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Assessment of Heavy Metals in Water samples of Dharmavaram Tank, Dharmavaram, Anantapuramu District, Andhra Pradesh, India

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Abstract: Aquatic ecosystem is the ultimate recipient of almost everything including Heavy metals. This paper deals with the analysis of heavy 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 Dharmavaram tank, Anantapur district AP, during May, 2011 to April, 2013. 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.
Key words: Trace metals- ICP-MS- Dharmavaram.

I. INTRODUCTION

Environmental pollution is a worldwide problem, heavy metals belonging to the most important pollutants. Aquatic ecosystem is the ultimate receipt of almost everything including heavy metals. This has long been recognized as a serious pollution problem (Farombi et al., 2007). 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 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 (Vellee and Ulmer, 1972).

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 (Vinodhini and Narayan, 2008). 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 (Yanina et al., 2015). In recent years, the contamination of aquatic systems has become a problem of great concern throughout the world (Hongganag et al., 2010). The main purpose of the study was to obtain basic and simple information for a better understanding of environmental impact of some of the heavy metals contaminates the aquatic life. 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 (Adebayo., 2017), Hussainsagar lake water (Sreenu et al., 2017), River Noyyal (Babunath and John, 2017), Ground water of Goa mining region (Gurdeep Singh and Rakesh, 2017), Drinking water contaminated with Heavy Metals (Malik and Khan, 2016). 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 (Vijayalakshmi and Brahmaji Rao, 2017), Surface and Ground water in and around Tirupati (Rami Reddy et al., 2012), water samples of Tirupathi region (Latha et al., 2016), In ground water of SPSR Nellore district (Venkata subbaraju et al., 2014), Surface and ground water of rural and urban areas of Kakinada, East Godavari district (Srinivas et al, 2013), Fish pond in around Bhimavaram, West Godavari district (Priyamvada et al., 2013).

II. STUDY AREA

The study area is located 40 km from Ananthapuramu and it is 2nd largest tank in Ananthapuramu district. GeoFig.ically it is the source of water to this tank is from Chitavathi River. Dharmavaram is located at 14.43°N 77.72°E. It has an average elevation of 345 meters (1131 feet). It is famous for handloom silk sarees. Dharmavaram town as the second biggest tank in Ananthapuramu district located on Chitravathi river origin at Nandi hills, Karnataka. The storage capacity of this tank is 0.4 TMC. Dharmavaram tank serves as the main source of drinking water and for irrigation.

