

Estimation Concentration of Lead, Cadmium and Cobalt in Al Guarshah Agricultural Project Soil

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Abstract: Soil samples were collected from Al Guarshah Agricultural Project and analyzed. Three different heavy metals Cadmium, Cobalt and Lead. Seven samples (total 24 subsamples) were collected from different places using auger at different depths (from 0.00 to 100cm). Collected samples were dried at air and sieved into course (< 2mm) and fine fractions. Sieving samples were achieved using by mechanical sieving apparatus which is consisted of different sizes of meshes (10.0- > 0.075 mm). After rolling the samples to break down the large masses of soil particles, well mixed samples of 2 g each were taken in 250 ml glass beakers-and digested with 8 ml of aqua regia on using a sand bath for 2 hours. After the majority of dissolved samples were evaporated, 10 ml of 0.25 M of HNO₃ was added to the samples and then filtered and diluted to 50 ml with distilled water. Extracted samples were measured by atomic absorption

Keywords: Sampling, Heavy metals, Soil, Atomic absorption spectrometry

1. Introduction

Soils are reservoir for many harmful constituents, elements, trace metals and biological organisms. Total metals content of soils are useful for many geochemical applications but often the speciation (bioavailability) of these metals is more of an interest agriculturally in terms of what is biologically extractable.[1] Heavy metals contamination of soil results from anthropogenic such as mining, smelting procedures and agriculture as well as natural activities. Chemical and metallurgical industries are the most important sources of heavy metals in the environment.-The Metals are can be classified as heavy metals if in their standard state they have a specific gravity of more than 5 g/cm³. There are known sixty heavy metals. In small concentrations, the traces of the heavy metals in plants or animals are not toxic, but lead, cadmium and mercury are exceptions; they are toxic even in very low concentrations .Theoretically every 1000 kg of normal soil contains 200 g chromium, 80 g nickel, 16 g lead, 0.5 g mercury and 0.2 g cadmium. [2]

The pH of soil is an important factor to a controlling leaching of many metals from contaminated soils; However. The greater of acidity, the more of metals are leached out. [3]

Cadmium is classified as a human carcinogen by the National Institute for Occupational Safety and Health (NIOSH). Absorption of cadmium through the skin is low (0.5%) and would be of could be concerned of only in situations where concentrated solutions would be in if it contacts with the skin for several hours or longer. Cadmium binds to epidermal keratin when applied topically, thus explaining the limited dermal absorption observed *in vitro*. However, significant dermal exposure as could occur in an occupational setting can cause irritant dermatitis.[4] The input of cadmium to the soils is from both natural and anthropogenic sources. Natural sources include underlying bedrock or transported parent material such as alluvium. The cadmium in soils occur at very low levels, but it is added to the soils by other products such as, fertilizers, phosphogypsum, certain zinc additives, biosolids (sewage sludge), manures and other wastes. Cadmium added to the

soil remains for a long time and it may take about 100 to 1000 years for leaching of cadmium from the soil to half. The higher concentrations of cadmium have been reported in different rocks and ores. Cadmium in agricultural soils is relatively immobile but become mobile under acidic conditions. The chemistry of cadmium in soil is controlled by the pH. Cadmium mobility increases with a decreasing pH of the soil. The guideline value for cadmium content in agricultural soils is 5.0 ppm [5]

The occurrence of Cobalt in the earth's surface varies greatly. This element cannot be found in its native form; it is found only in meteorites. Cobalt is most often found in the form of arsenides and sulphides. The most important cobalt minerals are cobaltite, linnaet, smaltyn and karrolit. The source of cobalt pollution (apart from industrial waste) is the burning of cobalt. Cobalt occur at oxidation number ranged from -1 to +4, but naturally it occurs as a double valence cation Co²⁺ (cobalt compounds). In effect of environmental conditions. It is easily undergoes to oxidation forms Co²⁺ to Co³⁺ which leads to forming complex anion of Co(OH)₃³⁻. It becomes relatively easily mobile in acidic oxidizing environments, but does not undergo extensive aqueous migration, since it combines with the hydroxides of iron and manganese as well as salty minerals [6]

