Available online at www.joac.info

ISSN: 2278-1862

Journal of Applicable Chemistry

2014, 3 (5): 2181-2187

(International Peer Reviewed Journal)

Short Communication

Heavy metal analysis and WQI studies of the ground water of champavathi river basin, India

G V S R Pavan Kumar*[1], K Rama Krishna[2]

1. Department of Chemistry, M V G R College of Engineering Vijayaramnagar Campus, Vizianagaram-535002 (AP), **INDIA**
2. K Rama Krishna, Department of Chemistry,GITAM Institute of Sciences, GITAM University, Visakhapatnam, **INDIA**

Email: prs_ganti@yahoo.co.in

Accepted on 15th September 2014

ABSTRACT

The present study is the analysis of some selected heavy metals and assessment of water quality based on Water Quality Index (WQI) method in chosen villages of champavathi river basin in Vizianagaram district of Andhra Pradesh, India. Ten different villages were chosen for the study. Different ground water and well water samples were collected and analyzed for physico-chemical parameters such as pH, EC, TDS, THW, Ca, Mg, Na, K, Fe, Cl, nitrite, phosphate, fluoride, total alkalinity for calculating WQI and heavy metals such as, Mn, Cr, Ti, Ba, Pb, As, Hg, Cd , Cu and elements Si and Al by using ICP-OES. Except silicon, all the other metals were found in undetectable range. From the WQI reports it was found that the water samples analyzed, collected from the chosen villages are not suitable for human consumption as they posses high WQI values. From our reports it was found that all the ground water samples collected from the chosen villages and analyzed are free from heavy metal contamination and not potable with respect to the WQI data.

Keywords: ICP-OES, heavy metals, ground water, WHO.

INTRODUCTION

Water quality index (WQI) is a single number derived from various physical, chemical and biological parameters to assess the quality of water. Various methods are available for the calculation of WQI such as Weighted Arithmetic mean, weighted geometric mean, Un-weighted Harmonic Square mean). In the present method, the authors used the following methodology to calculate WQI and the procedure is given under here:

$$W_i = k/S_i$$

Where W_i is the unit weight of and S_i is the standard for i^{th} parameter, K is the proportionality constant.

$$Q = 100V_i / S_i$$

Where Qi is the sub index of the i^{th} parameter, Vi is the monitored value of i^{th} parameter and WQI is calculated as follows

$$WQI = \sum Q_i W_i / \sum Wi$$

Heavy metal is the one with high density and specific gravity with toxic nature. Living organisms require varying trace amounts of "heavy metals". Iron, cobalt, copper, manganese, molybdenum, and zinc are required for humans. Excessive levels can be toxic. Other heavy metals such as mercury and lead are toxic metals and their accumulation over time in the bodies of humans and animals can cause serious sickness. Some of them are dangerous to health and the environment (e.g. mercury, cadmium, lead, chromium),[1] some may cause corrosion (e.g., lead), and others are harmful in other ways (e.g. arsenic may pollute catalysts)[2]. Heavy metal toxicity can cause problems concerned to liver, kidneys, lungs and other vital organs [3]. In literature [4-8] it was found that, on international level scientists have conducted studies on the heavy metal analysis in ground water, surface waters, reservoir waters and sediments. G Biksham et al., studied the heavy metal distribution in sediments of Godavari river basin and that of Krishna river basin. Studies were done by R Ramesh et al., [9,10]. Imran Ahmad Dar et al studied the heavy metal concentration in ground water of Mamundiyar river basin, Tamilnadu India [11].

In the present study the authors aimed at the determination of heavy metal concentrations in the samples of ground water and surface water in some selected villages of champavathi river basin. The river champavathi flows through the district of Vizianagaram of Andhra Pradesh, India. In the present paper the authors determined the concentrations of heavy metals such as Si, Al, Mn, Cr, Ti, Ba, Pb, As, Hg, Cd and Cu by using ICP-OES in the water samples of villages under study.

