

Quantitative Determination of Heavy Metals in the Soil along Musi River of Hyderabad

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Abstract: Quantitative determination of five heavy metal ions viz., Cd, Pb, Cu, Fe, Cr and Zn in the soil of banks along Musi River from Nagole to Parvathapur in Hyderabad have been carried out using atomic absorption spectrophotometry. Calibrations were constructed for the six metals using standard solutions. The analysis showed that the concentrations of Pb and Cd are appreciably high where as Cu, Cr, Fe and Zn are too high compared to standard given by WHO. The concentrations however showed small variations from sample to sample and place to place in a collection of 20 samples in a length of 3 Km with a width of 1Km.

Keywords: Heavy metal ions, Analysis, Atomic absorption spectrophotometry.

I. Introduction

The metals are divided into two categories. Class 1 consists of toxic elements (The Big Four) As, Cd, Pb and Mg. Class 2 pollutants include catalysts which may have been introduced during processes such as Cr, Cu, Mn, Mo, Ni, Pd, Pt, V, Os, Rh, Ru and Ir. Limits of each element are based upon EMEA guidelines. Analysis of heavy metals has become very important because the metals from industrial effluents enter soil and water. Subsequently they enter into the plants and animal kingdom consequently the crops, animal fodder and other living bodies depending upon the polluted¹⁻³ soil and water. Human beings are affected a lot as consumers⁴. Presence of polluting metals like Pb, Cd, Cu, Fe, Cr and Zn are known to show effect⁵⁻⁶ on human body. Excessive accumulation of Pb causes impaired kidney functions⁷, multiple sclerosis, anemia neurological diseases and encephalitis. Excess Cd leads to nephritis and wrong bone metabolism⁷. Wilson's disease is caused by excess Cu⁷ and heart failure and excess Zn causes the disease of metal-fume fever⁷.

The impact of heavy metals on human body gained importance in the scientific community. After going through literature, the authors observed that the analysis of above metals in irrigative areas of Musi River at Hyderabad is important as soil and water of the river are polluted due to industrial effluents. Authors are prompted to analyze the irrigative soil of the above river for a length of 3Kms and width of 1Km from Nagole bridge to Parvathapur for the presence of the heavy metals.

II. Experimental

2.1 Chemicals : Analar (AR grade) samples of Lead nitrate, Nitric acid, perchloric acid, Copper nitrate, Cadmium chloride, Chromium chloride, Ferrous sulphate, Zinc nitrate were purchased from SD Fine chemicals. The metal ions are used for construction of calibration.

2.2 Collection of samples: 20 samples of soil were collected on either banks of the Musi River. These samples are air dried, stored in labeled, sealed paper bags and placed in an oven for 7 seven days at a temperature of 60°C. The forage samples were cleaned with distilled water to bathe soil particle and other impurities. These samples were dried in air and placed in an oven at 60°C temperature for 5-7 days. These soil forage samples were subjected to wet digestion in HNO₃ and HClO₄ (1:2) supplied by Sd fine chemicals, Mumbai. Triply distilled water is used in the experiments. After digestion, samples were analyzed for Pb, Cd, Cu, Cr, Fe and Zn using atomic absorption spectrophotometer according to standard methods as described in the manual supplied along with the atomic absorption spectrophotometer.

2.2 Instrumentation

Elico SL 163 Atomic Absorption Spectrophotometer is used to analyze the concentrations of metal ions. The calibration curves were constructed using standard solutions of the metal ions by following the procedure given in the manual using appropriate detectors in the wavelength range suitable for the concentration range. Six replicates of each experiment are carried out. The calibrations are precise and accurate as demonstrated by % RSD being less than 2.

III. Results & Discussion

The analysis of the soils showed that the concentrations of Pb and Cd are appreciably high whereas that of Cu, Cr, Fe and Zn are moderately high compared to standards given by WHO. Table shows the results of analysis together with the permissible range of metal ions as defined by WHO.

IV. Conclusion

The heavy metals observed in the soil in high concentrations indicate that they cause damage⁸ to water, crops, fodder and animal kingdom including human beings.

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Table: Analytical results of metals in the samples of soils

Sl. No.	Metal	Concentration found (ppm)	Permissible ⁹ concentration by WHO (ppm)
1	Pb	0.41 ±0.02	0.10
2	Cd	0.04 ±0.02	0.01
3	Cu	3.00 ±0.02	1.50
4	Cr	0.10 ±0.02	0.05
5	Fe	0.70 ±0.02	0.30
6	Zn	25.00 ±0.02	15.00