Determination of Arsenic, Antimony, Lead and Physiological Parameters in Groundwater of Bhatapara (C.G.)

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Abstract: *This Paper presents the method of determination of Arsenic, Antimony and lead spectrophotometric, electroanalytical (voltametry), activation analysis, atomic fluorescence and mass spectrometry. The description is based on literature data describing the present state in different matrices. The physiochemical parameters for groundwater of Bhatapara. The datas are also compared by methods. The purpose is to observe the behavior of ground water and their levels in different hydro geological environments in order to estimate the ground water resource from time to time and to know the water quality changes. Arsenic pollution is a worldwide problem, most researchers focus on the arsenic originating from the natural sources, human activities, but present paper is dealing with the changes developed in ground water and its effects on human health.*

Keywords: spectrophotometric, electroanalytical, atomic fluorescence, activation analysis, arsenic

1. Introduction

The State of Chhattisgarh lies between North Latitude 17°47' to 24°06' and East Longitude 80°14' to 84°24' (Fig. 1.1). Central Ground Water Board, North Central Chhattisgarh Region, Raipur is carrying out ground water regime monitoring in the State. The State covers a geographical area of 1,37,360 sq. km. Nearly 65.90 % of the total area is covered by tribals and hence it is said as tribal dominated State. The ground water regime is monitored through a network of observation dug wells and piezometers. The monitoring includes measurement of ground water level and quality. The purpose is to observe the behavior of ground water and their levels in different hydro geological environments in order to estimate the ground water resource from time to time and to know the water quality changes. Ground water level is not static. It is always under the influence of time-dependant recharge and discharge factors.

Arsenic is widely distributed in surface water, groundwater, and drinking water. Its concentration in different types of water varies considerably. In some cases, it significantly exceeds expected mean values for arsenic and maximum permissible arsenic concentration allowed for drinking water, indicating a degree of pollution (Fowler et al. 2007). Arsenic pollution is a worldwide problem many scientists have repeatedly expressed concern about. As a result, the biological and environmental consequences of its contamination are being studied in detail. Although most researchers focus on the arsenic originating from the natural sources, human activities (such as smelting of arsenic bearing minerals, the disposal of industrial waste, or burning of fossil fuels) can locally introduce a very high contamination (Bissen and Frimmel 2003; Matschullat 2000).Issue of great importance is presence of arsenic in groundwater used as a source of drinking water.

2. Materials and Method

All samples were collected in polyethylene bottles previously cleaned with metal-free detergent, rinsed with deionized water, then soaked in 5 % nitric acid for 24 h and finally rinsed once again with deionized water. After collection, samples were promptly transported in a cool-box to the laboratory. Total arsenic and arsenic species determination were followed by water quality parameter's investigation (pH, conductivity, COD, BOD, TOC) and determination of major inorganic ions (Ca^{2+}, Mg^{2+}, Na^+, K^+, Cl^-, $SO_2{-}4$, $PO_3{-}4$, $NO{-}3$). Arsenic, antimony and selenium were determined in the samples by inductively coupled plasma optical emission spectrometry (ICP-OES) (Perkin Elmer, Elan 4000). The risk of arsenic, antimony and selenium levels in groundwater to adults and children within the different study areas [residential, commercial, industrial and agricultural] was evaluated based on the risk assessment techniques

3. Analysis of Water Levels

The ground water levels observed over a period provides valuable information on the behaviour of the ground water regime, which is constantly subjected to changes due to recharge and discharge phenomena. A balance between these two factors results in the decline or rise in the ground water storage. When the recharge exceeds discharge there will be a rise in the ground water storage and vice versa. On the other hand a rise in water level may be due to an increase in rainfall and/or due to changes in irrigation practices. The dug wells are tapping the phreatic aquifer which is mostly limited to a depth of 15 m. The depth of piezometers which are tapping both the phreatic and deeper aquifers varies from 18 to 90 m. Hence the water level recorded in the piezometers may not be the same as that of dug wells for a particular period though both the structures are in the same place. In this report the water level data collected from the dug wells is presented. The water level in some of the wells on the southern part of the State could

not be measured due to various reasons. Hence those areas are left blank while preparing different maps.

