Trace Elements in Soil Systems

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Abstract: Trace the element in Soil Systems discusses the adverse effects or the essentiality of trace elements in soil under field and laboratory conditions. The trace elements are taken up by living industries of Jaipur, transferred to their sites of action, and function in different metabolic events. It explores how the trace elements occur in various chemical compounds with varying solubility's. It explores the principles governing the distribution of elements in minerals and also the Voltammetric studies of these soil samples. Soil sampling is the most vital step for any soil Analysis. As a very small fraction of the huge soil mass is used for analysis. It becomes extremely important to get a truly representative soil sample of the field.

Keywords: Lead, Zinc, Cobalt, Nickel

I. INTRODUCTION

Zinc promotes RNA synthesis, growth harmones, starch formation, seed maturation and production. Some other functional roles attributed to zinc include auxin metabolism, synthesis of cytochrome C, stabilizing ribosomal fractions and enhancing heat and frost resistance of plants at sharp temperature. It also appears to play a significant role in regulating uptake of mineral nutrients.

In cobalt the elements exert substantially positive influence on the reproduction of nodule bacteria. It also activates dehydrogenase, hydrogenase and nitrate reductase, increases the content of chlorophyll total hematin and Vitamin E generally associated with chlorophyll. The essentiality of cobalt, for the growth of symbiotic microorganisms such as rhizobia, free living nitrogen fixing bacteria and blue green algae is attributed to its role in the formation of B_{12}. It has also been reported to be one of the several metals that activate enolase and succinic kinase. It also improves growth, transpiration and photosynthesis, raises reducing activity and chlorophyll contents of leaves.

Nickel is involved in various physiological processes in plants. Nicked concentrations of 200 mg/kg result in death of plants in certain cases. It has been reported to affect the growth of beans. A reduction in dry matter yield was observed at nickel levels above 10 mg/kg for sandy soils. Corn yield has been reported to decrease with increasing levels of nickel. Strong toxic effects of nickel were observed on spring barley. There was also found a negative correlation between total C_2H_2 reduction and increasing distance along the transact corresponding to increasing soil concentration of nickel.

The Lead accumulation and distribution within the plant body have been comprehensively studied. Chronic ingestion of lead contaminated soil causes a potential health concern. Lead chloride negatively affects the yield of oat grain and decreases the yield of alfalfa hay. The compound has been reported to be highly phytotoxic. The growth of spinach and turnip was inhibited when lead was added to low pH alluvial soils. High concentrations of lead also disturb the physiological processes in plants and cause lower water consumption and low crop yield. The inhibition of copper translocation caused by lead was responsible for yield depression.

II. LEAD AND ZINC IN SOIL SAMPLES

All the experiments were performed on two instruments one is polarographic Analyzer model 174 A and another is microprocessor based polarographic analyzer model 384A supplied by EGeG Princeton Applied Research Cooperation USA.

2.1.1 Proposed Methodology: Soil samples of vishwakarma industrial area were also analyzed for lead and Zinc using DPP and DPASV. Ten different soil samples were taken from steel, pharmaceutical, food, chemical and soil textile industries of the area. Procedure for determination of lead and zinc in these soil samples of Sanganer area. The soil samples were oven dried and grinded thoroughly in a mortar top remove any lumps. The samples were then filtered through a 0.2 mm sieve. 2 grams of accurately weighed soil sample was taken in a beaker. To this, was added 5 ml of 1:1 HNO_3-HCI solution. The sample was heated up to dryness. Bumping was checked by heating the solution very slowly in the last phase of digestion. For complete digestion the procedure was repeated with another v5 ml of the acid solution. Excess acid was removed by heating the residue three times with the 5 ml fraction of triple distilled water. 25 ml of TDW was then added to the residue. The contents were boiled for fifteen minutes, cooled and filtered. Washings were done with hot tripled distilled water. The solution was transferred to volumetric flask and its volume was made up to the mark using triple distilled water.

