ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Studies on Distribution and Concentration of Trace Elements in Surface and Groundwater in and Around Special Economic Zone of Mambattu, SPSR Nellore, A.P, India

K Prakash, R Chenna Krishna Reddy, V Hanuman Reddy, PMN Prasad, V Krishnaiah, O Venkata Subba Raju, YV Rami Reddy*

Electro-Enviro Research Laboratory, Dept. of Chemistry, S.V.University, Tirupati-517502.

ABSTRACT

The distribution and concentration of trace elements in ground water and surface water in different locations in Mambattu SEZ of SPSR Nellore District, Andhra Pradesh has studied five ground water samples and five surface water samples were collected in November 2011, and were subjected to analysis for trace elements like B, Al, Mn, Fe, Ni, Cu, Zn, As, Sr, Mo, Ag, Cd, Ba, Pb, U, Sn, Sb and Hg by using ICP-MS. ICP-MS is most advanced technique for determination of trace metal concentration up to 1 part per billion (ppb). The trace elements in ground water and surface water in this area were found to be very low levels except Fe, Cd, Sn, Ag. The concentrations of these metals were compared with drinking water quality limits given by the World Health Organization (WHO), 4th edition in 2011.

Keywords: Determination of trace elements, ground water, surface water, Mambattu, ICP-MS

Corresponding author

ISSN: 0975-8585

INTRODUCTION

Trace elements constitute a natural component of the earth crust and they are not biodegradable, hence persist in the environment. Trace elements may come from natural sources, leached from rocks and soils according to their geochemical mobility or come from anthropogenic sources, as the result of human land occupation and industrial pollution. Depending on their solubility, these metals may eventually become associated with suspended particulate matter and accumulate in the bottom sediments. The increase of industrial activities has intensified environmental pollution problems and the deterioration of several aquatic ecosystems with the accumulation of metals in biota and flora. Although trace metals at low concentrations are essential to life, at high concentrations, may become hazardous. High concentrations of trace elements are dangerous because they tend to bio-accumulate resulting in heavy metal poisoning. However, at higher concentrations they can lead to poisoning [1, 2]. Heavy metal poisoning could result, for instance, from drinking-water contamination (e.g. lead pipes), high ambient air concentrations near emission sources, or intake via the food chain.

Many trace metals are regarded as serious pollutants of aquatic ecosystems because of their environmental persistence, toxicity and ability to be incorporated into food chains [3]. Various metals from industrial, agricultural, domestic and urban wastes may enter river and lake waters through leaching, runoff, effluents and dry deposition.

Heavy metals pollution represents a serious problem as these metals leach into ground water or soil, which is detrimental to human health. Ground water pollution is a consequence of several activities like chemical manufacturing, painting and coating and mining. Metals exert a deleterious effect on fauna and flora of lakes and streams [4, 7].

A number of sophisticated instruments (like ICP-MS, ICP-OUS, AAS, UV-VIS spectrometer, Cyclic Voltammetry, etc.) were used for the determination of heavy metals in water. The most effective technique for the determination of trace level contamination of heavy metals in water is ICP-MS and GFAAS. By using ICP-MS (Inductively Coupled Plasma Mass Spectrometry) we can determine up to 0.1µg/L of metal concentration in water [5].

Nellore district is one of the coastal areas in Andhra Pradesh and is located south east of Andhra Pradesh and touches the Bay of Bengal. Nellore District is very famous for export of prawns and sea foods, good agricultural area. In this paper an attempt has been made to evaluate the quality and concentration of trace elements in surface and ground water in the area of Mambattu, SPSR Nellore district, Andhra Pradesh using Inductively Coupled Plasma - Mass Spectrometer [5].

SAMPLE COLLECTION

10 water samples (5 from surface water and five from ground water) were collected in the above said area. Standard methods were adapted for the analysis of various water qualities. 1liter polythene bottles were used for water quality parameter analysis and all bottles were

washed with dilute acid followed by distilled water and were dried. At each sampling location, water samples were collected in two poly ethylene bottles. Before taking final water samples, the bottles were rinsed three times with the water to be collected. Two Liters of each sample was collected and homogeneous sample is prepared for analysis of physicochemical parameters [6, 9]. Separately 100ml of each water sample is collected and acidified with Con.HNO_3 heavy metal and toxic metal analysis.