The main source of Soil contaminated by lead is anthropogenic it cannot biodegradable or decay and is not rapidly absorbed by plants. However it remains in the soil at elevated levels. Lead is estimated to have a half-time of residence in soil of 1,000 years..Atmospheric lead is retained in the upper 2 to 5 centimetres of undisturbed soil.. EPA estimates that 23 %, or 18 million who have privately owned homes in the United States which built before 1980 have soil-lead levels above 400 parts per million (ppm); that 3 %, or 2.5 million, have levels exceeding 2,000 ppm[7]

2. Materials and Methods

Sampling

Seven samples (total 24 subsamples) were collected from different sites by using auger at different depths ranged from 0.00 to 100cm. The used auger is suitable for sampling hard

soils. It consists of a sharpened spiral blade attached to a central metal rod which can be screwed into the soil. The auger was screwed to the desired depth and the sample was collected

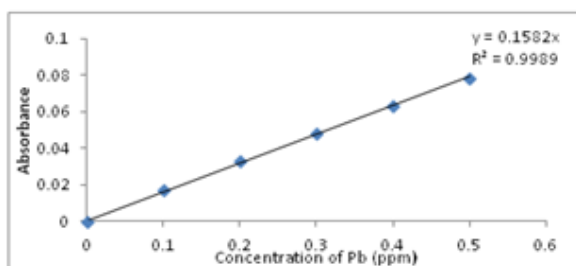
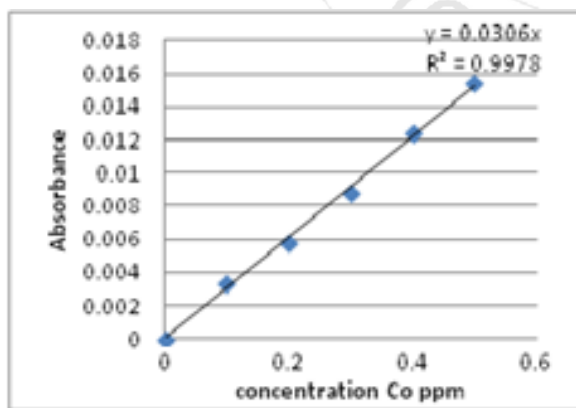
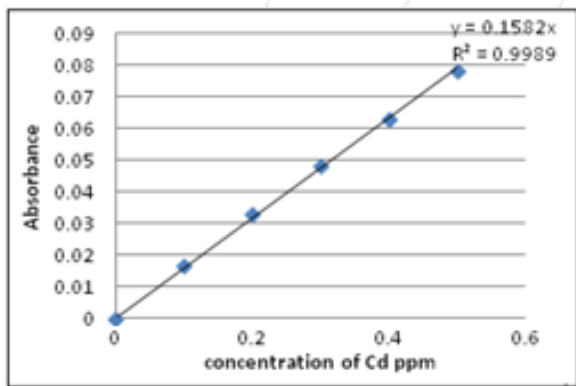
Sample Preparation

Collected samples were air dried and sieved into course (< 2 mm) and then fine fractions. Sieving was achieved by mechanical sieving apparatus. It consists of different sizes of meshes (10.0- > 0.075 mm) after rolling the samples to break down the large masses of the soil particles. [8], [9], [10] and [11]

Mixed of 2 g of each sample was dissolved in 8 ml of aqua regia in 250 ml glass beakers and then digested using sand bath for 2 hours. After the majority of solution is evaporated, a 10 ml of 0.25 M of nitric acid was added, filtered and then diluted to 50 mL with distilled water. [12] metals cadmium, Cobalt and Lead was analyzed through atomic absorption spectrophotometer model novAA300

3. Results and Discussion

The calibration curves for heavy element solutions as determined by AAS are shown in Figures 1



The values for each sample soil, individually, are summarized in the following six tables:

Table 1: Sample (1) Shows concentrations of Cd, Co and Pb in different depth

Depth	Cd (µg/g)	Co (µg/g)	Pb (µg/g)
0-20	0.8500 ± 0.00135	2.7875 ± 0.01780	10.4100 ± 0.08878
20-40	0.7760 ± 0.00138	5.705 ± 0.01525	10.8350 ± 0.08880
40-60	0.8597 ± 0.00112	6.92 ± 0.0528	10.9600 ± 0.08835