2.1.2 Lead and Zinc in soil samples in Vishwakarma Industrial Area:

Representative differential pulse anodic stripping voltammograms for **zinc** determination in soil sample number 6 is shown in fig 5.25.
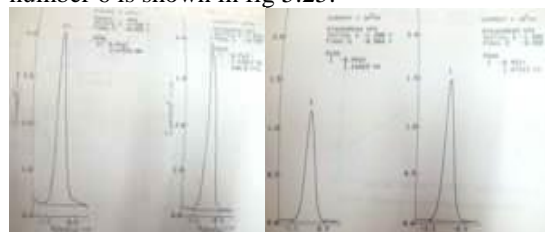
Fig: 5.25 differential pulse anodic stripping voltammograms for zinc

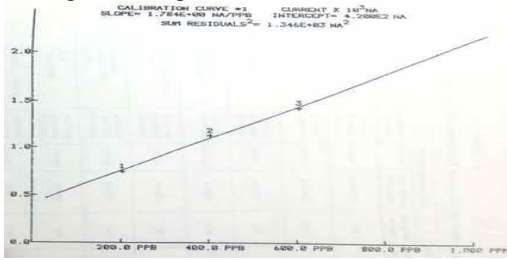Calibration curve of standard addition of zinc in soil sample number 2 is given in fig 5.26.

Fig5.26: calibration curve of zinc in soil sample

Table 5.5. Shows zinc contents in ten different soil samples of V.K.I.

Fig. 5.27 shows differential pulse anodic stripping voltammograms of **lead** in soil sample number 7 of V.K.I.
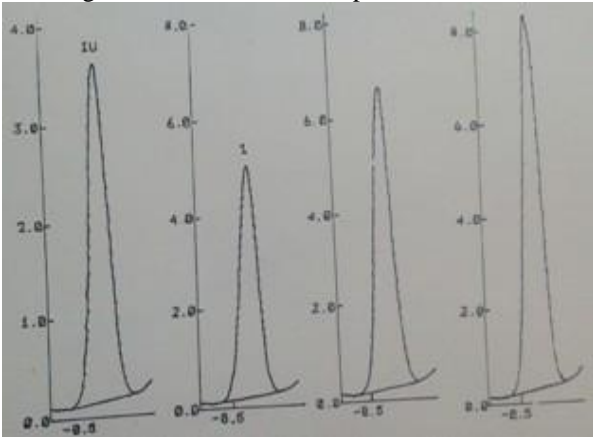

Fig 5.27 differential pulse anodic stripping voltammograms of **lead in VKI**

Calibration curve of lead in soil sample number 3 of the area is given in fig 5.28. which shows the linear relationship between peak height and concentration.
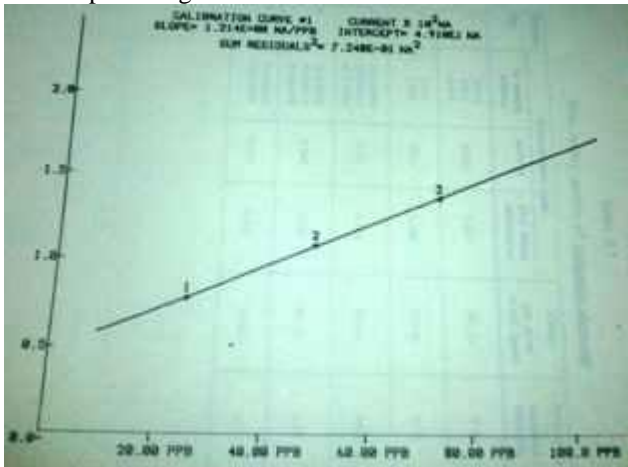

Fig: 5.28 Calibration curve for lead in VKI

Results obtained for lead estimations in these ten soil samples of V.K.I are given in table 5.6.

As is clear from the table, the results obtained are quite reproducible and standard deviation varies from 0.4% to 2.0% only except in a single case.

2.1.3 Lead and Zinc in soil samples of Sanganer industrial area:

Soil samples were collected from the dyeing, printing and washing industries of Sanganer industrial area. Samples were also taken from agricultural fields near these industries. Representative differential pulse anodic stripping voltammograms for zinc determination in soil sample is shown in fig. 5.21.
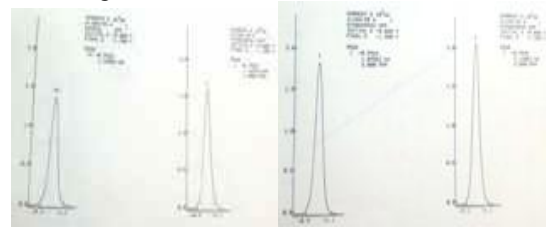

Fig 5.21 differential pulse anodic stripping voltammograms for zinc determination in soil sample