III. 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.

IV. RESULTS AND DISCUSSION

The mean Lithium levels in water sample were ranged from maximum 9.861 ppb in the month of May, 2011(Fig. 1) and minimum of 2.99 ppb in the month of May, 2012 (Fig. 1). The concentration of Lithium was above desirable limit i.e., 0.2 mg/L according to the Drinking water specifications IS 10500:2012. The mean Aluminium ranged from the maximum value of 9.296 mg/L in the month of September, 2011(Fig. 5) to a minimum of 1.109 mg/L in the month of October, 2011 (Fig. 6). The concentration of Aluminium was above desirable limit i.e., 0.3 mg/L according to the Drinking water specifications IS 10500:2012. Frances Salmon, (2008) also observed the range of Aluminium in the present study in the study of Impact of metals on Aquatic Ecosystems. On the observation of the results of Vanadium were ranged from the maximum of 79.2 ppb in the month of March, 2013 (Fig. 11) to a minimum of 5.47 ppb in the month of November, 2012 (Fig. 7). 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 (Yip, 1996 and Brody, 1999). The mean value of Fe ranged from a maximum value of 546.85 ppb in the month of November, 2012 (Fig. 7) to a minimum of 123.6 ppb in the month of March, 2012 (Fig. 11). 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 concentration of Iron in the study area is due to the presence of Iron by washing vehicles, which was also mentioned by Srinivas et al., (2013). Cobalt is beneficial for humans because it is a part of vitamin B_{12}, which is essential for human health. Cobalt is used to treat anaemia with pregnant women, because it stimulates the production of red blood cells. The concentration of Cobalt tank ranged from maximum of 4.99 ppb in the month of May, 2011 (Fig. 1) to a minimum of below detective level (bdl) in the months of March and April, 2013 (Fig. 11). 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 concentration range of Nickel was found the maximum value of 26.01 ppb in the month of May, 2011 (Fig. 1) to the lowest range of 5.6 ppb in the month of December, 2011 (Fig. 8). 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 (Baralk et al., 1999). Copper is one of the earliest known metals. The range of Copper was found ranged with the maximum value of 9.95 ppb in the month of February, 2013 (Fig. 10) to the minimum value of 1.06 ppb in the month of November, 2011 (Fig. 7). It was noticed that the desirable limit of Copper in water is 0.05mg/L. The higher values of Cu may be attributed to the huge amounts of raw sewage, agricultural discharge in to the water bodies (Abdel-Moati and El-Summak, 1997). Zinc involved in the nucleic acid synthesis and participates in a variety of metabolic processes involving carbohydrates, lipids, proteins and nucleic acid (Mc. Dowell, 1992). The fluctuations of Zinc were found maximum with the value of 73.24 ppb in the month of March, 2012 (Fig. 11) to the minimum value is 11.03 ppb in the month of June, 2011 (Fig. 2). 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 (Abdel-Moati and El-Summak, 1997). The high level of Arsenic was found 5.2 ppb in the month of March, 2013 (Fig. 11) to the lowest level found is 0.83 ppb in the month of February, 2013 (Fig. 10). 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. (Mustaq and Prasad Rao, 2014). 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 ranged maximum 21.6 ppb in the month of April, 2013 (Fig. 12) to the minimum level is 0.88 ppb in the month of November, 2012 (Fig. 7). The range of Cadmium value was found between 5.846 ppb in the month of May, 2011 (Fig. 1) to the lowest value of Cadmium is 0.357 ppb in the month of April, 2012 (Fig. 12). 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 (Mason, 2002). The concentration of Caesium was assessed in water sample ranged maximum value of 0.104 ppb in the month of March, 2012 (Fig. 11) to the minimum value of 0.012 ppb in the month of September, 2011 (Fig. 5). Barium is one of the 14 abundant element found in earth's crust. The fluctuations of Barium values were ranged highest value observed 448.6 ppb in the month of November, 2012 (Fig. 7) and the lowest value is 182.2 ppb in the month of June, 2011 (Fig. 2). The concentration of Barium was above desirable limit i.e., 0.7 mg/L according to the Drinking water specifications IS 10500:2012. Titanium was detected in the water sample ranging from the maximum of 0.98 ppb in the month of April 2012 (Fig. 12) and a minimum of below detectable level (bdl) in the months of May, June, July, August, September and November, 2012 (Fig. 1,2,3,4,5 and 7). 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 in the water sample varied from highest range 37.6 ppb in the month of September, 2012 (Fig. 5) to the lowest range is 11.6 ppb in the month of April, 2013 (Fig. 12). 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 (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 in the water sample ranged highest value is 36.47 ppb in the month of April, 2013 (Fig. 12) to lowest value is 5.989 ppb in the month of November, 2011 (Fig. 7). 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. Kidney injury is the most sensitive end point for Uranium, which means that the kidney is the organ that is most susceptible to the effect of Uranium.

V. CONCLUSION

From all the above mentioned research findings, it is finally concluded that Dharmavaram tank water was contaminated by effluents coming from runoff through the fields and canals during rainy season, fishing cleaning vehicles, washing cloths and dyes coming from silk industries etc. So the metal concentrations were beyond the permissible limits of Drinking water specifications IS 10500:2012 which may cause harmful effects on cultured fish. Consuming this water by animals affect their health and using this water for agriculture may drastically affects the Agricultural produce.