Table 2: Sample (2) Shows concentrations of Cd, Co and Pb in different depth

Depth	Cd (µg/g)	Co (µg/g)	Pb (µg/g)
0-20	4.3275 ± 0.0903	4.3275 ± 0.01567	8.990 ± 0.0899
20-40	1.11425 ± 0.0031	6.13 ± 0.01518	8.650 ± 0.08920

Table 3: Sample (3) Shows concentrations of Cd, Co and Pb in different depth

Depth	Cd (µg/g)	Co (µg/g)	Pb (µg/g)
0-20	0.7760 ± 0.0028	5.6425 ± 0.01518	12.8475 ± 0.08689
20-40	2.2810 ± 0.001334	9.5775 ± 0.01761	11.235 ± 0.08813
40-60	4.440 ± 0.002914	8.5925 ± 0.01643	12.3125 ± 0.08730
60-80	3.74750 ± 0.00288	9.5775 ± 0.01761	9.060 ± 0.0894

Table 4: Sample (4) Shows concentrations of Cd, Co and Pb in different depth

Depth	Cd (µg/g)	Co (µg/g)	Pb (µg/g)
0-20	4.5875 ± 0.002927	11.8075 ± 0.02129	14.5875 ± 0.08558
20-40	2.8625 ± 0.0279	12.555 ± 0.0227	16.615 ± 0.08108
40-60	2.7725 ± 0.0279	13.2925 ± 0.02425	13.686 ± 0.08626
60-80	2.71 ± 0.02795	13.7 ± 0.02521	15.7975 ± 0.08468
80-100	3.25 ± 0.02795	39.475 ± 0.00030	21.4325 ± 0.08069

Table 5: Sample (5) Shows concentrations of Cd, Co and Pb in different depth

Depth	Cd (µg/g)	Co (µg/g)	Pb (µg/g)
0-20	2.8575 ± 0.02795	40.275 ± 0.00357	17.605 ± 0.08336
20-40	4.415 ± 0.002911	46.3 ± 0.00031	16.595 ± 0.08410
40-60	2.9175 ± 0.002911	45.125 ± 0.01691	15.640 ± 0.08480
60-80	3.925 ± 0.002796	56.9125 ± 0.02050	14.300 ± 0.08579
80-100	4.4025 ± 0.002910	54.825 ± 0.01977	16.765 ± 0.08397

Table 6: Sample (6) Shows concentrations of Cd, Co and Pb in different depth

Depth	Cd (µg/g)	Co (µg/g)	Pb (µg/g)
0-20	4.445 ± 0.002914	65.650 ± 0.02392	18.815 ± 0.08250
20-40	3.925 ± 0.002864	68.425 ± 0.02509	16.585 ± 0.08410
40-60	4.368 ± 0.002907	59.750 ± 0.02156	15.285 ± 0.08506
60-80	3.035 ± 0.0799	82.962 ± 0.01985	20.320 ± 0.08145

Table 7: Sample (7) Shows concentrations of Cd, Co and Pb in different depth

Depth	Cd (µg/g)	Co (µg/g)	Pb (µg/g)
0-20	4.5675 ± 0.00925	54.825 ± 0.01234	20.3925 ± 0.08153

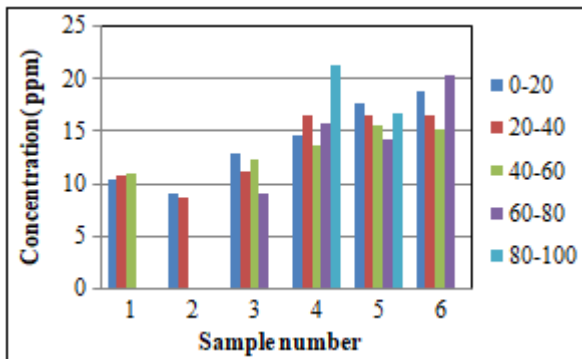


Figure 4: Show the relation between the sample position and concentration of Lead