The factors contributing to the ground water quality are the chemical composition of the rainwater, the soil types and the mineralogy of the rock formations. The geochemical processes in the soil zone and in the underlying unsaturated and saturated zones, temperature, pressure, duration of contact of the percolating water and the surrounding media, and other associated factors determine the chemical composition of the ground water. Pollution from near surface sources arising out of the human activities like industrial wastes disposal, use of fertilizers, pesticides also influence the ground water quality. The purposes of ground water quality sampling are varied viz. evaluation of regional water quality, detection and assessment of the extent of the contaminant release. In this context the important attributes are location and number of monitoring wells for ground water sampling. The information from the ground water sampling network is related to the number of stations to be sampled and the frequency of sampling. Due to slow rate of ground water movement, the ground water quality does not change rapidly.
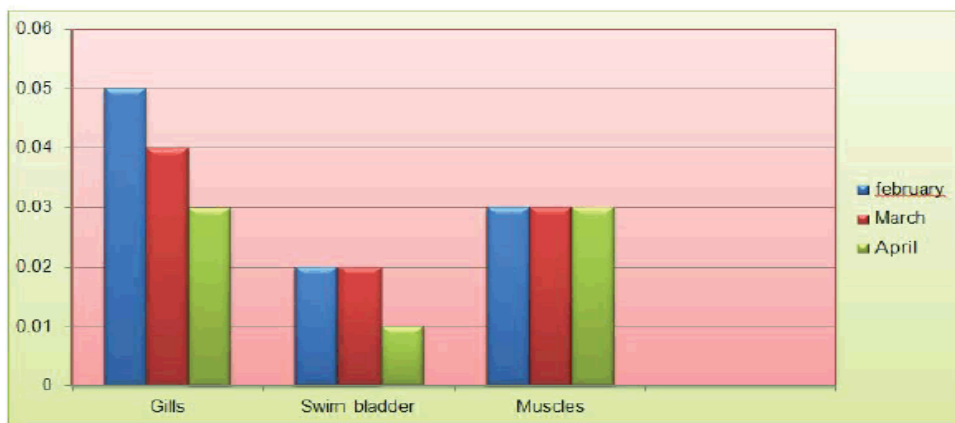

Figure 1: Showing comparative result of lead concentration observed in February, March and April.

4. Results and Discussion

After analysis of all selected parameters results were obtained. In this project we have taken ground water for the monitoring and determined the extent of Pollutant. The selected spots are Bilaigarh (GT1), Bhatgaon (GT2), Tenganakachhar (GW1), Chhuiha (GW2). In this chapter only discussed the value of temp., pH, EC, TDS, TS, TSS, acidity, alkalinity, total, permanent, temporary hardness, demand analysis, DO, BOD, COD and same selected anions such as fluoride, chloride, sulphate specially arsenic etc. and the results were compared with the desirable and permissible limit recommended. Almost all water solids of the Balodabazar were affected by the high value of TDS and TS than desirable and permissible limitation.

The chemical quality of ground water was determined from over 100 water samples collected from the water resources around Chhattisgarh. The samples were collected in pure cleaned polythene containers after rinsing with the water samples and were stored in cool place. These samples were collected during the month of May 2020 in the pre monsoon period, when the concentrations of ions were maximum. The water samples were analyzed for the major ions viz. pH, EC, CO3, HCO3, CI, Ca, Mg, TH, TA, Na, K, SO4, NO3, as, sb, pb and F. The TDS, Total alkalinity were calculated by the obtained conductivity value and carbonate, bi carbonate ion concentration. From the observation table it may be seen that the chemical quality of the ground water is suitable for drinking, domestic, industrial and agriculture uses in most of the places whereas in few places instinct of contamination is observed

that is due to local phenomena. The chemical analysis shows that the ground water is neutral to low alkaline in nature. The pH value was determined with direct reading pH meter. The electrical conductivity of water is also expressed as inverse of the electrical resistance across one cm cube of water. It is related to the TDS because it is a function of concentration of all ionic solutes. The EC is temperature dependent and all the readings are related to the equivalent reading at 25° C. The EC values for the groundwater in Chhattisgarh varied between 68 and 3840 micro-Siemens/cm at 25° C. In around 90.82% of the water samples (693 samples), the EC values are found less than 1000 micro-Siemens/cm at 25° C (i.e. 650 mg/l TDS) and is within the prescribed BIS limit for drinking purposes.