VI. ACKNOWLEDGEMENT

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Fig.: 1 Metals con. of Dharmavaram tank in May 2011-2013

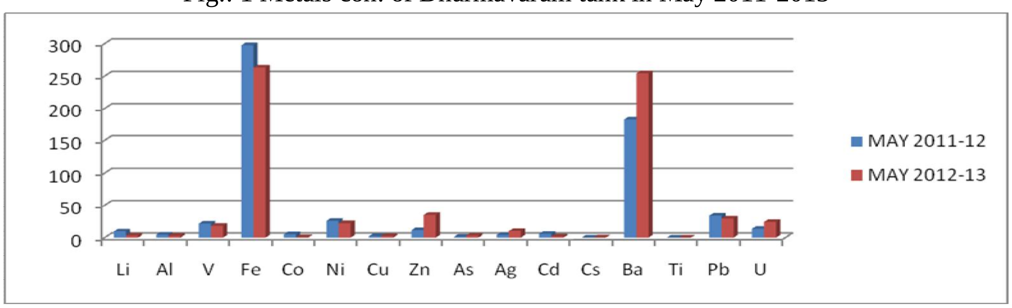

Fig.: 2 Metals con. of Dharmavaram tank in June 2011-2013

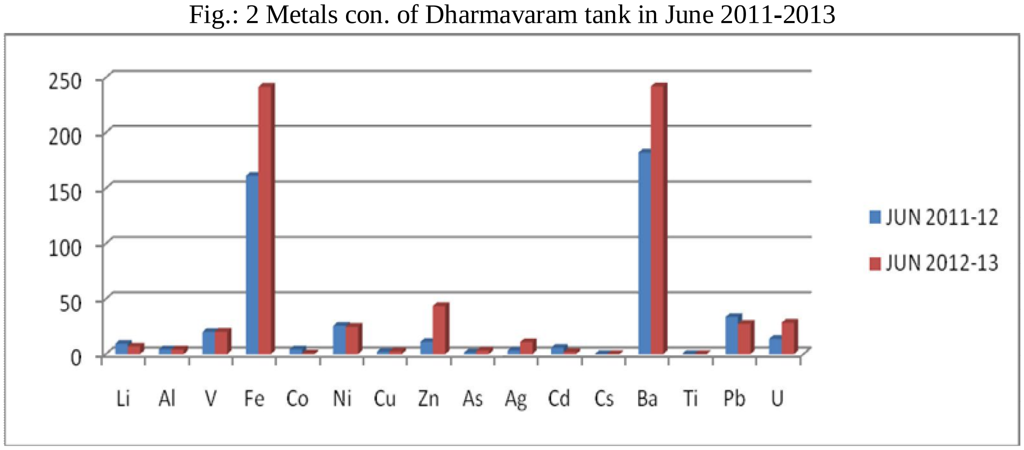

Fig.: 3 Metals con. of Dharmavaram tank in July 2011-2013

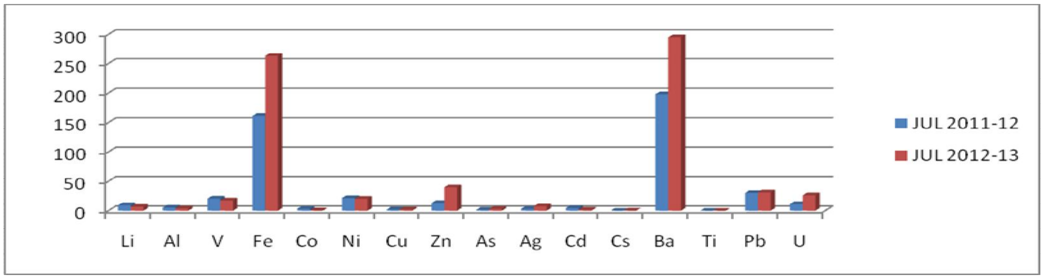

Fig.: 4. Metals con. of Dharmavaram tank in August 2011-2013

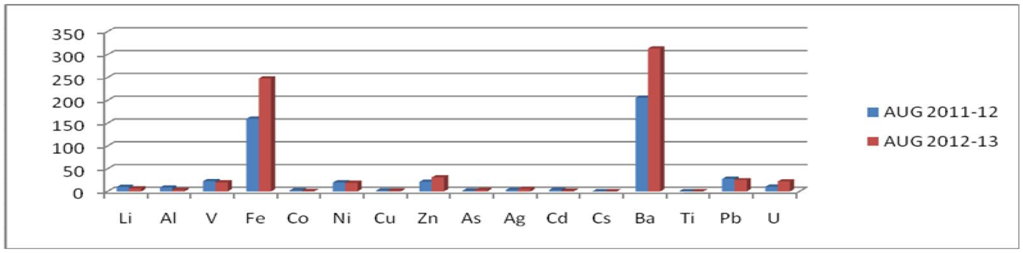