From tables (1-7) and figure (4), the results of analysis samples showed that there were small significant differences for lead between the samples sites and the concentrations. In tables (1-3), the lead concentrations are ranged between 8.650 - 12.85 mg/l and the location of these samples are far from the road of the Al Guarshah Agricultural Project soil. While the results in tables 4 show that the highest lead concentrations levels are ranged between 13.6860 and 21.4325ppm ($\mu\text{g/g}$), which are closed to the road. Lead can be mobilised from soils in surface run-off following heavy rain. Generally, the downward movement of Pb through the soil as a result of leaching is very slow. Leaching of lead can be accelerated when the solution of pH decrease due to acidic rainfall [13]

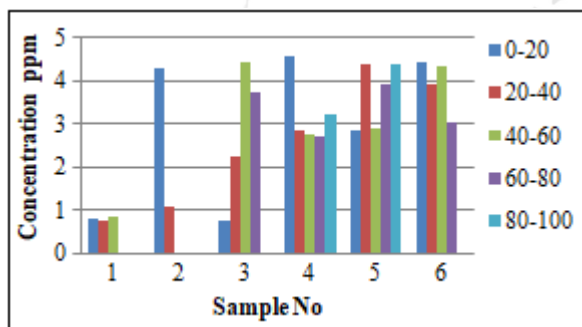


Figure 5: Show the relationship between the sample position and concentration of Cadmium

From tables (1-7) and figure (5), it is clear there is no a significant differences in the concentrations of the cadmium difference depths. Cadmium concentrations are ranged between (0.7760-4.5875 $\mu\text{g/g}$). Cadmium concentrations levels are found lower than the other two metals in soil. Cadmium is much less mobile in soils than in air and water.

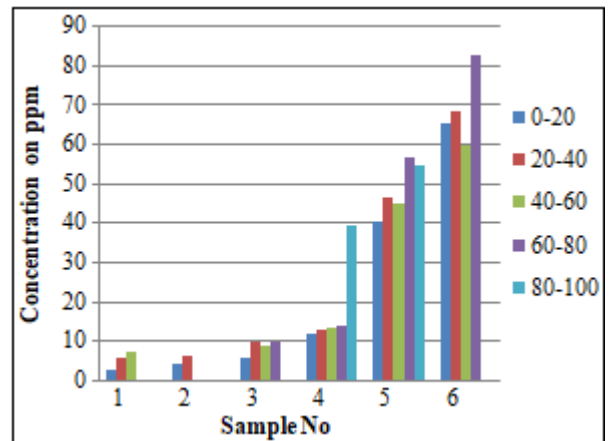


Figure 6: Show the relation between the sample position and concentration of Cobalt

From tables (1-7) and figure (6) we noted that low levels of cobalt are in samples (1-4) because this region far away from the sewage deposition. Samples from 5-7, contains high values (11.8075- 82.962). This is because these samples were collected from near of the road (arid soil)

Factors affecting the speciation sediments, and soil include organic ligands such as humic acids, anions, pH, and redox potential. The soil mobility of cobalt is inversely related to the strength of adsorption by soil constituents. Although plants may take up cobalt from the soil, the translocation of cobalt from the roots to other parts of the plant is not significant.[14]

Soil mobility of cobalt is inversely related to the strength of adsorption by soil constituents. The adsorption of cobalt to soil occurs rapidly, within 1–2 h. Mineral oxides such as iron and manganese oxide, and organic substances can retain cobalt. Soil oxides adsorb larger levels of cobalt than do other materials. Clay minerals adsorb relatively smaller amounts of cobalt. Desorption of cobalt from soil oxides is low. Adsorption in clay soils is most likely due to ion exchange at cationic sites of clay with simple ionic cobalt or hydrolysed ionic species such as CoOH^+ . Adsorption of cobalt with iron or manganese increases with pH As pH increases, insoluble hydroxides and carbonates may form that also reduce cobalt mobility. In contrast, adsorption to mobile colloids would enhance cobalt mobility. Typically, cobalt is more mobile than other metals, such as lead, chromium (II), zinc, and nickel, in soil, but less mobile than cadmium accounted for 84–95% of sorption variation [15].

4. Conclusion

Results obtained from this study showed that lead levels obtained exceed the allowed limit according to the international standard. Cobalt content in soils very high in the sites near the road. Cadmium results slightly high and may be increase during time if the sewage added continuously.

Possible sources of heavy metals may come from internal sources such as building paint residues. Heavy metals concentration decreases with distance from the road due to metals emitted from Throw sewage. The sewage must be treated before introduced to the soil

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