Table: Method of Different Water Quality Parameters

S.N.	Parameters	Unit	Methods Of Analysis	Instruments/Apparatus
1	Temperature	°	° Electrometric	Water Analyser Kit
2	pH -		Electrometric	Water Analyser Kit
3	Electrical Conductivity (EC)	μmhos/cm	Electrometric	Water Analyser Kit
4	Turbidity	NTU	Turbidity metric	Water Analyser Kit
5	Total Dissolved Solid (TDS)	mg/L	Gravimetric Crucible	heating unit/Muffle furnance
6	Total Solids (TS)	mg/L	Gravimetric	heating unit/Muffle furnance
7	Total Suspended Solid (TSS)	mg/L	Mathematical	
8	Total Hardness (TH)	mg/L	EDTA Titrimetric Method	Titration
9	Alkalinity	mg/	Titrimetric Method	Titration Unit
10	Dissolved Oxygen (DO)	mg/L	Electrometric	Water Analyser Kit
11	Biological Oxygen Demand (BOD)	mg/L	Incubation Method	Titration Unit
12	Chemical Oxygen Demand (COD)	mg/L	Digestion Method	Refluxing Unit
13	Chloride (Cl^-)	mg/L	Argentometric Method	Titration Unit
14	Fluoride (F^-)	mg/L	SPADNS Method Digital	Spectrophotometer

5. Result and Discussion

After analysis of all selected parameters results were obtained. In this project we have taken surface and ground water for the monitoring and determined the extent of Pollutant. The selected spots are Bilaigarh (GT1), Bhatgaon (GT2), Tenganakachhar (GW1), Chhuiha (GW2), Sivarinarayan (GR1). In this chapter only discussed the value of temp., pH, EC, TDS, TS, TSS, acidity, alkalinity, total, permanent, temporary hardness, demand analysis, DO, BOD, COD and same selected anions such as fluoride, chloride sulphate etc. and the results were compared with the desirable and permissible limit recommended.

Temperature, PH & EC:- Temperature of the various water were found in the range from 20^0C to 30^0C. The maximum temp. was recorded at sampling point GR1,GW1 23.32^0C pH was obtained from 7.21 to 7.85 as low and high value, The data of pH of different sampling stations clear indicated the mostly water sources were alkaline in nature. This value was above the permissible limit. Electrical conductivity of different water systems were noted from 705.25 μmhos/cm to 723.87μmhos/cm. as the minimum and maximum value. The large value of EC value was due to dissolved of high magnitude of organic and inorganic salts.

TS, TDS, TSS: There parameters of water quality were determined the soluble ions; cations and anions and also confirmed the extent of their ions. Gravimetric method was used for the calculation of these parameters. Total solids was obtained in the range of 451.23 mg/L to 455.87 mg/L as the minimum and maximum value, GT1 spot was showed low value while GW1 sampling point was noted high value, both datas were the permissible limit 2000 mg/L recommended. Total dissolved solids are other parameters, which is also used for the determination of soluble ions. The result of the parameter was obtained from 438.94 mg/L to 445.99 mg/L in the from of min. and max. value. Sampling spot GT2 was responsible for the low value while GW2 water sample was got high value of TDS, TSS, was calculated out by the theoretical with using formula TSS = TS – TDS. Almost all water solids of the Baloda Bazar were effected by the high value of TDS and TS than desirable and permissible limitation.

Demand analysis: In this analysis we have taken three different water quality-dissolved oxygen (DO), Biology Oxygen demand (BOD), Chemical Oxygen Demand (COD). There parameters were determined the amount and extent of dissolved oxygen DO was found 5.4 mg/L to 5.5 mg/L as the min, and maximum value for the sampling spot GW1 and GW2 respectively.

The low value of DO showed high degree of pollutant. Were present 0.9 and 1.3 mg/L of BOD was detected in two sampling location GW1 and GR1. Rest water samples were also expressed the amount of BOD in low amount which were the permissible value; 5.0 mg/L recommended. The COD was observed by the titrimetric method from 1.9 mg/L to 2.1 mg/L on the spot GW1 as well GW2 as low and high value then there datas were compared with the standard data.

