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 hormones, 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 rhizobias, free living nitrogen fixing bacteria and blue green algae is attributed to its role in the formation of B12. 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. Nickel concentrations of 200 mg/kg result in decreased yield of oat 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 HNO3-HCl 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 5 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.

Calibration curve of standard addition of zinc in soil sample is shown in fig. 5.21.

Table 5.5. Shows zinc contents in ten different soil samples 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.

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.

Fig5.22: 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.

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

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.

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.
2.2 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 HNO₃-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 dimethylglyoxime 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.

Fig 5.37 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.

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 in 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
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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.

### III. RESULT ANALYSIS

| Sample No. No. | Site from where sample is taken                  | Concentration(ppm) | Percentage |
|----------------|-------------------------------------------------|--------------------|------------|
|                |                                                 |                    |            |
|                |                                                 |                    |            |
| 1              | Effluent of printing, washing and dyeing industry| 2.458              | 2.435      | 152.2      | 1.26       |
|                |                                                 | 2.471              | 2.4        |            |            |
| 2              | Bleaching industry - 20 meters away             | 0.03795            | 0.0378     | 0.03       | 1.88       | 0.26       |
|                |                                                 | 0.03772            | 0.03762    |            |            |
| 3              | Agricultural field - 20 meters away from bleaching industry | 0.22245           | 0.222      | 0.214      | 13.39      | 1.76       |
|                |                                                 | 0.22652            | 0.21698    |            |            |
| 4              | From washing place                              | 0.035237           | 0.0351     | 0.027      | 1.7        | 0.86       |
|                |                                                 | 0.035349           | 0.035989   |            |            |
| 5              | 40 meters away from washing place               | 0.12               | 0.112      | 0.12       | 7.01       | 0.33       |
|                |                                                 | 0.1199             | 0.122      |            |            |
| 6              | Bleaching industry                              | 0.09916            | 0.0987     | 0.091      | 5.68       | 0.2        |
|                |                                                 | 0.099215           | 0.09781    |            |            |
| 7              | Drainage water soil                             | 0.043726           | 0.0439     | 0.036      | 2.26       | 0.46       |
|                |                                                 | 0.043802           | 0.044127   |            |            |
| 8              | Printing industry                               | 0.053726           | 0.0537     | 0.046      | 2.28       | 0.09       |
|                |                                                 | 0.053634           | 0.05374    |            |            |
| 9              | 20 meters away from washing place               | 0.042406           | 0.0421     | 0.034      | 2.14       | 1.33       |
|                |                                                 | 0.041361           | 0.042629   |            |            |
| 10             | 60 meters away from washing place               | 0.077341           | 0.0774     | 0.07       | 4.35       | 1.1        |
|                |                                                 | 0.077835           | 0.076987   |            |            |

### 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.

REFERENCES

1. Nicholas D.J.D. and Egan A.R (Eds) 1975. Trace elements in soils-plants-Animal Systems [New York Academic Press]
2. The nature and properties of soil-Nyle C. Brady Eurasian Publishing House (p) Ltd. New Delhi 1988.
3. Frumkin H. Agent Orange and Cancer: An Overview for Clinicians. CA Cancer J Clin. 2003;53:245. [PubMed]
4. Garbarino JR, Snyder-Conn E, Leiker TJ, Hoffman GL. Contaminants in Arctic snow collected over northwest Alaskan sea ice. Water,Air and Soil Pollution. 2002;139:183–214.
5. Geluso KN, Altenbach JS, Wilson DE. Bat mortality: pesticide poisoning and migratory stress. Science. 1976;194:184–186. [PubMed]
6. Zhang A, Li Y, Chen L (2014a) Distribution and seasonal variation of estrogenic endocrine disrupting compounds, N-nitrosodimethylamine and N-nitrosodimethylamine formation potential in the Huangpu River, China. J Environ Sci 26: 1023-1033.
7. Zhang QQ, Ying GG, Pan CG, Liu YS, Zhao JL (2015a) Comprehensive evaluation of antibiotics emission and fate in the river basins of China: Source analysis, multimedia modeling and linkage to bacterial resistance. Environ Sci Technol 49: 6772-6782.
8. Liu X, Steele JC, Meng XZ (2017) Usage, residue and human health risk of antibiotics in Chinese aquaculture: A Review. Environ Pollution, 223: 161-169.
9. Dr.Bhawana Mathur, “Proposed Method for Modern Voltammetric Studies “International Journal of Emerging Technologies and Innovative Research (www.jetir.org), ISSN:2349-5162, Vol.5, Issue 12, page no.21-24, December-2018.
10. Voltammetric studies and Determination of pesticides in soil samples.

AUTHORS FROFILE

Dr. Bhawana Mathur, IJRAR, vol 6 , Issue 1, pp-385-389, March 2019. http://www.ijrar.org/IJRAR19H1059.pdf

Estimation Of Metals In Plants, Dr. Bhawana Mathur, IJAR, vol 9 , Issue 5, May 2019.

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