Calibration curve for standard addition in soil sample is given in fig 5.22. Table Shows the Zinc concentration in soil samples of Sanganer with its standard deviation.
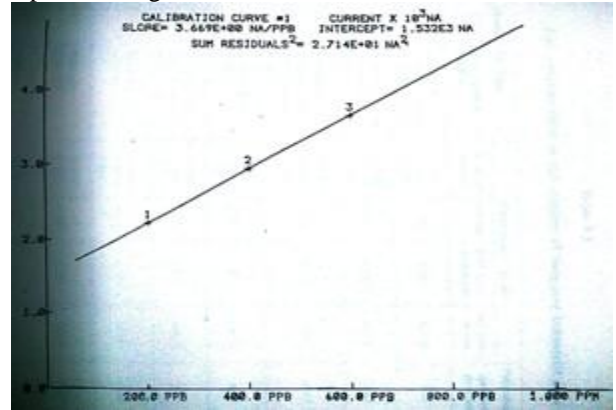

Fig22: Calibration curve of Zinc

Differential pulse anodic stripping voltammograms for lead in soil sample 3 of Sanganer industrial area is given in fig 5.23.
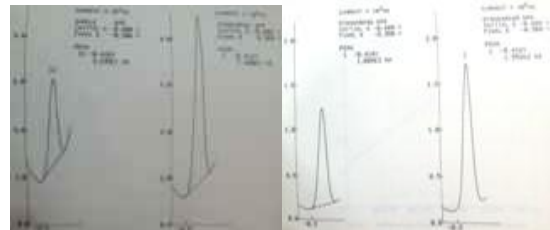

Fig 5.23: Differential pulse anodic stripping voltammograms for lead

Calibration curve of standard additions of lead in soil samples of the area is given in fig 5.24.
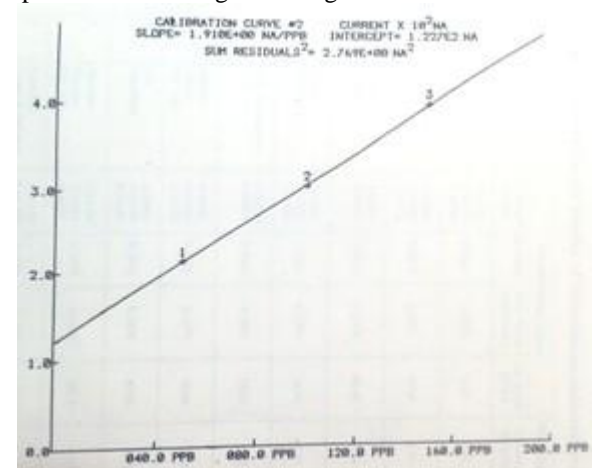

Fig 5.24 Calibration curve of standard additions of lead

2.2 Cobalt and Nickel in Soil Samples: A four inch post hole auger was used to collect the soil samples from Sanganer and Vishwakarma industrial area. Initially, the surface area was sampled separately. Remaining soil samples were taken from 6, 12 and 15 inches depth, then after these samples are mixed thoroughly.

2.2.1. Proposed Methodology: Sample is prepared with the 2 grams of soil sample and digested using 1:1 HNO_3-HCl solution.

2 ml of the soil sample was taken in the sample cup. To this was added 1 ml of ammonia –ammonium chloride buffer, 1 ml of 1000 ppm dimethylgyoxime and 6 ml of triple distilled water. The solution was deaerated for 15-20 mins using pure form of nitrogen gas. The adsorptive stripping voltammograms were then recorded by applying the potential scan at the rate of 2mV/sec following two mins accumulation.

2.2.2 Cobalt and Nickel in Soil Samples of Sanganer: Very sharp well defined adsorptive stripping voltammograms were thus obtained for both the metals. Their calibration curve plots of standard additions are also quite linear.

Representative adsorptive stripping voltammograms for **cobalt** in soil sample of Sanganer area is given in fig 5.37.
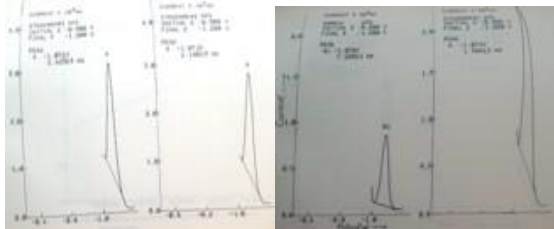

Fig5.37 adsorptive stripping voltammograms for **cobalt** in soil sample of Sanganer area