Anion parameter: Fluoride, chloride and sulphate ion was consideration as the anion parameters. F^- ion was detected by spectrophotometric method and its range was recorded 0.5 mg/L to 1.0 mg/L as the low and high value on sampling spot GW2 and GW1 respectively. Chloride ion was absorbed in the range of 204.23 mg/L to 210.25 mg/L as minimum and maximum value. Except sample of GR1, GW2 were showed the amount of chloride ion high the permissible value.

Hardness parameter:- These parameter contain, we was determined the permanent, temporary and total hardness was detected from 284 mg/L to 298 mg/L as low and high value on sampling spot GW1 and GT2. Permanent hardness was observed in the range of 4.17 mg/L to 497 mg/L as the

minimum and maximum value. The maximum value was compared to the standard value. Temporary hardness are generally measured of fresh collected water. Its value was found from 506 mg/L to 778 mg/L as low and high value n the water collection spot GW1 and GT2

6. Conclusion

Environment is provided favorable conditions for surving animals. Plants and men. Air, water and soils are basic parts of environment. Now owing to huge commercialisation, anthropogenic activity acid rain, unscientifically using of fertilizers, deforestation and over human population, the component of the planet become gradually changes. As a result creating global worming and altheration of climate cycle. Air has been lost the own properties whereas water has become extreme contaminated so unfit for the human, inomitralization and agricultural consumption. The fertility of soil has also been deteriorated, resulting crops yielding regularly decreases. Ultimately we can say the earth planet is going to destroying. In present study, we have undertaken to determine the water quality status of Balodabazar and this study was categorized in following five chapters.

In chapter first we have discussed the elementary part of environment; ecosystem and cause of pollution we have already mentioned the occurrence of water as well the physical and chemical properties. Past work review, actual plane and list of references were described in last of chapter.

Experimental portion of the study was detailed discussion in the chapter two. In thus part of the dessertation required, concise procedure, formula and table of result were fully described. At the end of the chapter listed short references.

Chapter 3 included the result and discussion of the experimental data.

pH of the study field clear indicated the nature of different water bodies is from neutrals to alkaline in nature. The maximum value of pH was detected 7.85 on the sampling spot TW1, which was below of range from the standard value. Electrical conductivity was measurement by the digitals temp. Compensation conductometric method. Its value is depending upon the quantitative of dissolved ions. The higher value was reported at sampling spot GW2 723.87 μmho/cm due to presence of inorganic and organic ions.

Total solids and total dissolved solids were observed in the high value of spot GW1, GW2, GW2. These datas were below from the permissible-limits owing to the presence of soluble and suspended dust particles these parameters were occurring in maximum amount. Hardness was determined in terms of permanent, total and temporary. These water quality was fixed by the volumetric means. Total hardness was obtained as maximum value 298 mg/L on the sampling spot TG2. The hardness and chloride of Ca^{++}, Mg^{++}, Fe^{++}, Sn^{++}ions etc. Temporary hardness may be removed by the boiling of water sample.

In demand analysis we was preferred dissolved oxygen, chemical oxygen demand and biological oxygen demand.

The standard value for these parameter was 5, 10, 5 gm/L as per recommended. The minimum value of DO was 5.5 mg/L for spot GW2 and maximum value of BOD and COD for sampling spot GR1, GW2 were reported in this investigation.

Anion was analyzed only fluoride, chloride as per our lab facilities fluoride and was determined by the spectrophotometer while chloride was calculated by titrimetric method. Fluoride was detected 1.0 mg/L as the high value on sampling spot TW1, whereas chloride was noted 210.25 mg/L as maximum value on the sampling spot GW2. Which was below the permissible value from the analytical data of these sampling station supported in reaching at that point of conclusion, where pollution of water bodies are permissible.

7. Acknowledgement

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Observation Table-2 Arsenic, Antimony and lead Levels (µg/L) in Groundwater

Codes	Arsenic		Antimony		lead	
	Mean±SD	Range	Mean±SD	Range	Mean±SD	Range
GW1[*]	0	0	19.0±21.2	(0–45.0)	21.2±19.6	(2.0–43.0)
GW2[*]	0	0	28.0±15.3	(10.0–46.0)	20.7±19.3	(1.0–32.0)
GW3[*]	0	0	25.8±29.8	(0–67.0)	12.8±11.4	(0–26.0)
GW4[*]	6.67±8.48	(0–21.0)	28.8±25.2	(0–66.0)	28.7±21.1	(4.0–53.0)