Analysis of Heavy Metals in Water samples of Kanekal Tank, Kanekal, Anantapuramu District, Andhra Pradesh, India

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Abstract- **Trace metals are the metals subset of trace elements, that is metals normally present in small but measurable amounts in animal and plant cells and tissues and that are a necessary part of nutrition and physiology. Many biometals are trace metals. Ingestion of, or exposure to excessive quantities of metals can be toxic. This paper deals with the analysis of trace metals concentration of like Li, Al, V, Fe, Co, Ni, Cu, Zn, As, Ag, Cd, Cs, Ba, Ti, Pb, U etc. in the water samples collected from Kanekal tank, Kanekal, Anantapuramu district AP, during the period of 2012-2014. They were measured by A Perkin Elmer SCIEX®, Model ELAN 5000 Inductively Coupled Plasma-Mass Spectrometer (ICP-MS), is most advanced technique for the determination of trace metals concentrations up to 1 part per billion (ppb). The concentration of these metals in the study area was above desirable limits given by the Indian Standard Specification for Drinking Water IS 10500:2012.**

Index Terms- **Trace metals- ICP-MS- Kanekal- Tank**

I. INTRODUCTION

Trace metals are the metals subset of trace elements, that is metals normally present in small but measurable amounts in animal and plant cells and tissues and that are a necessary part of nutrition and physiology. Many biometals are trace metals. Ingestion of, or exposure to excessive quantities of metals can be toxic. By the term "heavy metals" we usually refer to any metallic element that contain a relative high density and applies to the group of metals and metalloids with atomic density greater than 4 g/cm3. There are about fifty heavy metals that are of special concern for their toxicological importance to human health and many of them, like Zn, Cu, Ni and Mn are also essential trace elements for living organisms. However, if these accumulated at high levels, or ingested in greater amounts than the required concentration, then they cause health problems (1). Aquatic ecosystem is the ultimate receipt of almost everything including heavy metals. This has long been recognized as a serious pollution problem (2).

Heavy metals enter the environment by natural and anthropogenic means. Such sources include: natural weathering of the earth's crust, mining, soil erosion, industrial discharge, urban runoff, sewage effluents and pest or disease control agents applied to plants, air pollution fallout (3). For the past few decades the concern over the studies on different pollutants such as trace metals, pesticides, oil and fertilizers and their impacts on environmental compartments such as soil, plants and water have attained a great importance (4). In recent years, the contamination of aquatic systems has become a problem of great concern throughout the world (5). The present study is aimed to investigate the analysis of heavy metal concentration levels in water and to study the ecological status of heavy metals in Owk reservoir. Monthly variations and year wise variations of metals like Li, Al, V, Fe, Co, Ni, Cu, Zn, As, Ag, Cd, Cs, Ba, Ti, Pb, U etc., and assess the level of concentrations.

In India much research has been carried out with regards to assessment of Heavy metal concentrations in different tanks like Ureje water Reservoir (6), Hussainsagar lake water (7), River Noyyal (8), Ground water of Goa mining region (9), Drinking water contaminated with Heavy Metals (10). Andhra Pradesh has good number of Reservoirs, Ponds and Tanks. Qualitative and quantitative heavy metal investigations had been carried out in water bodies like Kolleru lake (11), water samples of Tirupathi region (12), In ground water of SPSR Nellore district (13), Surface and ground water of rural and urban areas of Kakinada, East Godavari district (14), Fish pond in around Bhimavaram, West Godavari district (15), Surface and Ground water in and around Tirupati (16).

II. METHODOLOGY

Study Area: Kanekal tank is located at 4o 53’11” N, 77o 1’54” E. Kanekal is a small town situated in the Anantapuramu district, 100 Km from district headquarters. This is an important fresh water tank in Anantapuramu district. It is a perennial tank into which water flow from Tungabhadra dam. This tank is used for culture of fish and this water is used for irrigation of different crops of this area.

