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SPECTROPHOTOMETRIC DETERMINATION OF ZINC METAL CONTENT FROM SOIL IN TURBAT CITY-MAKRAN REGION, BALUCHISTAN, PAKISTAN

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Abstract

In the course of time, soil as the essential human habitat in which they depend and from which they make their living has been subjected to various types of pollution resulting more from anthropogenic influences than from natural causes. Anthropogenic activities resulting from urbanization, industrialization, and agricultural practices like fertilizer, pesticide, and herbicide application Of course heavy metals still exist, but only at toxic levels. Since such metals are possible environmental pollutants and harmful to living beings, the quality and availability of heavy metals in heavily agricultural soils are important concerns. The objective of this study was, therefore, to assess the amounts of zinc (Zn) the vital metal present in soil of four agricultural fields of Turbat City, Makran region, Balochistan, Pakistan. The collected samples from four different areas are placed in clean plastic bags. Using UV / Visible Spectrophotometer, soil samples were analyzed and absorbance was recorded as 213.90 to 214 nm. The results show that soil sample content in Zn ranged from 1.70 to 1.27 mg /g. The study findings above show that zinc metal is present in Turbat City's studied areas, and the level of normal soil zinc concentrations ranges from 1 to 900 µg / g, as recommended by the WHO. It indicates that the analyzed results of zinc metal from the subjected areas can have serious effects on human health and can also affect the growth of plants.

Keywords: *Agricultural Soil, Heavy metals, Human Health, Physical and Chemical Parameter.*

INTRODUCTION

The soil is a valued natural resource on which directly or indirectly depends man's life. It is a medium for growing plants and storing water and it is a shelter for organisms. Besides being substrates for agricultural production and construction, the soil also acts as sinks for contaminants that originate mainly from industrial processes. [1] Soil is the final accepter of different contaminants. Contamination of the soil is caused by direct oil and waste water spills, use of fertilizers and pesticides, unintended or natural introduction of organic and inorganic compounds (fires, volcanic eruptions, etc.), movement of air pollutants by dry and wet deposition. [2] A significant contemporary concern with indiscriminate manufacturing processes that can produce substances that contain toxic metals known as heavy metals. Heavy metals are classified as metals that occur naturally in the earth's crust and show more than 5 g cm of normal gravity −1. These metals include lead (Pb), mercury (Hg), arsenic (As), cadmium (Cd) , chromium (Cr), and higher micronutrient levels (e.g., iron (Fe) , copper (Cu), nickel (Ni) and zinc (Zn)). [3] It has been noted that lead, cadmium, copper, and zinc are the main metal contaminations in roadside conditions and are discharged from years in lead enriched fuel burning, tire wear, oil spillage, and battery and metal parts corrosion, such as radiators, etc. [4] The presence of these heavy metals even at low concentrations can potentially affect the quality of the environment and human health, and can pose a long-term risk. [5] Industries pursuing this

process (Soil-Plants – Man) release heavy metals into the environment; heavy metal (HM) from the soil travels to plant tissues and fresh vegetable surfaces, which are primarily for consumption. Such vegetables are irrigated with untreated wastewater discharged into the rivers from factories and can be a source of HM exposure to humans due to excessive consumption, resulting in adverse health effects. [6] The release of heavy metals into the environment may be triggered by both natural and anthropogenic processes. The biohazard nature of metals has caught global interest, contributing to increased public awareness and studies on the toxicity and persistence of metals in earth's ecosystems. [7] Soils have 4 important segments. Such as mineral matter, natural matter, air, and water. As a rule the standard soil check is 45% minerals, 25% water, 25% air, and 5% natural matter. [8] The Cd, Mn, Cu, Pb , Ni, and Zn levels of natural soil depend on the material of origin and the degree of pedo-genesis, thus occurring at low concentrations that do not endanger human health or the environment. [9] But soils differ across the countryside, and each soil contains specific concentrations of trace elements based on its parent material and other soil-forming factors which may have added or removed these elements from the soil. [10] Chemicals such as inordinate metals once acquainted with the Earth by one specific technique will spread to various environmental portions which can be accomplished by the likelihood of interactions arising in this ordinary structure. Overwhelming metals may interact synthetically or physically with the specific mixes that alter their presence types in nature. They may respond by changing oxidation states and accelerating with specific species. [11]

The goal of the current study was to assess the concentration of zinc metal in soils from four important regions of Turbat City, Makran area. Because the subjected regions are primarily used for agricultural purposes, the public then consumes the vegetables from these regions, and it is the utmost necessity of the day to explore the concentrations of such essential nutrients and to make their public health impact known.