Fig.: 5. Metals con. of Dharmavaram tank in September 2011-2013

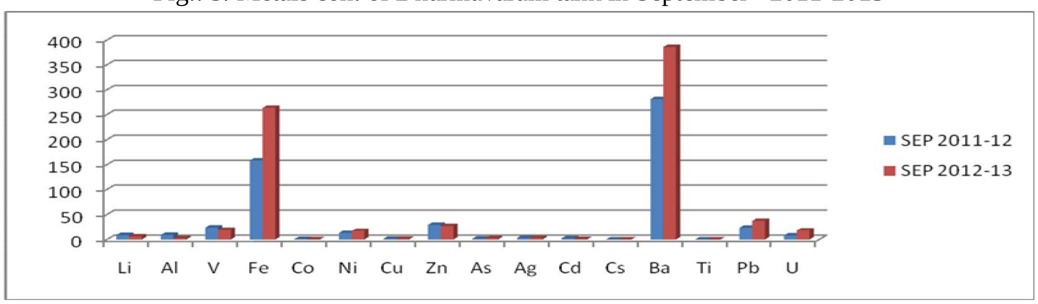

Fig.: 6. Metals con. of Dharmavaram tank in October 2011-2013

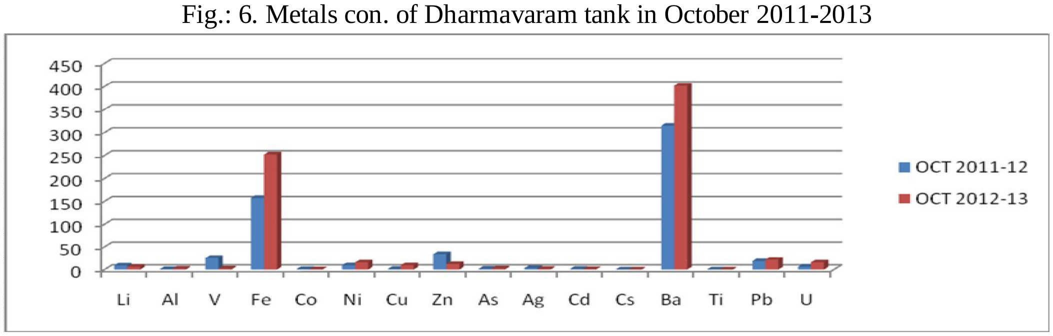

Fig.: 7. Metals con. of Dharmavaram tank in November 2011-2013

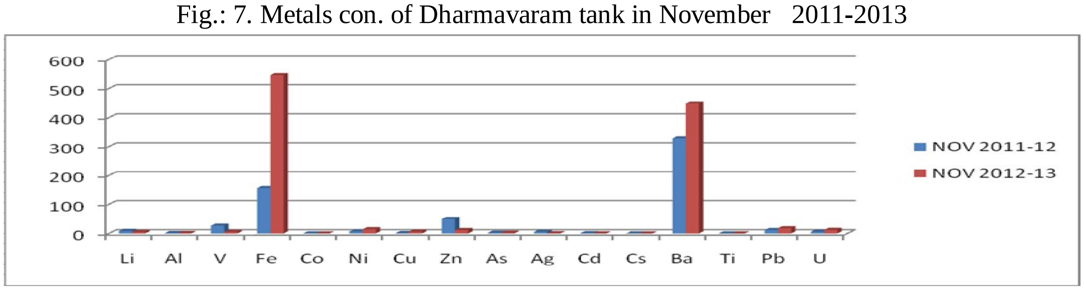

Fig.: 8. Metals con. of Dharmavaram tank in December 2011-2013

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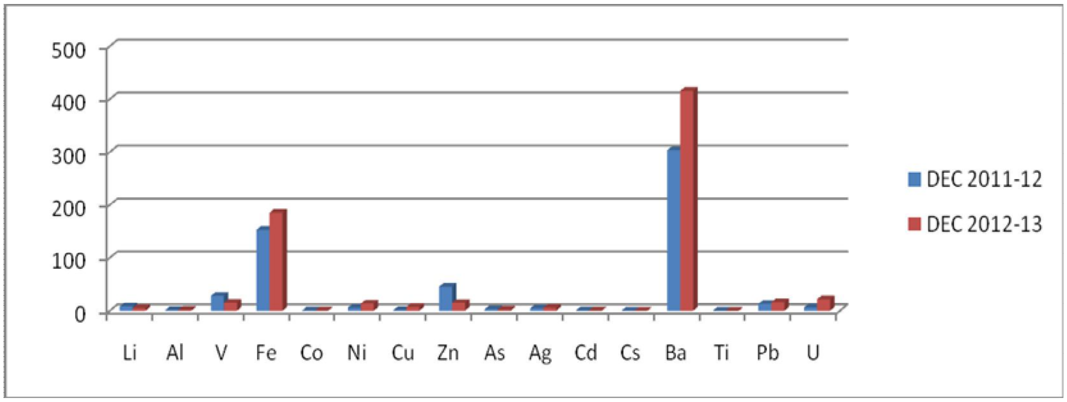