Methodology: The water samples were collected and stored in 1liter capacity clean plastic bottles. Before collection of samples, the bottles were washed with double distilled water. All the samples were filtered using Whattman 42 filter paper and were diluted to bring down the TDS 200 ppm for further analysis by ICP-MS. The trace element samples were treated with 0.6N HNO3. The elements were analyzed by Inductive Coupled Plasma-Maas Spectrophotometer (ICP-MS). A Perkin Elmer SCIEX®, Model ELAN 5000 Inductively Coupled Plasma-Mass Spectrometer (ICP-MS) (Concord, Ontario, Canada) was used throughout. Acidified water samples were directly fed into the instrument nebulizer after proper dilution and filtration. Calibration was performed using the certified reference material NIST 1640a (National Institute of Standards and Technology, USA) to minimize matrix and other associated interference effects and accuracy was better than 6% RSD. Relative standard deviation (RSD) was found to be better than 6% in the majority of the cases, which indicates that the precision of the analysis is reasonably good. Trace elements analyses were carried out at Department of Geophysics, Andhra University, Vishakapatnam, AP, India.

III. RESULTS AND DISCUSSION

The levels were recorded maximum of 8.99 ppb in the month of July, 2014 (Graph 7) and a minimum value of 2.131 ppb in the month of November, 2012 (Graph 11). The concentration of Lithium was above desirable limit i.e., 0.2 mg/L according to the Drinking water specifications IS 10500:2012. The levels of Aluminium ranged from the maximum of 1.892 mg/L in the month of May 2014 (Graph 7), to the minimum of 1.035 mg/L in the month of February, 2013 (Graph 2). The concentration of Aluminium was above desirable limit i.e., 0.3 mg/L according to the Drinking water specifications IS 10500:2012. The range of Aluminium in the present study was also observed by Frances Salmon, (17) in the study of Impact of metals on Aquatic Ecosystems. The concentrations of Vanadium were ranged from a maximum of 19.8 ppb in the month of May, 2014(Graph 5) to a minimum of 10.6 ppb in the month of October, 2012 (Graph 10). The concentration of Vanadium was above desirable limit i.e., 0.3 mg/L according to the Drinking water specifications IS 10500:2012. Iron (Fe) is an essential metal for most living organisms and humans. It is a constituent of proteins and many enzymes, including haemoglobin and myoglobin (18, 19). The values of Iron were observed maximum of 226.8 ppb in the month of June, 2013 (Graph 6) to a minimum of 111.11 ppb in the month of March, 2014 (Graph 3). The concentration of Iron was above desirable limit i.e., 0.3 mg/L according to the Drinking water specifications IS 10500:2012. The high values of Fe in the monsoon season might be associated with the phenomenon of leaching due to heavy precipitation from the dumps and tailing ponds (20). Cobalt is beneficial for humans because it is a part of vitamin B12 which is essential for human health. Cobalt is used to treat anemia with pregnant women, because it stimulates the production of red blood cells. The concentration of Cobalt the water sample was found maximum of 0.841 ppb in the month of September, 2014 (Graph 9) to a minimum of below detective level (bdl) in the months of June, July and August 2013 Graph 6,7,8). The desirable limit of Cobalt was not mentioned according to the Drinking water specifications IS 10500:2012. In fresh waters it is generally low and higher concentrations are generally associated with industrialized or mining areas. The highest range of Nickel was found 11.28 ppb in the month of June, 2013(Graph 6) and the lowest range of Nickel was observed as 2.55 ppb in the month of September, 2014 (Graph 9). The concentration of Nickel was above desirable limit i.e., 0.05 mg/L according to the Drinking water specifications IS 10500:2012. It was found maximum in rainy season. It can be deposited in the sediment by such process as precipitation, complexation and adsorption on clay particles (21). Copper is one of the earliest known metals. The range of Copper was found the maximum value of 6.22 ppb in the month of August, 2014 (Graph 8) to the minimum value is 1.076 ppb in the month of November, 