MATERIALS AND METHODS

Study Area

Vizianagarram (Fig.1) district is one of the coastal districts of Andhra Pradesh. It is located at 18.12°N 83.42°E. It has an average elevation of 74 m (242 f). The district is bounded on the east by Srikakulam District, on the west and south by Visakhapatnam district, on the southeast by the Bay of Bengal, and on the northwest by Odisha state. Vizianagaram district extends over an area of 6,539 $km^{2.}$ The district is recognized by government of India as “backward district” in the north coastal region of Andhra Pradesh. The main rivers flowing through the district are Champavathi, Naqgavali, Gosthani, Vegavathi and Gomukhi. The climate of Vizianagaram district is characterized by high humidity nearly all the year round, with oppressive summers and good seasonal rainfall. The summer season extends from March to May, followed by southwest monsoon season, which continues to September. October and November constitute the post-monsoon or retreating monsoon season. The normal rainfall of the district for the year is 1,131.0 mm, as compared to the actual rainfall of 740.6 mm received during 2002-2003.

The Champavathi River Basin (CRB) is located in Vizianagaram District of Andhra Pradesh bounded by 18^0 0’ – 18^0 28’ 30” ^{N}. Lat and 83^0 2’ 30” – 83^0 36’ 15” E Long. The river originates at an altitude of 1200 m above msl in Andra hilly area and joins the Bay of Bengal near the village, Konada (Lat 18^0 2’ N and Long 83^0 34’ 20” E). The river has a drainage area of about 1410.875 sq.kms (Fig.1). The CRB is in the physiographic province of northern Eastern Ghats. Physiographical, the area is divisible into 1) Hilly terrain 2) Vizianagaram plains with isolated hillocks and 3) Coastal plains. Champavathi River is a non-perennial and medium category watershed It flows through rain fed cultivated areas.

