



Determination of Gross Alpha Activity and Physico-Chemical Parameters of Borewell Samples of Mysore District, India

Suriyanarayanan S*, Anil K M, Divya L, Jessen George, Magesh S.B and Rashmi R

Department of Water and Health, Faculty of Life Sciences, JSS University, SS Nagar, Mysore, Karnataka-570015, INDIA

Available online at: www.isca.in, www.isca.me

Received 4th July 2014, revised 19th February 2015, accepted 17th March 2015

Abstract

A study was conducted in Mysore District, Karnataka to determine the gross alpha and physico-chemical parameters of drinking water quality from bore wells samples. The purpose of the study to determine the gross alpha activity of bore well samples of Mysore district and to create a baseline data for ascertaining possible changes in environmental radioactivity due to nuclear, industrial and other human activities. In this study bore well water samples were collected from seven taluk headquarters of Mysore district from January 2014 to March 2014 were subjected to determine the gross alpha activity analysis and detection of physico-chemical parameters like pH, electrical conductivity, alkalinity, total dissolved solids, chloride, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, total hardness, calcium, and magnesium. From this study, it was observed that in most of the locations the quality of water is exceeding the prescribed limits of drinking water. As most of the water samples do not meet the water quality standards, it is recommended that water is not suitable for direct consumption without prior treatment.

Keywords: Gross alpha; physico-chemical; water quality; radioactivity, background radiation.

Introduction

Ground water is the one of the earth's most important and most widespread and highly used resource. Over half of the fresh water on earth is stored as groundwater¹. The increasing interaction of radioactivity and its applications have brought about the need for an assessment of human exposure to radiation. In ground water the physical characteristics of the solid aquifer influences the radionuclide concentration in the stored water². These solids aquifers or rocks known as geological materials usually contain some trace amounts of radioactive elements such as uranium, thorium decay series and non-series of ⁴⁰K, which may dissolve into groundwater system during water/rocks-soils interaction mechanism. Considering the presence of these natural radionuclide's in the groundwater system and the radio toxicity to human, consumption of groundwater with high amounts of natural radionuclide's may rise to internal exposure caused by the decay of natural radionuclide's taken into body through ingestion as well as inhalation. During the decay process, they release several alpha and beta particles which are also responsible for natural radioactivity as well as artificial³.

Determination of gross alpha and gross beta activity concentration levels in groundwater are of particular interest for routine monitoring of radioactivity levels in groundwater resources⁴. Hence, there is a necessity to examine naturally occurring radioactivity in the environment, especially the occurrence of natural radioactivity in groundwater⁵. If the radioactivity level of groundwater is beyond tolerable limits, it could result into several health hazards among the population⁶.

In India few studies has been carried out to determine various chemical parameters in ground water^{7,8,9}. But very few studies are available for the Karnataka region^{7,10}. There is no systematic study under taken to determine the natural background radiation especially gross alpha activity in the ground water quality of Mysore district, Karnataka. In the view of the above present study aims to assess the natural background radiation as gross alpha activity and physico-chemical parameters of the bore well waters in the taluk headquarters of Mysore district.

Material and Methods

Study area: The study was carried out in taluk headquarters of Mysore district. Mysore is one of the major tourist destination in India and second largest city in the state of Karnataka, which lies between 12°18' N latitude and 76° 39' E longitudes and 770m above sea level. The present study focused on seven taluk headquarters of Mysore district. They are Krishna Raja Nagar, Periyapatna, Hunsur, Heggada Devana Kote, Mysore, Nanjangud and Tirumakuda Narsipur.

Collection of Water samples: Water samples were collected from bore wells of seven taluk headquarters of Mysore district from January 2014 to March 2014. The samples were collected in a pre-cleaned, sterilized polyethylene bottles. The samples were subjected to determine the gross alpha activity analysis and detection of physico-chemical parameters like pH, electrical conductivity, alkalinity, total dissolved solids, chloride, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, total hardness, calcium, and magnesium.