2012 (Graph 11). The higher values of Cu may be attributed to the huge amounts of raw sewage, agricultural discharge in to the water bodies (22). Zinc involved in the nucleic acid synthesis and participates in a variety of metabolic processes involving carbohydrates, lipids, proteins and nucleic acid (23). The fluctuations of Zinc were observed the maximum value of 25.27 ppb in the month of June, 2013(Graph 6) to the minimum value of 11.232 ppb in the month of October, 2013 (Graph 10). The concentration of Zinc was above desirable limit i.e., 5.0 mg/L according to the Drinking water specifications IS 10500:2012. The higher values of Zn may be attributed to the huge amounts of raw sewage, agricultural discharge into the water bodies (22). The high value of Arsenic ranged from the highest value 1.02 ppb in the month of June, 2014 (Graph 6) and the lowest value of Arsenic in Kanekal water tank is 0.071 ppb in the month of June, 2013 (Graph 6). The concentration of Arsenic was above desirable limit i.e., 0.05 mg/L according to the Drinking water specifications IS 10500:2012. High values of Arsenic are mainly due to discharge of effluents from industries like paints, pharmaceutical, fertilizers and pesticides. (24). The presence of minimum range of Silver in our food is very much essential for human beings, but the higher presence causes many abnormalities, especially the salts of Silver like $AgNO_3$ causing bluish or black pigmentation. The variation in the concentration of Silver was detected the maximum value of 1.87 ppb in the month of September, 2013 (Graph 9) to the minimum value is 0.01 ppb in the month of July, 2013 (Graph 7). The range of Cadmium value was the highest (1.888 ppb) in the month of November, 2012 (Graph 11) to the lowest (0.047 ppb) in the month of May, 2014 (Graph 5). The concentration of Cadmium was above desirable limit i.e., 0.01 mg/L according to the Drinking water specifications IS 10500:2012. The high levels of Cd in water were known to be attributed to the agricultural discharge (25 Mason, 2002). The values of Caesium assessed more (0.852 ppb) in the month of May, 2014 (Graph 5) to a less (0.013) ppb in the month of April, 2014 (Graph 4). Barium is one of the 14 abundant element found in earth's crust. The fluctuations of Barium ranged varied from the highest of 199.01 ppb in the month of April, 2014 (Graph 4) and the lowest value is 112.3 ppb in the month of January, 2014 (Graph 1). The concentration of Barium was above desirable limit i.e., 0.7 mg/L according to the Drinking water specifications IS 10500:2012. The levels of Titanium were measured between the maximum of 0.412 ppb in the month of December, 2013 (Graph 12) to the minimum of below detectable level (bdl) in the months of October and November 2012 (Graphs 10, 11). The concentration of Titanium was within desirable limit i.e., 0.05 mg/L according to the Drinking water specifications IS 10500:2012. The analysis of the concentration of Lead was found highest with the value of 25.33 ppb in the month of April, 2014 (Graph 4) to the lowest value below detectable levels (bdl) in the month of March, 2014 (Graph 3). The concentration of Lead was above desirable limit i.e., 0.1 mg/L according to the Drinking water specifications IS 10500:2012. The high levels of Pb in water can be attributed to the agricultural discharge (25 Mason, 2002). Uranium is the radioactive trace element occurring naturally in soil and rocks. The concentration of Uranium in water is typically very small, but varies from region to region. The variation in the concentration of Uranium was recorded the highest value of 3.85 ppb in the month of August, 2013 (Graph8) to the lowest value is 0.845 ppb in the month of June, 2014 (Graph 6). The concentration of Uranium was above desirable limit i.e., 0.1 mg/L according to the Drinking water specifications IS 10500:2012 in both the tanks.

VI. CONCLUSION

From all the above mentioned research findings, it is finally concluded that Kanekal tank water metal concentrations were within the permissible limits according to the Drinking water specifications IS 10500:2012. Hence, it can be said that water is good for Drinking. It can be used for Fish culture and for the purpose of Agriculture.