METHODOLOGY

All of the chemicals and reagents used were of analytical grade including hydrochloric acid (HCl), nitric acid (HNO_3), distilled water, ethanol, and zinc solution. Sigma Aldrich (USA) obtained ethanol, and distilled water from Alfa Aesar (USA). [12]

SAMPLE COLLECTION

Soil samples from four separate areas of Kech Turbat City District, Turbat Balochistan, Pakistan were collected. Samples were collected around the sample area, at a depth of 10 cm. Soil samples were completely mixed and labelled with name and depth of area, and samples were stored in plastic bags. A number was given for each sample as Sample 1 Sample 2 Sample 3 and Sample 4. Sample 1 soil was collected on 24 August 2019 from Absor, Kech, Turbat, sample 2 from Jusak, sample 3 from Overseas Colony, and sample 4 from Gokdan, all collected at Kech, Turbat. *[13]*

SAMPLE TREATMENT

The soil samples were dried air for 2 days at ambient laboratory temperature, and dried for six hours at 105 ° C by oven. The samples of dried soil were then crushed, and 2.00 mm mesh sieved to obtain the representative samples. [14]

MOISTURE CONTENT DETERMINATION

Weighed the soil sample from the collection area, and then dried for 2 hours at 105 ° C. The sample in a desicator was removed and cooled, and weighed again. The weight loss was calculated by using the following equation to subtract the weight of the dry sample from the sample's original weight: [15]

$$\text{Moisture content (\%)} = \frac{\text{Loss in weight on drying (g)}}{\text{Initial weight of sample (g)}} \times 100$$

SOIL PH

The soil pH was measured in suspension 1:1 of soil water and 1:2 of soil 0.01 M of calcium chloride. The mixture was stirred for 30 minutes, and allowed for 1 hour of standing. After inserting the pH electrode into a partially settled suspension the pH reading was taken and the result was recorded as soil pH in the water and 0.01 M $CaCl_2$. Before usage, the pH meter was adjusted with pH to buffer, and the electrode washed with distilled water and cleaned after each reading with dry clean filter paper.[16]

PREPARATION OF STANDARD SOLUTION

To obtain a calibration curve by diluting stock standard solution of concentration 1000 ppm, the standard solutions of Zn metal under analysis were prepared at four to five different concentrations. 2 g of analysis grade granulated zinc metal purity (99.9 per cent) was dissolved in 30 ml 5 M HCl to create Zn stock solution. [17]

HEAVY METAL DETERMINATION IN SOIL SAMPLES

In the oven, 2 grams of the soil sample were dried & weighed using a top analytical balance, & It was then put in a 100 ml beaker washed with 20 ml distilled water + 10 ml nitric acid. Then 50 ml of freshly prepared aqua regia (12.5 ml, 1:1 HNO_3 + 37.5 ml HCl 1:3) were added into samples. The beaker was coated and heated for 1 hour at 80 ° C using hot plate. The mixture was permit to cool, & the digested samples were then filtered into a 100 ml volumetric flask by filter paper. Filtrate volume was then made with purified water up to the 100 ml. The concentration of heavy metal was calculated in all the soil samples using UV/ Visible spectrophotometer (UV 752(D), China). Before real analysis of the desired element, the four standard samples were also run in the system, and their absorbencies were read after analyzing the same element. The mean of each of the four standard samples was measured, and thus the detection limits for the desired element were determined. Calibration curve was then drawn for analysis of the desired feature. All of the samples were analyzed in duplicate and normal. [18]

RESULTS

The concentrations of zinc metal in soil samples, from four different areas of Turbat city are presented and discussed below. The results which were obtained from the analysis of soil samples are given by graphical representation.