Fig.: 9. Metals con. of Dharmavaram tank in January 2011-2013

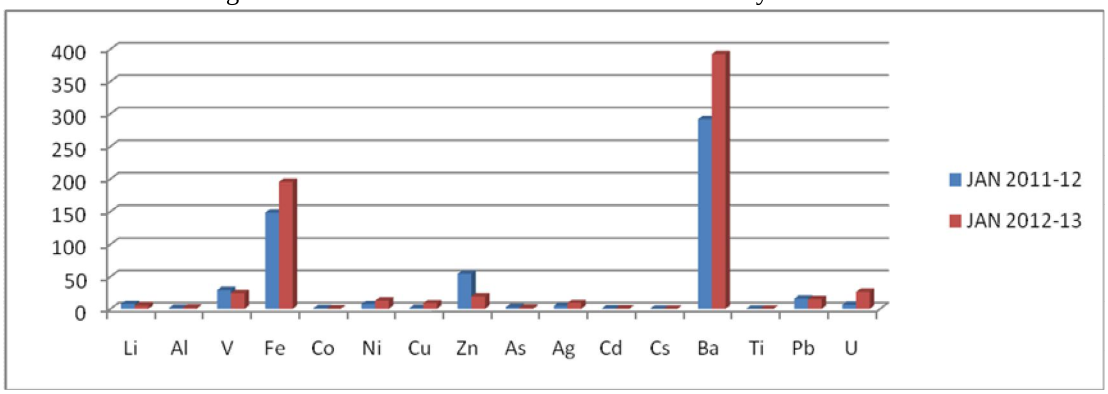

Fig.: 10. Metals con. of Dharmavaram tank in February 2011-2013

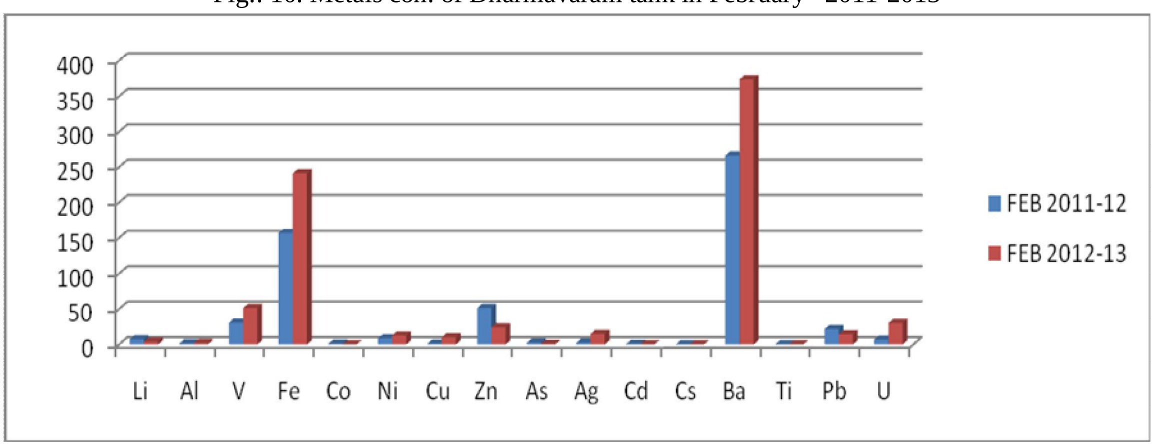