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REFERENCES

[1] B. L. Vellee and D. D Ulmer, "Biochemical effect of mercury, cadmium and lead". Ann Rev Biochem, 1972. 41:91-128.

[2] E.O. Farombi, O. A. Adelowo and Y. R. Ajimoko, "Blomarkers of oxidative stress and heavy metal levels as indicator of environmental pollution in African Catfish (Clarias gariepinus) from Nigeria Ogun river".International Journal of Environmental Research and Public Health. 2007. 4:158-165.

[3] R. Vinodhini and M. Narayanan, "Bioaccumulation of heavy metals in organs of fresh water fish Cyprinus carpio (Common carp)", Int. J. Environ. Sci. Tech., 2008. 52(1).

[4] L. Yanina Idaszkin, Julio L. Lancelotti, Pabl J. Bouza, Jorge E. Marcovecchio, "Accum,ulation and distribution of trace metals within soils and austral cord grass Spartina densiflora in a Patagonian salt marsh", Marine Pollution Bulletin. 2015. 101:457-465.

[5] Honggang ZHANG, Baoshan CUI, Rong XIAO, Hui ZHAO, "Heavy metals in water, soils and plants in riparian wetlands in the Pearl River Estuary, South China". Procedia Environmental Sciences, 2010.2:1344-1354.

[6] I. A. Adebayo, "Determination of Heavy Metals in water, Fish and Sediment from Ureje water Reservoir".Journal of Environmental and Analytical Toxicology, 2017. 7(4):486-490.

[7] N. Sreenu, C. Venkateswar, B. Reddya Naik and J. Avinash Kumar, "Evaluation of CV Technology for reducing levels of heavy metals in polluted Hussainsagar lake water, Hyderabad, Telangana state, India", 2017. 7(9):18-23.

[8] R. Babunath and G. John, "A study on Physico Chemical and Heavy Metals Characteristics of River Noyyal, Tamilnadu,India". Environmental Science: An Indian Journal, 2017. 13(1):1-9.

[9] Gurdeep Singh and Rakesh Kant Kamal, "Heavy metal contamination and its indexing approach for groundwater of Goa mining Region, India", 2016. 7:1479-1485.

[10] Q. A. Malik and M. S Khan, "Effect of Human Health due to Drinking Water Contaminated with Heavy Metals", Journal of pollution Effects and control, 2016. 5(1):1-2.

[11] B.B.R.G. Vijalakshmi and P. Brahmaji Rao, "Assessment of Heavy Metal distribution of Water and Sediments in Kolleru Lake A.P". IOSR Journal of Pharmacy and Biological Sciences (IOSR-JPBS), 2017. 12(4):40-46.

[12] P. Latha, B. Gangadhar and G. Ramakrishna , "Trace Metal Analysis in Soil and Plant Samples of Tirupati Region, Andhra Pradesh". International Journal of Engineering Science Invention, 2016. 5(60):15-18.

[13] O. Venkata Subbaraju, P.M.N. Prasad, V. Varalakshmi and V. Rami Reddy Y, "Determination of heavy metals in ground water by ICP-OES in selected coastal area of SPSR Nellore district, Andhra Pradesh, India. International journal of innovative research in Science, Engineering and Technology,2014. 3(2):9743-9749.

[14] J. Srinivas, A. V. Purushotham and K.V.S.G. Murali Krishna, "A study of heavy metals contamination in surface and ground water of rural and urban areas of Kakinada, East Godavari District, A.P" .International journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development (IJCSEIERD), 2013. 3(5):231-236.

[15] Priyamvada Devi, D. Sirisha and N. Gandhi, "Study on the Quality of water and soil from Fish pond in around Bhimavaram West Godavari District, A.P", India.International Research journal of Environmental Sciences, 2013. 2(1):58-62.

[16] Y.V. Ramireddy, V. Hanuman Reddy, P.M.N. Prasad and A. V. Ramanareddy, "Determination of heavy metals in surface and groundwater in and around Tirupati, Chittoor District, Andhra Pradesh, India". Den Pharma Chemica, 2012. 4(6):2442-2448.