Table 1: pH of Soil samples

Sources	Soil pH in H_2O	Soil pH 0.01 $CaCl_2$
Soil.1	5.7	5. 84
Soil.2	6.0	5.76
Soil.3	5.8	5.87
Soil.4	5.5	5.68

Sources: Current Research

CALIBRATION FOR ZINC STANDARD SOLUTION

By the help of the method of UV/Visible Spectrophotometer, a straight standard curve of calibration was drawn between concentrations of Zn varying from 10 to 50ppm. The correlation coefficient of the calibration curve was R=0.907, showing that the measure was very good at the given concentration. Therefore, the calibration curve was used to determine Zn concentration in the soil samples. Look at the **(Figure.1)** below.

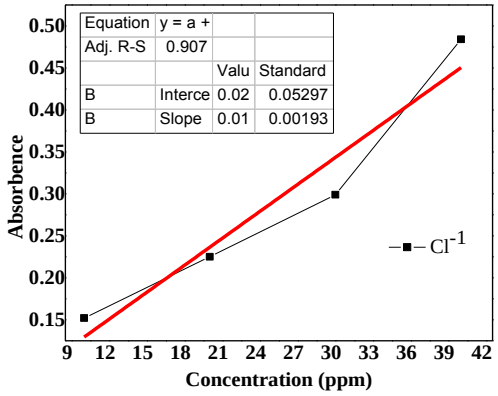

Figure 1. Graphical representation of calibration curve for zinc standard solution

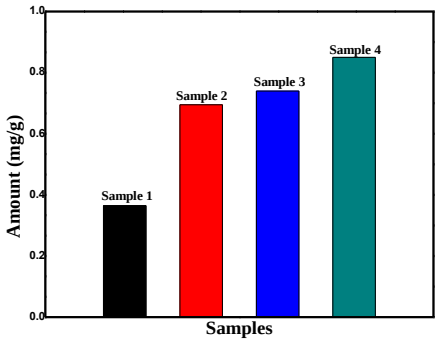

Figure. 2. Graphical representation for Zn content in soil samples from Turbat

ZINC (ZN) METAL CONTENT IN SOIL SAMPLES

The four soil samples from Turbat city were analyzed for the presence of Zn. The soil sample from Gokdan (Sample 4) showed the highest contents of Zn (1.70 mg/g), while the soil of Overseas (Sample 3) had the Zn concentration of 1.48 mg/g. Sample 3 (Jusak city Turbat) had the concentration of Zn of 1.39 mg/g, and the Sample 1 (Absor Turbat) had the lowest content of Zn of 1.27 mg/g **(Figure. 2).**

DISCUSSIONS

Heavy metals are toxic to humans and livestock, and are vulnerable to bioaccumulation in the food chain. In urban areas, heavy metals can come from several different sources. Atmospheric pollution is an important contributor to the accumulation of heavy metals in top-soils. [19] Excessive concentrations of heavy metals in polluted soils are responsible for observed delayed growth, varying growth rates & make the plants leaves yellowish-green. [20] Natural concentration of zinc in soil will range from 1 to 900µg / g, as suggested by the WHO. [21] In addition, soil pH is the most helpful calculation that can be performed to assess the soil properties. The salt content of the soil is a significant factor affecting the pH of soils. [22] Maximum growth in the range 5.5 to 6.0 was achieved for most species. There were nevertheless major variations in species' ability to expand beyond this range. [23]

CONCLUSION

For the selection of suitable remedial options, background knowledge of the sources, chemistry & potential risks of toxic heavy metals in polluted soils is required. Remediation of heavy metals in polluted soil is important to reduce the associated risks, to make the land resources

accessible for agricultural production, to boost food security & to reduce land tenure problems. Moreover, in this study we calculated the concentration of zinc metal from the subjected areas of Turbat region, ranged from 1.70mg/g to 1.27 mg/g and not the acceptable limits of WHO norms. We also noted the pH of the studied soils, which ranged from 5.5 to 6.0 and indicates that, the maximum growth of this range reached by most plants.

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