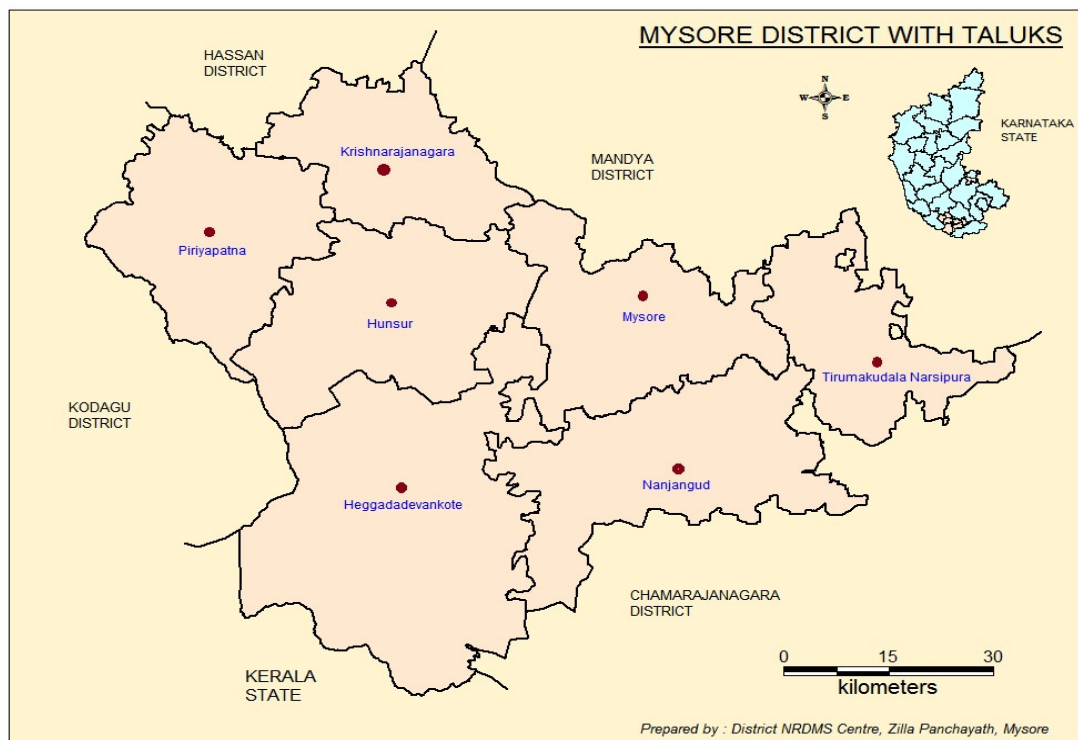


Figure-1
Location Map of the Study Area

Results and Discussion

The observed Gross alpha and physico-chemical parameters showed considerable variations in different samples. The observations are depicted in table-1 and 2.

Gross Alpha Activity: The values of the activity concentrations of the Gross alpha measured in the ground water samples are given in (table-1). The minimum and maximum elevation was observed as 575-821 mts respectively above the sea level. In the present study the gross alpha activity concentration of the ground water samples ranged from 0.0043 Bq/L – 0.018 Bq/L. WHO, (2011) advised that 0.1 Bq/L for gross alpha activity is the limit value for drinking water. It is found that (figure-2) the Gross alpha activity concentrations of the samples are lower than the recommended upper limit value of 0.1 Bq/L.

The Gross alpha activity of the ground water samples were randomly collected at different villages from each taluks in Mysore District, were measured to check the compliance with national and international regulation and obtain the data which can be used as a base line for ascertaining possible changes in environmental radioactivity due to nuclear, industrial and other human activities.

Physico-chemical Analysis of Water: pH: In the presence study the average pH value of the water samples are alkaline ranging from 7.02-7.5 (Table-2) during the sampling period.

According to standard all the samples have pH values within the prescribed limit.

Conductivity: The electrical conductivity of water samples ranging from 549 μmho -2334 μmho . In the present study most of the areas with the permissible limit except Periyapatna. In this study it was concluded that most of the samples do not have corrosive property and needs minimal treatment before used.

Total Dissolved solids: In this study the concentration of total dissolved solids is ranging from 356-1526 mg/L. It is found that all samples are within the limit except Periyapatna according to WHO (2011). It may influence the taste, hardness and corrosive property of the water.^{12,13} The result indicates that the bore well waters are unfit for direct consumption it requires pre-treatment before use.

Alkalinity: In the present study the observed values of alkalinity in seven taluks of Mysore district ranged between 235-612 mg/L. In the present study the Periyapatna sample is exceeding the prescribed range of 600mg/L (BIS, 2012).

Total Hardness: The observed value of Total Hardness in seven taluks of Mysore District is ranged from 475-1333 mg/L as CaCO_3 . In comparison with the prescribed standard of BIS, (2012)¹⁴ and WHO, (2011) all samples had hardness exceeding the limits except Mysore.