Fig.: 11. Metals con. of Dharmavaram tank in March 2011-2013

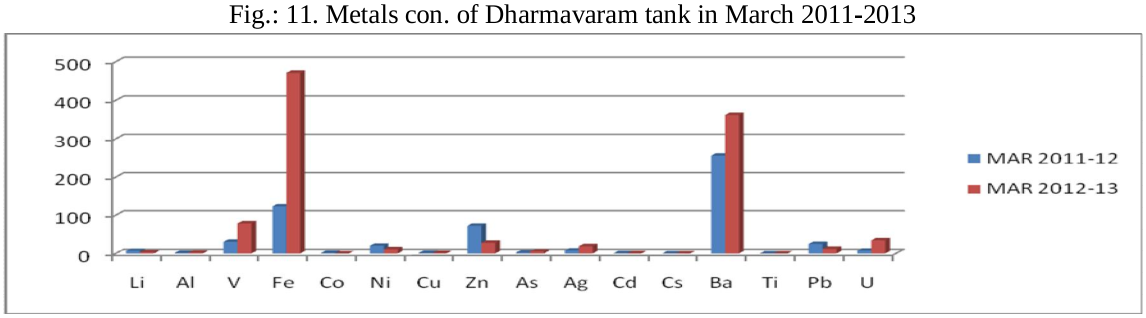

Fig.: 12. Metals con. of Dharmavaram tank in April 2011-2013

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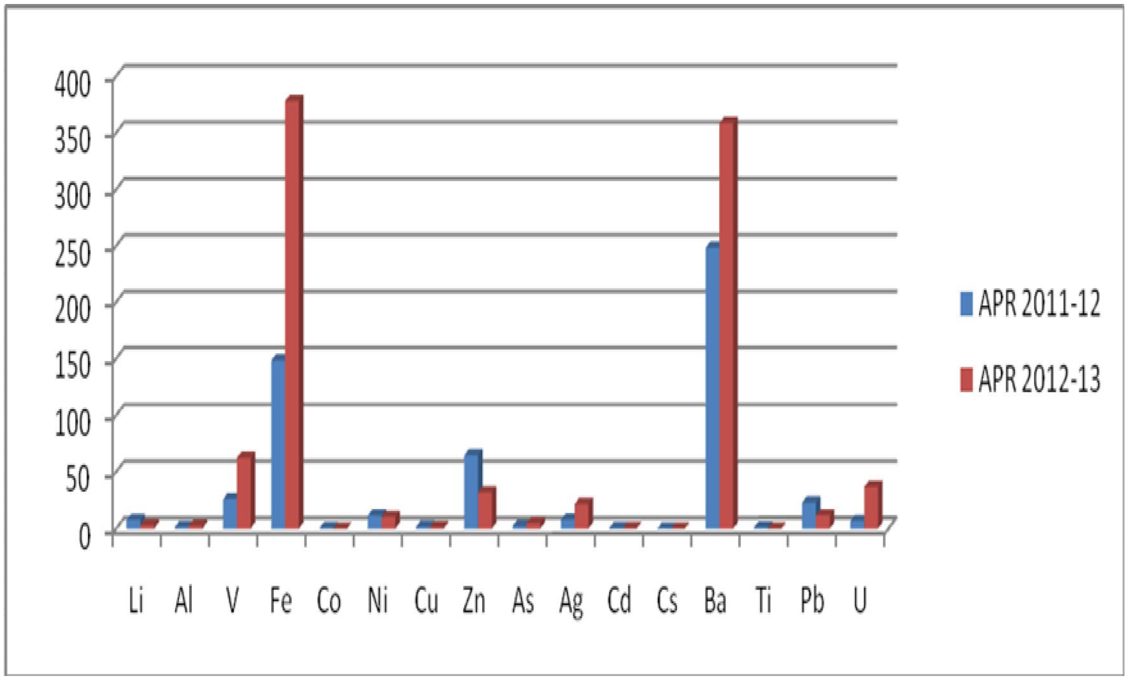