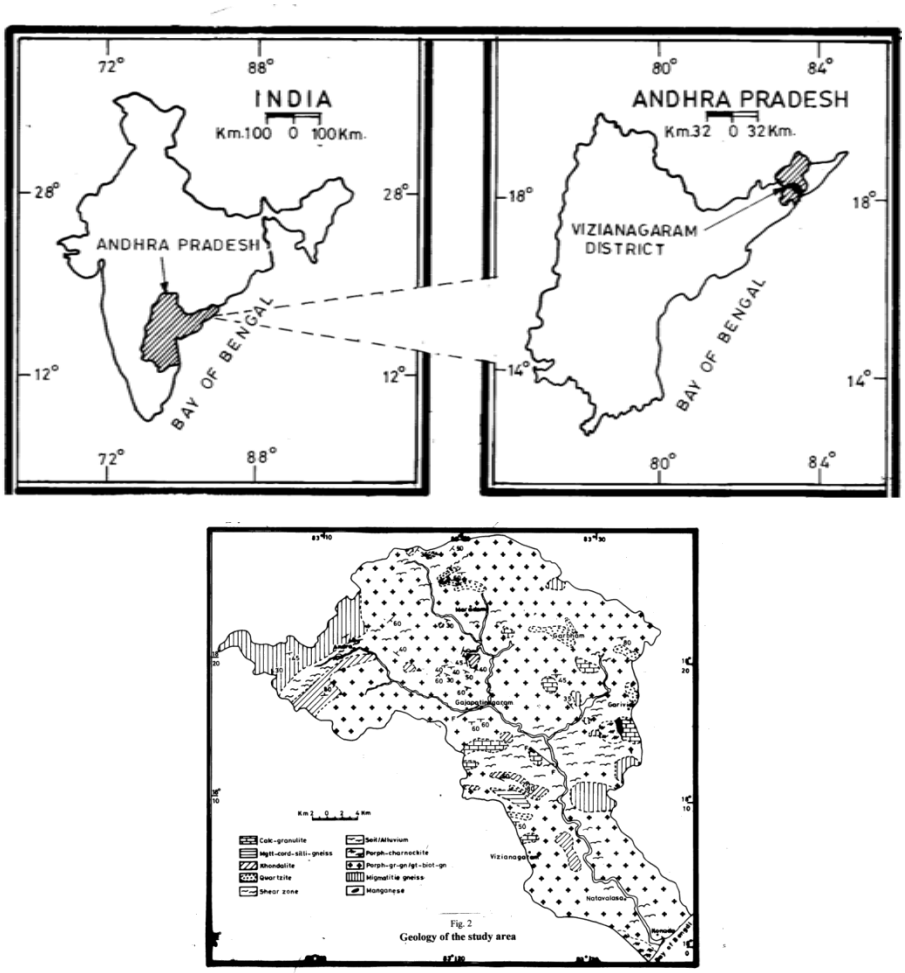

Fig.1 Champavathi river basin, India

Sampling: Composite sampling procedures were adopted in order to get a true representative sample of water from the chosen villages. The samples were collected during different seasons such as April 2013, August 2013 and December 2013. The samples were collected in previously cleaned, dry polyethylene bottles of capacity 1000ml and mixed with appropriate preservatives such as dilute nitric acid, for the determination of heavy metals for further analysis.

Standard methods of APHA [12] were used for the analysis of physico- chemical parameters of the water samples. ICP-OES was used for the analysis of heavy metals. All the chemicals and reagents used were of AR grade only and the aqueous solutions were freshly prepared using double distilled water.

RESULTS AND DISCUSSION

The complete analysis reports for the analysis of heavy metals and WQI in the ground water and surface waters of the chosen villages are presented in table1and 2. Details of villages under study are presented in table.3. From the reports it was found that the concentration of heavy metals under study are not detected in all the samples water such as ground water as well as surface water in all the seasons studied. It indicated that the ground water and surface waters of the river basin are free from heavy metal contamination. The concentration of iron in all the water samples analyzed is found to be in the range of 0.08- 0.1 mg L^{-1}, which is well within the prescribed standard limits.

In all the water samples analyzed, collected from the chosen villages' silicon is present in detectable concentration limit and ranges from 19.01 -28.98 mg/L during April 2013; 19.4- 29.25mg L^{-1} during August 2013 and 19.5-29.35 mg L^{-1} during December 2013. The highest concentrations of silicon were found in the village Saripalli in all the seasons under investigation. The lowest concentration of silicon in all seasons was found in the village Mentada. It was found that the soils of Vizianagaram district contained pegmatite, Garnet biotite, Cordirite, Silimanite and Quartz [13]. Most of these minerals are rich in aluminum, silica and beryllium. Though, the soil contained only metals as mentioned above, the study was carried out to know the presence of any other toxic metals in the ground water of the river basin due to any contamination in the aquifers. And from the ICP-OES analysis results it was found that the water analyzed from the chosen villages of the river basin are free from heavy metal contamination.

From the WQI data, it was found that water samples collected from all the villages under investigation are not suitable for human consumption based on their WQI values. The village Mentada has WQI of 64.6 as least during the season April 2013 and with a value of 97.6 water samples of the village Gajapathinagaram stand the highest. During August 2013 with a WQI value of 67.22 Mentada village stand the least and Gajapathinagaram stand the highest with respect to a highest value of WQI as 105.6. The WQI values calculated for the water samples of village Mentada found to be the least with a value of 68.9 and Gajapathinagaram the highest with 108.6 during December 2013. In all the three seasons under study water samples from the village Mentada showed least WQI value and Gjapathinagaram the highest. All the villages under examination found to have water with poor quality according to their WQI values and unsuitable for human consumption. The water quality index values are presented in Fig. 2, 3, 4 and 5. In the two villages, Nadipalli and Konada, due to the percolation of saline water into the ground water aquifer is responsible for the high WQI values reported and the water unsuitable for drinking. The higher values of WQI reported in the two villages Gajapathinagaram and Aaguru is due to the presence higher concentration of dissolved solids in all the seasons under study. The villages that are situated south eastern region (V1, V3, V6, V8) of the river basin are found have a correlation in the water quality index values and found to lower when compared to those of the villages situated north eastern regions. This is due to the soil texture and nature of the aquifer in the upper and lower catchment areas[13].