Table-1
Gross Alpha Activity of Bore well Water samples of Mysore District

Sl.No	Name of taluks	Latitude and Longitude	Elevation in meters	Name of the villages	Gross Alpha Activity (Bq/L)	WHO Standard (2011) (Bq/L)
1	H D Kote	12 ^o 05'12.087 76 ^o 19'52.841	626	Annur	0.0083	0.1
				Sagare	0.0079	0.1
				Mullur	0.0080	0.1
				N.begur	0.0081	0.1
				N.belthur	0.0085	0.1
2	Periyapatna	12 ^o 20'06.292 76 ^o 05'57.015	783	Abbur	0.0067	0.1
				Begur	0.0069	0.1
				Halasoor	0.0070	0.1
				Kambipura	0.0071	0.1
3	Hunsur	12 ^o 18'20.725 76 ^o 22'40.777	655	Uthenahalli	0.0068	0.1
				Attiguppe	0.0097	0.1
				Dallalu	0.0099	0.1
				Harave	0.0092	0.1
4	K R Nagar	12 ^o 18'20.725 76 ^o 22'40.777	655	Sonahalli	0.0093	0.1
				Udduru	0.0094	0.1
				Abburu	0.0048	0.1
				Bherya	0.0043	0.1
5	T.Narasipura	12 ^o 26'20.930 76 ^o 22'50.138	821	Kuppe	0.0045	0.1
				Sakkare	0.0046	0.1
				Thippur	0.0051	0.1
				Alagudu	0.0090	0.1
6	Nanjangud	12 ^o 12'33.342 76 ^o 54'12.217	575	Vatalu	0.0093	0.1
				Maliyuru	0.0088	0.1
				Hegguru	0.0084	0.1
				Seehalli	0.0095	0.1
7	Mysore	12 ^o 07'10.128 76 ^o 40'43.952	601	Akala	0.013	0.1
				Debur	0.010	0.1
				Golur	0.011	0.1
				Suthur	0.015	0.1
				Yedahalli	0.014	0.1
7	Mysore	12 ^o 18'00.657 76 ^o 38'51.886	667	Anandur	0.0083	0.1
				Belavadi	0.0085	0.1
				Daripura	0.0089	0.1
				Hosakote	0.0081	0.1
				Varuna	0.0082	0.1

Calcium and Magnesium: In the present study calcium concentration ranged between 123-447 mg/L and Magnesium concentration ranged between 250- 1076 mg/L (table-2). It is found that all the samples except that from Nanjangud exceeds from the prescribed standards of BIS, (2012) and WHO, (2011). The Magnesium Hardness exceeds the permissible limit for all the samples compared to the BIS, (2012) and WHO, (2011).

Chloride: In the present study the chloride values of the selected 7 locations ranged from 48-355 mg/L (table-2) and found that most of the samples are below the prescribed value except periyapatna 354 mg/L. The Periyapatna sample is not fit for direct consumption without suitable treatment and it may affect the taste, corrosion and palatability.

Dissolved Oxygen: In the present study all the water sample analysed has dissolved oxygen content ranging from 3.7- 5.0 mg/l (table-2) and are found that the values are within the limit of CPCB, (2004) values of 6 mg/L.

BOD: In the present study all the water samples ranges from 0.3-1.6 mg/L. The highest degree of biochemical oxygen demand (1.6 mg/L) was observed from KR Nagar site and the lowest level (0.3 mg/L) was observed from Mysore.

COD: The chemical oxygen demand ranges from 0.7 mg/L- 4.9 mg/L. In the present study all the chemical oxygen demand values are in within the prescribed limits of BIS, (2012).