[17] Frances Solomon, "Impacts of Metals on Aquatic Ecosystems and Human Health". Environment and Communities, 2008. pp 14-19.

[18] R. Yip, Dallman PR. Iron. "In Present Knowledge in Nutrition", 7th ed.; Ziegler, E.E., Filer, L.J., Eds.; (ILSI Press: Washington DC., USA); 1996. pp. 277– 292.

[19] T. Brody, "Nutritional Biochemistr"y, 2nd ed.; Academic Press: San Diego, CA, USA, 1999.pp. 697–730.

[20] A. K. Tiwari, P. K. Singh, A. K. Singh and M. De Maio "Estimation of heavy metal contamination in groundwater and development of a heavy metal pollution index by using GIS technique". Bull Environ Contam Toxico, 2016. 96:508– 515.

[21] I.D. Barałk and J. Siepak "Chromium, nickel and cobalt in environmental samples and legal norms". Polish J. Environ. Studies, 1999. 8: 201.

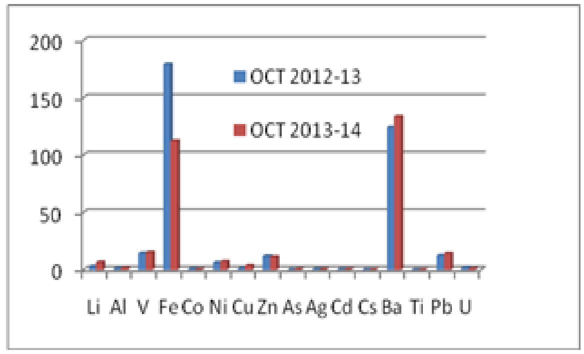
[22] M. A. Abdel-Moati and A. A. El-Sammak. "Man-made impact on the geochemistry of the Nile Delta Lakes. A study of metals concentrations in sediments".Water, Air and Soil Pollution, 1997. 97: 413-429.

[23] L. R. Mc Dowell, "Minerals in animal and human nutrition. In: Cunha, T.J. (Ed.). Animal feeding and nutrition, A.P". Inc. Lond., N.Y, 1992. 265-275.

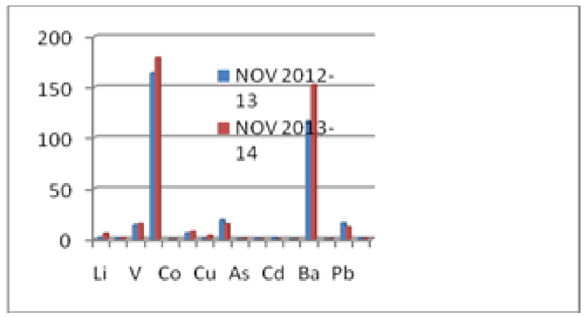
[24] Mushtaq Hussein and T.V.D. Prasad Rao, "Multivariate statistical analysis of heavy metals in ground water- A case study of Bolaram and Patancheru Industrial Area, Andhra Pradesh, India". International journal of Advanced Research. 2014. 2(2):876-883.

[25] C. F. Mason, "Biology of freshwater pollution". 4rd ed. Essex Univ. England, 2002. 387 pp.

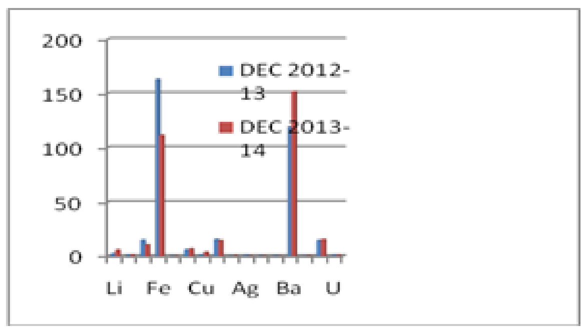
Graph: 1. Metal con. of Kanekal tank in October 2012-2014