Calibration curve for one of these soil samples is shown in fig 5.38.
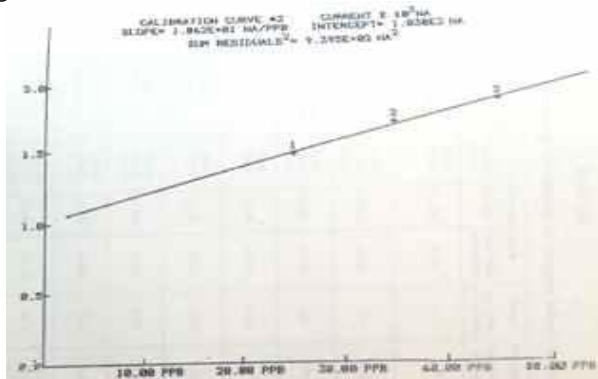

Fig: 5.38 Calibration curve of Cobalt in Sanganer

Relative standard deviation in these determinations varies from 0.27% to 2.52% only as shown in table 5.11.

Adsorptive stripping voltammograms for nickel in the soil sample is given in fig 5.39.
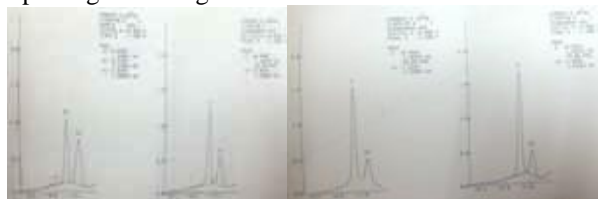

Fig 5.39 Adsorptive stripping voltammograms for nickel

Linearity between peak height and concentration was obtained as shown in fig. 5.40.
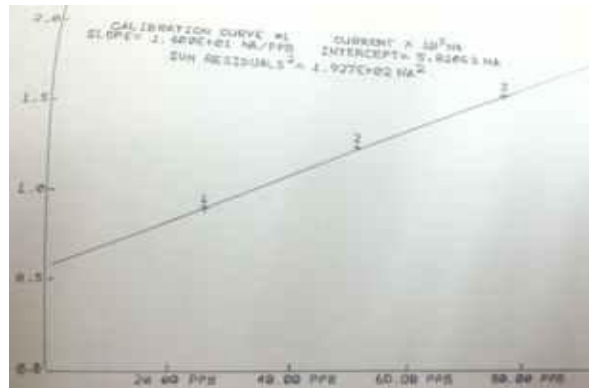

Fig 5.40 Calibration curve for Nickel in Sanganer area

Table 5.12 shows that results obtained for nickel in the soil samples of Sanganer industrial area are with standard deviation of 1.5% only in almost all cases.

2.2.3 Cobalt and Nickel in Soil Samples of Vishwakarma industrial area: Ten different soil samples were collected from the sites near different kinds of industries of Vishwakarma area. All these soil samples were analyzed for Cobalt and Nickel following the same procedure as for Sanganer area soil samples.

Adsorptive stripping voltammograms for cobalt in soil sample 6 is given in fig 5.41.
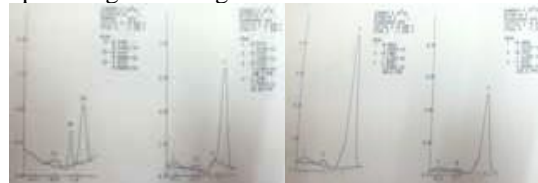

Fig 5.41 Adsorptive stripping of cobalt

Calibration curve for cobalt estimation in soil sample 2 is given in fig 5.42.
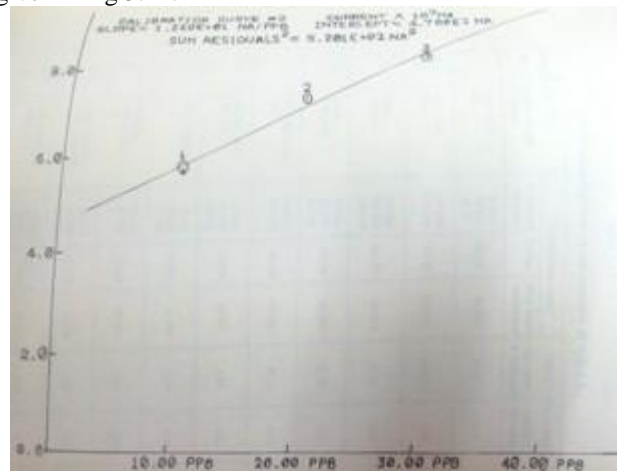