Table-2
Physico-chemical parameters of bore well water samples of mysore

Parameters	Months	H D Kote	Periyapatna	Hunsur	K R Nagar	T. Narasipura	Nanjangud	Mysore	BIS (2012)	WHO (2011)
pH	January	7.7	7.7	7.5	7.2	7.6	7.6	7.5	6.5-8.5	6.5-8.5
	February	7.6	7.5	7.3	7.1	7.3	7.5	7.4		
	March	7.5	7.4	7.1	6.8	7.0	7.4	7.2		
	Mean	7.6	7.5	7.3	7.0	7.3	7.5	7.3		
Temp (C°)	January	24	23	22	21	24	23	24	-	-
	February	25	26	23	26	27	26	25		
	March	26	27	28	28	29	28	27		
	Mean	25	25	23	25	26	25	25		
Conductivity (µmho)	January	1297	2056	1299	580	802	479	457	-	1400 (µmho)
	February	1352	2388	1378	612	990	521	509		
	March	1423	2560	1440	772	1026	649	615		
	Mean	1357	2334	1372	654	939	549	527		
Total Dissolved Solids (mg/L)	January	854	1307	809	314	556	340	315	2000 (mg/L)	1000 (mg/L)
	February	912	1544	910	381	593	308	348		
	March	942	1728	958	526	695	426	407		
	Mean	902	1526	892	407	614	358	356		
Alkalinity (mg/L)	January	480	590	208	290	389	256	198	600	500
	February	508	610	271	314	471	302	211		
	March	564	636	392	400	520	352	296		
	Mean	517	612	290	334	460	303	235		
Chloride (mg/L)	January	180.013	301.014	181.001	76.118	103.019	59.018	39.117	1000	250
	February	203.101	356.310	201.215	81.314	143.118	69.104	49.414		
	March	238.507	407.107	230.283	90.468	193.273	78.131	57.570		
	Mean	207.207	354.810	204.166	82.633	146.47	68.751	48.700		
Total Hardness (mg/L)	January	1295	958	1270	600	998	538	403	600	500
	February	1320	1001	1314	629	1014	601	480		
	March	1384	1072	1400	704	1072	688	544		
	Mean	1333	1010	1328	644	1028	609	475		
Calcium (mg/L)	January	240	414	421	289	318	99	191	200	200
	February	251	440	439	308	325	112	229		
	March	280	488	480	328	368	160	256		
	Mean	257	447	446	308	337	123	225		
Magnesium (mg/L)	January	1055	544	849	311	680	439	212	100	50
	February	1069	561	875	321	689	489	251		
	March	1104	584	920	376	704	528	288		
	Mean	1076	563	881	336	691	485	250		
Dissolved Oxygen (mg/L)	January	4.9	4.5	4.3	4.8	3.4	4.5	4.8	CPCB (6mg/L)	-
	February	5.0	4.7	4.6	5.0	3.8	4.7	5.0		
	March	5.2	4.8	4.8	5.2	4.0	4.8	5.2		
	Mean	5.0	4.6	4.5	5.0	3.7	4.6	5.0		
BOD (mg/L)	January	1.0	0.5	0.4	1.1	0.5	0.5	0.2	-	-
	February	1.1	0.6	0.6	1.8	0.6	0.6	0.3		
	March	1.2	0.8	0.8	2	0.8	0.8	0.4		
	Mean	1.1	0.6	0.6	1.6	0.6	0.6	0.3		
COD (mg/L)	January	3.1	1.3	1.1	4.2	1.1	1.0	0.4	250 mg/L	-
	February	3.3	1.6	1.6	5.1	1.5	1.4	0.7		
	March	3.5	2.4	2.3	5.4	2.3	2.3	1.1		
	Mean	3.3	1.7	1.6	4.9	1.6	1.5	0.7		