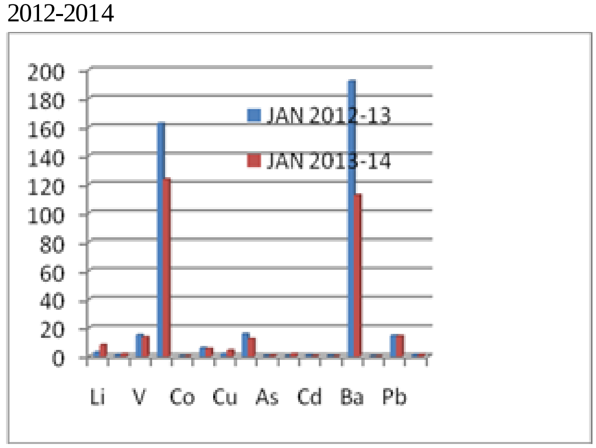
Graph: 2. Metal con. of Kanekal tank in November 2012-2014



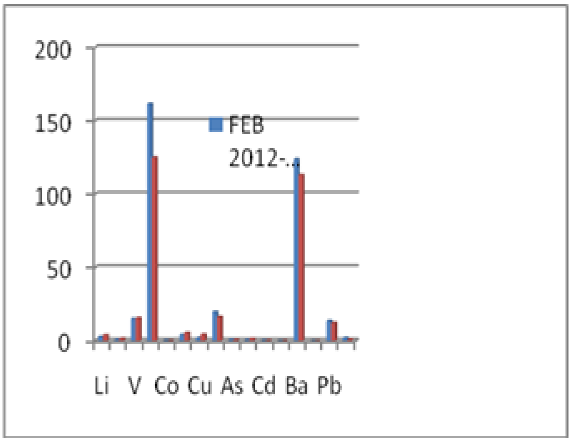
Graph: 3. Metal con. of Kanekal tank in December 2012-2014



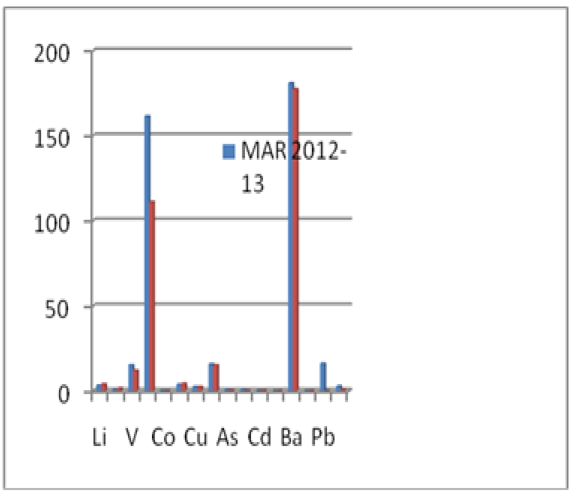
Graph: 4 Metal con. of Kanekal tank in January 2012-2014



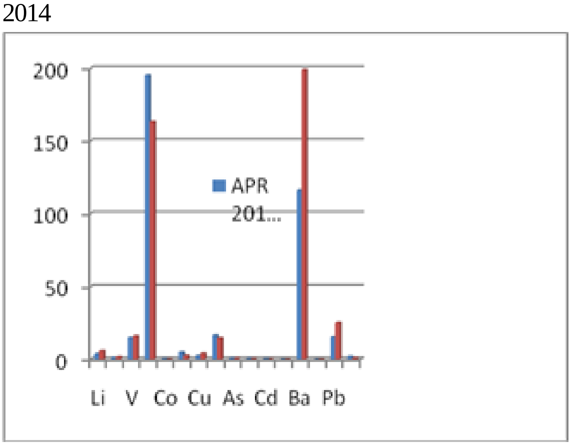
Graph: 5. Metal con. of Kanekal tank in February 2012-2014