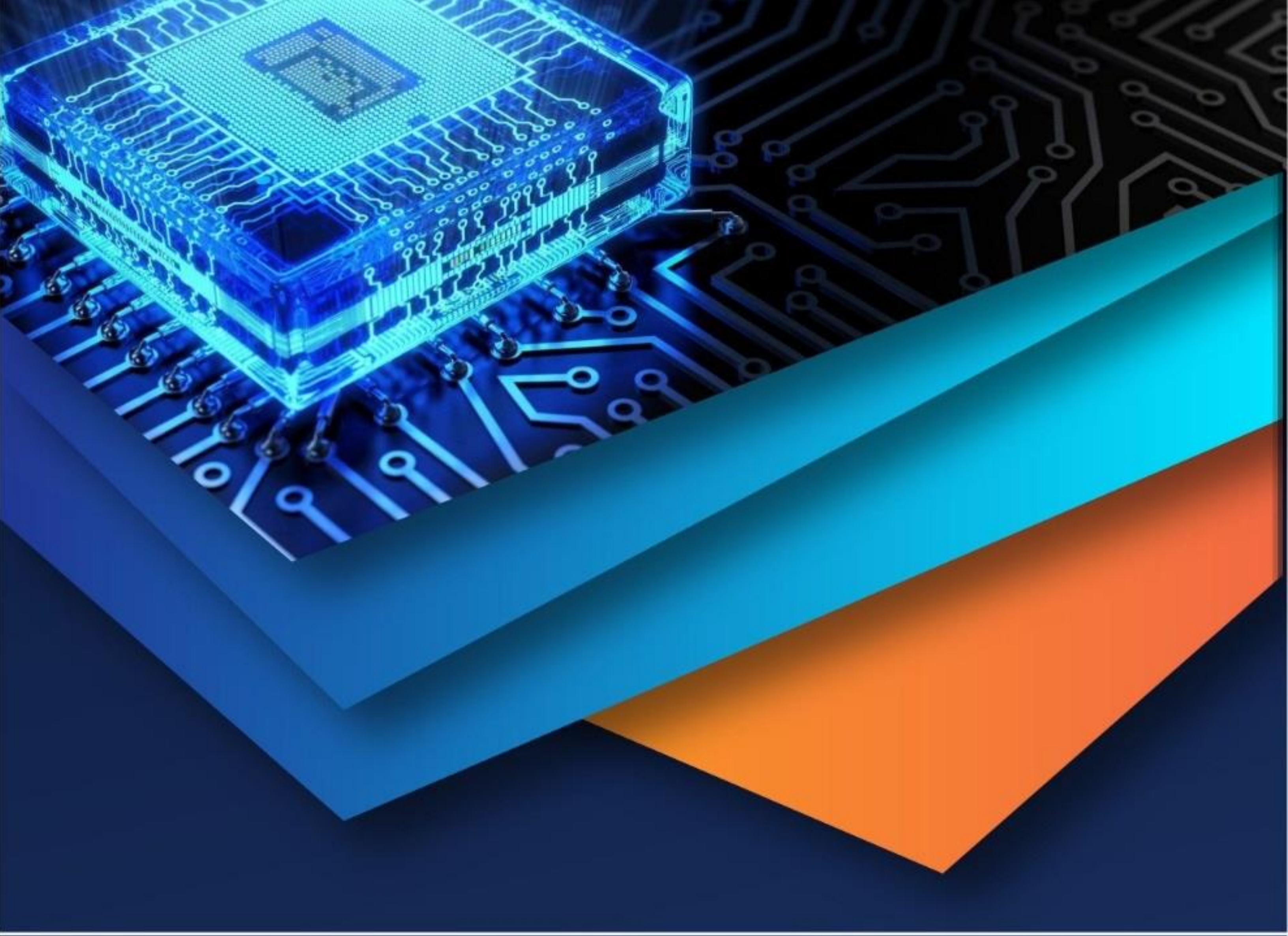

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