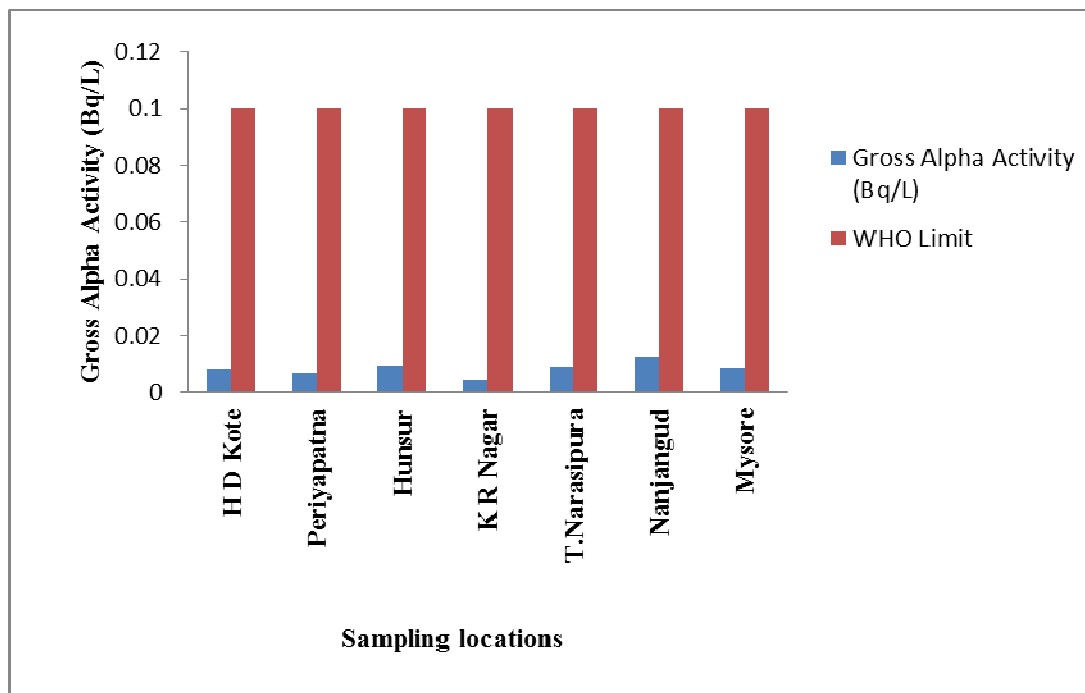


Figure-2
Gross Alpha Activity of Bore well Water Samples of Mysore District

Conclusion

In this present study the gross alpha activity concentration of the samples shows that the values are lower than the prescribed limit (WHO, 2011). The detection of physico-chemical parameters it was observed that in most of the locations the quality of water is exceeding the prescribed limit as per BIS, (2012) and WHO, (2011) standard. The purpose of the study is to check the compliance with national and international regulations and obtain the data which can be used as a baseline for ascertaining possible changes in environmental radioactivity due to nuclear, industrial and other human activities. This is the first attempt to study the radioactivity concentration in ground water samples of Mysore district.

Further detailed study has to be done in order to identify the variation of gross alpha activity in different seasons. The gross alpha activity is found to be within the limits of WHO standards and the physico-chemical parameters are indicates that the quality of the water varies from place to place. Higher values of certain parameters indicate the unfitness of water for drinking purpose. Therefore, it is suggested that further detailed study required in this study area with more samples. It is also suggested more emphasis should be given to reduce total hardness, conductivity, alkalinity, TDS, chloride etc, contents wherever these parameters exceeding the limits of the standards.

Acknowledgement

The authors are thankful to Department of Science and Technology (DST) for providing financial support through

Young Scientist Scheme to the corresponding author.

References

1. Ayodele J T and Abubakar M K., Trace Elements Contamination of Rain water in the Semi-arid Region of Kano, Nigeria, *Journal of Environmental Management Health*, **9(4)** (1998)
2. El-Mageed A. A. I., El-Hadi A., Abbady A. E. B and Harb S., Natural radioactivity of ground water and hot spring water in some areas in Yemen, *Desalination*, (2013)
3. Korkmaz Görür F., Keser R., Dizman S. and Okumuşoğlu N.T., Annual effective dose and concentration levels of gross α and β in various waters from Samsun, Turkey, *Desalination*, **279**, 1-3, 135-139 (2011)
4. Turhan Ş., Özçıtak E., Taşkın H.,Varinlioğlu A., Determination of natural radioactivity by gross alpha and beta measurements in ground water samples, *Water Research*, **47**, 3103-3108 (2013)
5. Nwankwo L I., Determination of Natural Radioactivity in Groundwater :Natural radioactivity in groundwater in Tanke-Ilorin, Nigeria, *West African Journal of Applied Ecology*, **21(1)** (2013)
6. Anjaneyalu Y., Water resource in introduction to environmental science (ed), BS Publication, (2004)
7. Malini S., Nagaiah N., Paramesh L., Venkataramaiah P

- and Balasubramanian A., Groundwater Quality around Mysore city, Karnataka, India, *International journal of Environmental Studies*, **60(1)** 87-98 (2003)
8. Gupta S.C., Chemical character of ground waters in Nagpur district, Rajasthan, *Indian J. Environ. Health*, **33(3)** 341-349 (1991)
 9. Somasundaram M.V., Ravindran G and Tellam J.H., Ground water pollution of the Madras urban aquifer, India, *Ground water*, **31(1)**, 4-11 (1993)
 10. Hegde S.H., Puranik S.C and Abbi A.K., Ground water quality determination in Hubli City area, *Indian J. Environ. Health*, **34(2)**, 138-142 (1992)
 11. WHO Guidelines for drinking water Quality Fourth Edition, Geneva: World Health Organization, (2011)
 12. Hari Haran., Evaluation of drinking water quality at Jalaripeta village of Visakhapatanam district, Andhra Pradesh, *National Env and Poll. Tech*, **1(4)**, 407-410 (2002)
 13. Nirmala B., Sureshkumar B.V., Suchetan P.A and Shet Prakash M., Seasonal variations of Physico-Chemical Characteristics of Ground water samples of Mysore city, Karnataka, India, *International Research Journal of Environmental Science.*, **1(4)**, 43-49 (2012)
 14. BIS, Indian Standards Specification for Drinking Water, IS: 10500. Bureau of Indian Standards, New Delhi, (2012)