Table .1 Heavy metal analysis during April 2013, August 2013 and December 2013

Season / parameter	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10
Cr	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Mn	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ba	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ti	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hg	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
As	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pb	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Table. 2 WQI for all the villages under study in season's mentioned

village	Apr-13	Aug-13	Dec-13
V1	69.49	66.09	69.69
V2	98.28	93.04	98.36
V3	64.6	67.2	68.9
V4	97.6	105.6	108.6
V5	81.71	74.6	79.4
V6	79.19	79.5	81.3
V7	93.4	93.3	95.5
V8	67.7	68.03	69.2
V9	81.8	85.8	82.3
V10	83.3	86.2	87.5

Table. 3 Details of all the villages under study from originating place to estuarine point of the river

S.NO	Village ID	village name
1	V1	Andra
2	V2	Aaguru
3	V3	Mentada
4	V4	Gajapathinagaram
5	V5	Seetharampuram
6	V6	Nellimarla
7	V7	Saripalli
8	V8	A T Agraharam
9	V9	Nadipalli
10	V10	Konada

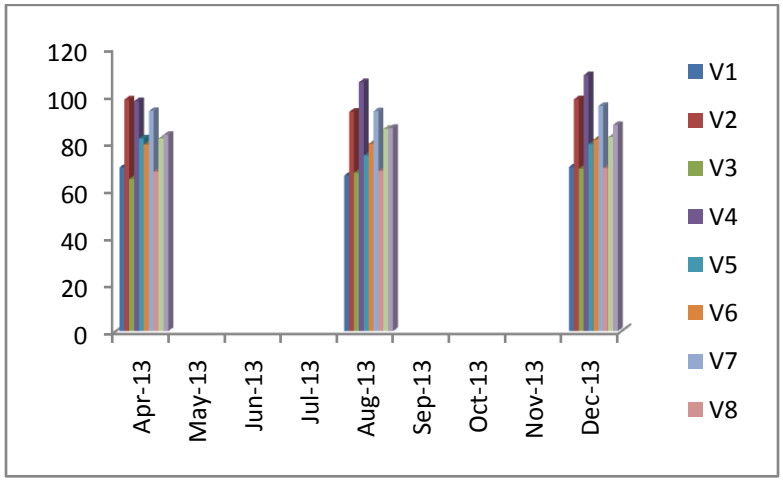

Fig. 2 Comparison between WQI of various villages under study in different seasons