QUALITY ASSURANCE PROCEDURE

Special precautions were taken during sampling and analysis of trace elements. Before collecting the samples, the sample containers are soaked overnight in 2% nitric acid and washed with double distilled water. All the samples were collected polythene containers and stored at 4 ^{o}C by using ice packs. Supra pure grade nitric acid was used to acidify the samples [6, 9].

ANALYTICAL METHODOLOGY

Trace metals were analyzed by using ICP-MS (Agilent 7300) Standard reference material of 1,000mg/L (Multi elements-Merck). Seven different linear concentration standards were prepared, ranging from 0.001 mg/L to 0.1 mg/L. Before conducting sample analysis, different concentrations of standards were analyzed and linear curve was prepared. All metals having good linear graph with correlation coefficient of > 0.999 were observed in the preparation of standard curves.

RESULTS AND DISCUSSION

ICP-MS and AAS-GFA are the most useful techniques for the determination of trace metals up to parts per billion levels. AAS-GFA is a single element analyzer and it will take more time to analyze multi elements. Whereas ICP-MS is very useful technique to determine traces levels of metals in single aspiration.

The conductivity in the most of the study locations found less than 548µs/cm. But WHO referral value is 400µs/cm. Therefore we suspect that there may be metals contamination in the selected samples of ground water and surface water. But from the data we found that almost all samples are having low levels of trace metals. Slight higher concentrations of metals like Fe, Cd, Ag are found in some samples. The concentrations of metals are shown in tables 1 and 2.

ISSN: 0975-8585

Table 1 SAMPLES OF SURFACE WATER

S.NO	TRACE ELEMENTS	SAMPLE-1 Mg/L	SAMPLE-2 Mg/L	SAMPLE-3 Mg/L	SAMPLE-4 Mg/L	SAMPLE-5 Mg/L	WHO Guidelines for drinking water quality(2011)-mg/L
1	B	0.05	0.0473	0.058	0.062	0.0621	2.4
2	Al	0.243	0.3424	0.071	0.0892	0.0850	0.9
3	Cr	0.0091	0.0057	0.0017	0.0025	0.0021	0.05
4	Mn	0.005	0.0015	0.0062	0.0046	0.0052	0.1
5	Fe	0.666	0.5500	0.086	0.071	0.376	0.3
6	Ni	0.0064	0.0011	0.0061	0.0072	0.0035	0.07
7	Cu	0.0022	0.0088	0.0064	0.0053	0.0045	2
8	Zn	0.0037	0.0079	0.0027	0.0035	0.0041	0.01
9	As	0.0011	0.0095	0.0073	0.0086	0.0076	0.01
10	Mo	0.0012	0.0043	0.0042	0.0035	0.0045	0.01
11	Ag	0.891	0.0031	0.0046	0.0590	0.0095	0.05
12	Cd	0.0023	0.0024	0.0019	0.0025	0.0035	0.003
13	Ba	0.073	0.0626	0.0646	0.0745	0.0546	0.7
14	Pb	0.0045	0.0018	0.0024	0.0036	0.0056	0.01
15	U(238)	0.0018	0.0016	0.0053	0.0042	0.0036	0.03
16	Sn	0.0018	0.0012	0.0080	0.0065	0.0065	0.001 – 0.002
17	Sb	0.0044	0.0050	0.0051	0.0032	0.0048	0.02
18	Hg	0.0017	0.000	0.000	0.0016	0.000	0.006

Table 2 SAMPLES OF UNDERGROUND WATER:

