDE. 2014a**. Water Quality Assessment Report: Seneca Creek Basin. Accessed 20 November 2017.
- **MDE. 2014b**. Water Quality Assessment Report: Potomac RiverMontgomery County Basin. Accessed 20 November 2017.
- **MDE. 2017**. Fact Sheet Reissuance of the NPDES General Permit forDischarges from Small Municipal Separate Storm Sewer Systems (MS4). Accessed 2 November 2017.
- **Nagajyoti, P. C., Lee, K. D., &Sreekanth, T. V. M.**(2010). Heavy metals, occurrence and toxicity for plants: a review. Environmental chemistry letters, 8(3), 199-216.
- **Nascimento, E.A., Chang, R., Morais SAL, Piló-Veloso, D. and Reis, D.C.** (2008). Um marcadorquímico de fácildetecçãopara a própolis de alecrim-do-campo (Baccharisdracunculifolia). Rev Bras Farmacogn (18): 379- 383.
- **Njoku, K. L., Akinola, M. O., &Oboh, B. O.** (2008). Growth and performance of Glycine max L.(Merrill) grown in crude oil contaminated soil augumented with cow dung.
- **Nriagu, J. O., &Pacyna, J. M**. (1988). Quantitative assessment of worldwide contamination of air, water and soils by trace metals. nature, 333(6169):134-139.

- **Ok, Y. S., Oh, S. E., Ahmad, M., Hyun, S., Kim, K. R., Moon, D. H., ...& Yang, J. E.** (2010). Effects of natural and calcined oyster shells on Cd and Pb immobilization in contaminated soils. Environmental Earth Sciences, 61(6), 1301-1308.
- **Pip, E., &Stepaniuk, J.** (1992). Cadmium, copper and lead in sediments and aquatic macrophytes in the Lower Nelson River system, Manitoba, Canada: I. Interspecific differences and macrophyte-sediment relations. ArchivfuerHydrobiologie AHYBA 4, 124(3).
- **UNEP.** (2012).Annual report.www.unep.org/annual report.
- **USEPA** United States Environment Protection Agency, (2006). method NO.7473.