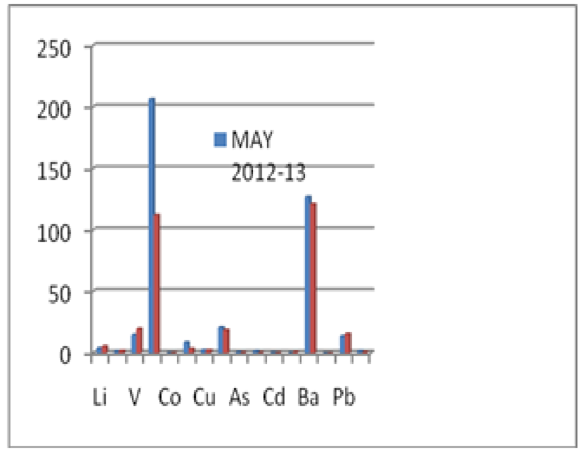
Graph: 6. Metal con. of Kanekal tank in March 2012-2014



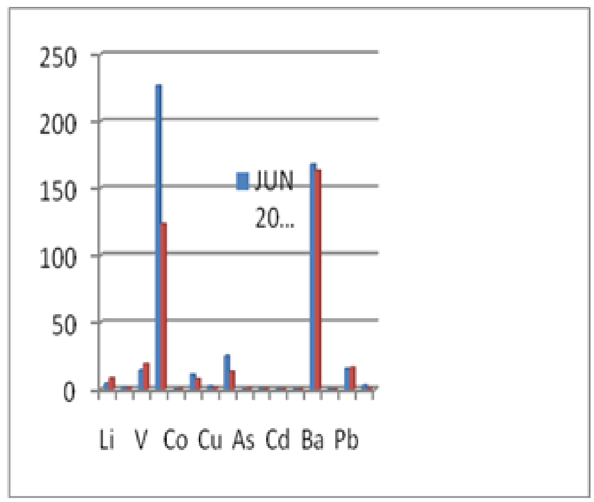
Graph: 7. Metal con. of Kanekal tank in April 2012-2014



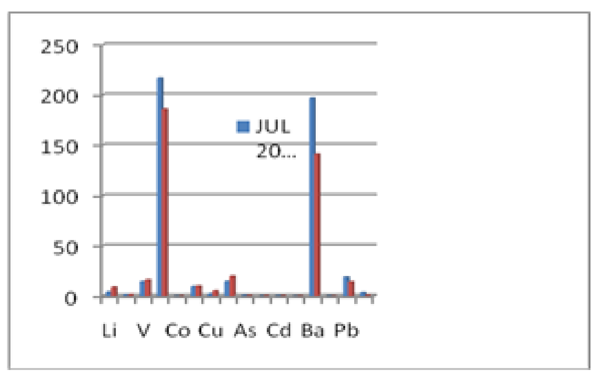
Graph: 8 Metal con. of Kanekal tank in May 2012-2014



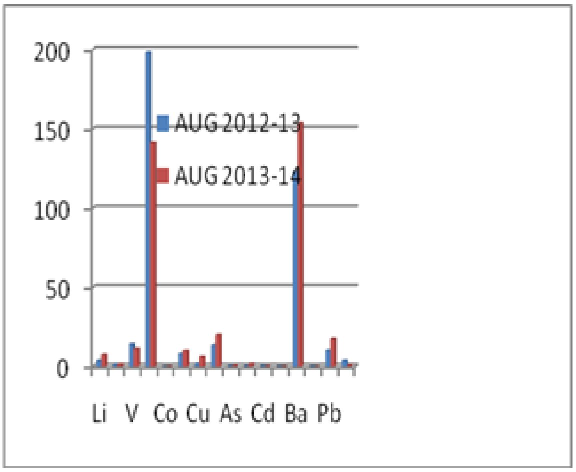
Graph: 9. Metal con. of Kanekal tank in June 2012-2014



Graph: 10 Metal con. of Kanekal tank in July 2012-2014



Graph: 11 Metal con. of Kanekal tank in August 2012-2014



Graph: 12. Metal con. of Kanekal tank in September 2012-2014