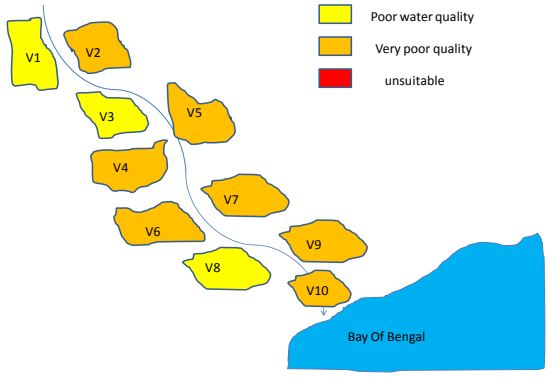

Fig.3 water quality index variation during April 2013

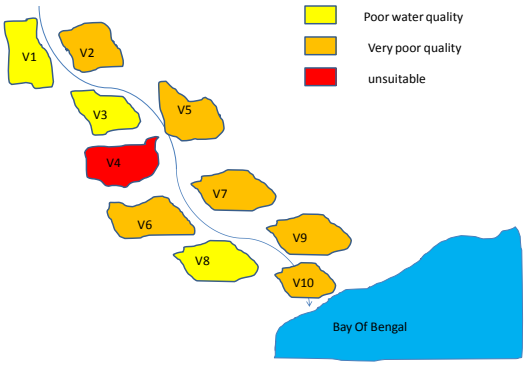

Fig.4 water quality index variation during August 2013

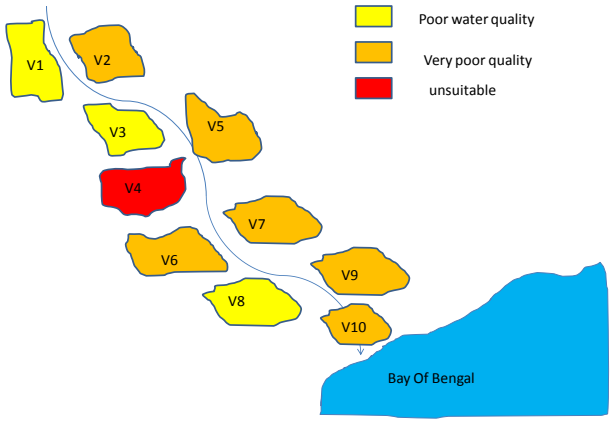

Fig. 5 water quality index variation during December 2013

These methods involve use of solvent free method or use of recyclable organic solvents. The low cost, recyclable solvent system and ready availability of catalyst, an environmentally benign procedure makes this methodology, a useful contribution to the existing procedures available for the synthesis of benzimidazole derivatives.

APPLICATIONS

The present study is applicable for the assessment of water quality of ground water including trace metal analysis throughout the chosen villages of champavathi river basin. From such results the potability of water is ascertained.

CONCLUSIONS

From the results of ICP-OES it was found that the ground water and surface water samples of chosen villages of champavathi river basin are free from presence of heavy metals. In all the seasons under study, silicon found in the water samples analyzed. Hence the water is suitable for human consumption with respect to heavy metal concentrations in them. From the water quality index data it is concluded that the water samples analyzed is not potable as they posses very poor in their quality.

ACKNOWLEDGEMENTS

The authors are thankful to Dr M R P Reddy, Scientist, CMET Hyderabad for all the ICP analyses. The authors also convey their gratitude to the principal and management of M V G R College of Engineering, Vizianagaarm for the facilities their constant support and encouragement.

REFERENCES

[1] C.Michael Hogan. Heavy metal. Encyclopedia of Earth. National Council for Science and the Environment. eds. E. Monosson & C. Cleveland. Washington, D.C. **2010**.
[2] Abdul-Wahab, Sabah Ahmed; Marikar, Fouzul Ameer, Central European Journal of Engineering, **2011 2** (2): 304–313.
[3] Ron Zevenhoven, Pia Kilpinen, Control of Pollutants in Flue Gases and Fuel Gases, The Nordic Energy Research Program Solid Fuel Committee, Espoo, Finland, **2001**
[4] Chandra Kumar Singh et. al., *Environ Earth Sci*, **2013**, 71, 201-206.
[5] Milan Dimkic, Ground water management in large river basins, IWA publishers, **2008**.
[6] Hassam Malasa et al., Journal of Environmental Protection, **2013** 4,818-820.
[7] Suman Banarjee et al., India, Int Jour. Of Chemtech Research, **2011,** 3, 1, 516-522.
[8] A.E EDet and O.E Offiong, Geo journal, **2002**, 57**,** 295-304,
[9] G Biksham et al., **1991**, 17, 2, 117-126.
[10] R Ramesh et al., Environmental geology and Water sciences, **1990**, 15, 3, 207-216.
[11] Imran Ahamad Dar et al., **2012**, Earth Sciences, pp 3, 527-540.
[12] Lenore S C, Arnold E G and Trussel R R, Standard methods for the Examination of Water and Waste water, 17th Edn (American Public Health Association, USA) **1989**, 2.35-4.13.
[13] P jagadesswara Rao et al., 2003, J.Ind.geophysics union, **2003**, **7**, 2, 105-113.