S.NO	TRACE ELEMENTS	SAMPLE-1 Mg/L	SAMPLE-2 Mg/L	SAMPLE-3 Mg/L	SAMPLE-4 Mg/L	SAMPLE-5 Mg/L	WHO Guidelines for drinking water quality(2011)-mg/L
1	B	0.061	0.056	0.082	0.074	0.063	2.4
2	Al	0.189	0.708	0.0082	0.0094	0.0074	0.9
3	Cr	0.0035	0.0076	0.0025	0.0039	0.0028	0.05
4	Mn	0.0056	0.0049	0.0062	0.051	0.0039	0.1
5	Fe	0.1313	0.234	0.085	0.0026	0.108	0.3
6	Ni	0.0075	0.0061	0.0045	0.0015	0.0069	0.07
7	Cu	0.0015	0.0053	0.0079	0.0019	0.0083	2
8	Zn	0.0031	0.0064	0.0012	0.000	0.001	0.05
9	As	0.0068	0.0022	0.0022	0.0017	0.0012	0.01
10	Mo	0.0087	0.0012	0.0075	0.0057	0.0022	0.01
11	Ag	0.0037	0.0026	0.0016	0.0019	0.0017	0.05
12	Cd	0.0014	0.0034	0.0024	0.000	0.0014	0.003
13	Ba	0.096	0.068	0.123	0.156	0.022	0.7
14	Pb	0.0096	0.0082	0.0035	0.0022	0.0031	0.01
15	U(238)	0.0019	0.0096	0.0045	0.0036	0.0091	0.03
16	Sn	0.0026	0.0088	0.0064	0.000	0.0085	0.001 – 0.002
17	Sb	0.0057	0.0013	0.0085	0.0059	0.0071	0.02
18	Hg	0.000	0.000	0.0000	0.000	0.000	0.006

ISSN: 0975-8585

CONCLUSION

The Ground Water and surface water samples were collected from various locations of SEZ of Mambattu, SPSR Nellore District, A.P., India in November 2011 for the determination of B, Al, Mn, Fe, Ni, Cu, Zn, As, Sr, Mo, Ag, Cd, Ba, Pb, U, Sn, Sb and Hg by using ICP-MS. The concentrations of the above listed elements were found to be at low levels in both ground and surface water samples. In ground water it is observed that Cd and Sn is presents slightly higher concentrations. Sn and Cd found <0.0088 mg/L and< 0.0034mg/L respectively. In the ground water samples which are slightly high compared to WHO standards (Sn 0.05mg/L and Cd 0.03mg/L). Similarly in surface water it is observed that Fe, Ag and Cd are found in slightly higher concentrations [8]. The occurrence of these elements are Fe were found <0.666mg/L, Ag - <0.891mg/L and Cd - < 0.0034 mg/L respectively. In the Surface water samples which are slightly high compared to WHO standards (Fe - 0.3mg/L, Ag-0.05mg/L and Cd-0.03mg/L). The concentration of the remaining metals were compared with WHO guidelines for drinking water quality, 4th edition,2011 and the concentration levels were found to be below permissible limits [8].

REFERENCES

[1] Allen SC, Crimshaw HM, Parkinson SA and Quarnaly C. Chemical Analysis of Ecological Materials, Blackwell Scientific Publications, London, 1974, pp: 3-389.
[2] Abernathy AR, Larson GL and Mathew RS Jr. Water Res 1984; 18: 651-654.
[3] Biney CA and Christopher AB. Ghana Trop Ecol 1991; 32(2): 197-206.
[4] UNESCO. Ground water. UNESCO Environmental and Development Briefs No 1992; 2.14p.
[5] USEPA. Method 1638: Determination of Trace Metals in Ambient Waters by Inductively Coupled Plasma-Mass Spectrometry, EPA 821-R-95–031. 1995; Washington, DC.
[6] APHA, 1998. Standard methods for the examination of water and waste water. 20th Edu., Published byAmerican Water Works Association/WaterEnvironmental Federation, Washington DC., pp: 1287.
[7] UNESCO 2000. Ground Water Pollution. International Hydrological Programme.
[8] Guidelines for drinking water quality, 4th edition, WHO,2011.
[9] APHA, Standard methods for examination of water and waste water. American Public Health Association 21st edition.