table 5.13 consists of results obtained for cobalt estimation is soil samples of vishwakarma industrial area. Fig. 5.43 shows adsorptive stripping voltammograms for nickel in soil sample number one of vishwakarma industrial area.
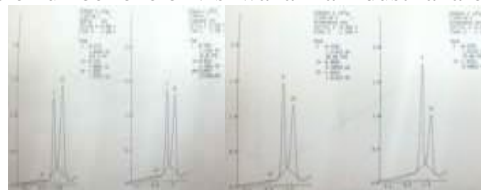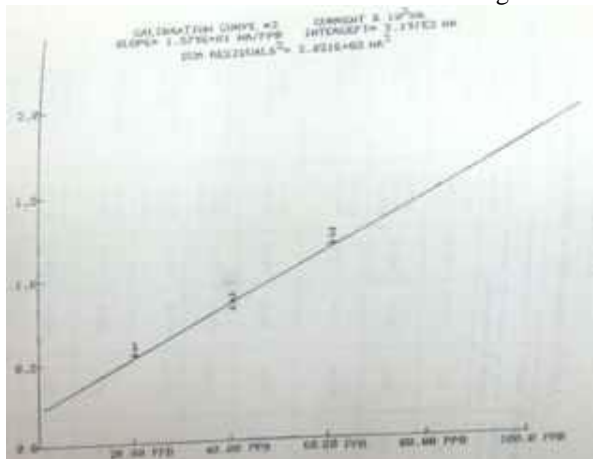

Fig 5.43 Nickel in VKI soil sample

Standard addition calibration curve for nickel in soil sample number 5 of the vishwakarma area is shown in fig 5.44.

The amounts of nickel in ten samples of V.K.I.A. are given in table 5.14.

All the results obtained for lead concentration in the soil samples are quite reproducible with the average standard deviation varying from 0.09 to 1.76%. The results of Zinc in VKIA are remarkably reproducible, standard deviation in which varied from 0.2% to 3.3%. Cobalt in VKIA results are obtained with average standard deviation of 0.28% to 5.05%. Results obtained in Nickel in VKIA are the determinations which quite reproducible with 1.0% of average standard deviation. In Sanganer industrial area the results of zinc is 0.5% except in one case, lead concentration is 0.09to 1.76%, cobalt is 0.27 to 2.52% and in Nickel it is 1.5%.

III. RESULT ANALYSIS

Sample No. No.	Site from where sample is taken	Concentration(ppm)				Percentage
		In sample solution	Average	After blank subtraction	Per gram of soil	Standard deviation
1	Effluent of printing, washing and dyeing industry	2.458 2.471 2.4	2.443	2.435	152.2	1.26
2	Bleaching industry-20 meters away	0.03795 0.03772 0.03782	0.0378	0.03	1.88	0.26
3	Agricultural field 20 meters away from bleaching industry	0.22245 0.22652 0.21698	0.222	0.214	13.39	1.76
4	From washing place	0.035237 0.035349 0.035989	0.0351	0.027	1.7	0.86
5	40 meters away from washing place	0.12035 0.1199 0.122	0.12	0.112	7.01	0.33
6	Bleaching industry	0.09916 0.099215 0.09781	0.0987	0.091	5.68	0.2
7	Drainage water soil	0.043726 0.043802 0.044127	0.0439	0.036	2.26	0.46
8	Printing industry	0.053726 0.053634 0.053747	0.0537	0.046	2.28	0.09
9	20 meters away from washing place	0.042406 0.041361 0.042629	0.0421	0.034	2.14	1.33
10	60 meters away from washing place	0.077341 0.077835 0.076987	0.0774	0.07	4.35	1.1

IV. CONCLUSION

Among large number of analytical techniques available for trace analysis purposes voltammetry has been proved to be one of the most sensitive and reproducible techniques for carrying out trace analysis in diverse matrices.

Methods were developed for the analysis of lead, zinc, cobalt and nickel in soil samples of Sanganer industrial area and vishwakarma industrial area of Jaipur. The results for these samples are reproducible when obtained. On the basis of these results, it may be concluded that Voltammetric techniques are the best in providing the reliable data for soil samples.

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Dr. Bhawana Mathur, IJRAR, vol 6 , Issue 1, pp-385-389, March 2019. http://www.ijrar.org/IJRAR19H1059.pdf 11. Estimation Of Metals In Plants, Dr. Bhawana Mathur, IJAR, vol 9 , Issue 5, May 2019. Dr.Bhawna Mathur is an Professor in Chemistry from more than 20 years. She is having multiple research papers and the expertise area of her is chemistry and human values.