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Analysis of Chloride, Sodium and Potassium in Ground-water Samples of South Rourkela ,Odisha, India

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Abstract

The present study the quality of ground water quality was carried out in South Rourkela. The analysis of ground water characteristic provides important information in water resource management .About 45 nos of groundwater samples were collected from different locations in and around South Rourkela in the pre monson and post monsoon month during the year 2015-16 from different bore wells/dug wells. The parameters selected for the study were Chloride, Sodium and Potassium.. The quality of groundwater in this area is mostly moderately hard. The evaluation of quality of water has been made by using WHO, Indian standards classification. The results indicate that groundwater in a few sampling sites, were unsuitable for domestic purpose and irrigation.

Keywords: *Water quality, Groundwater, Chloride, Sodium, Potassium.*

Introduction

Water is an universal solvent and most chemical compounds ionized readily in water and provide many radicals and considerable versatility in the rearrangement of chemical substances. All biological reaction take place in water and it is the integrated system of biological metabolic reaction in aqueous medium for sustenance of life. The properties of water as a solvent relates to the polarity for water molecules .Many molecules that are important in living things have Polar Regions. The positive regions of such molecules are attracted to the negative ends of water molecules and vice versa. The groundwater chemistry is controlled by the composition of its recharge components as well as by geological and hydrological variations within the aquifer. Many a time ground water carries higher mineral contents than surface water, because there is slow circulation and longer period of contact with sediment materials in case of groundwater .So the problem is therefore determining what quality of water is needed to meet a given purpose And finding the practical means of achieving that quality. Approximately 26 % of the inhabitants use the public water supply; the rest obtain their water from shallow drilled or dug wells or Bore wells. The usage of groundwater has in-creased substantially in Rourkela. Hence, it is necessary to undergo for quality analysis of groundwater in order to assess its suitability for consumption, irrigation and industrial activities.

Due to Industrialization and growth of population the quality groundwater has become a major concern, firstly because of increasing utilization for human needs and secondly improper practices of waste disposal. The groundwater is believed to be comparatively much clean and free from pollution than surface water. But the most common and wide spread threat is associated with water contamination either directly or indirectly by sewage, industrial waste of every conceivable kind and many of them are highly toxic.

Water quality criteria of various groundwater has been studied from different sources e.g. Tube well, Dug well, Bore well etc. by a number of Researchers. The Ground Water quality parameters of in some city demonstrate that, expansive positive relationship amongst BOD and Permanent hardness(r=0.991) and for BOD and aggregate Hardness is r=0.989.[2] Another study of ground water found that physio synthetic parameters like Nitrates', Fluorides, Phosphates, Iron and Sulfates were observed to be within the permissible limit .[11]

Ground water chemistry also depend on overwhelming metal substance in water Cd, Pb, Fe, As and Se and it has been found out that the levels are higher than points of confinement recommended by BIS for drinking water because of overflow from mining fields, residential discharge, mechanical discharge and so on.[6,5] .Even the drinking water of township are of the steel city are having higher contents of Nitrate, Chloride ,calcium and Magnesium. [14]

However in some of the city area other than industrial belt, the presence of Nitrate, Sulfate, Chloride and Phosphate in drinking water and the anions acquired were well inside allowable cut off points suggested by WHO and ICMR.[7,8]

The inorganic anions like Nitrate, Sulfate Fluoride and Phosphate in drinking water also demonstrates regular variance in the Port area [9,2]

However in contrast, the tube well water are found to be unacceptable for drinking[13] but the bore well water are found to be within reasonable range [12] It has also been observed that out ground water pollution due to iron content and water quality in and around tribal belt are causing health disorders . [1]

Justification of Present Study

An attempt has been made to study the quantification of Chloride, Sodium and Potassium in South Rourkela which is dominated by Villages whose source of earning is agriculture.

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Chloride is regularly connected with sodium since sodium chloride is a typical constituent of some water sources, particularly well water. Levels above 140 ppm are thought to be lethal for plants.(7)

Sodium is the principal electrolyte in the extra cellular fluid which maintains normal osmotic pressure and water balance along with other ions. It maintains the normal irritability of nerve cell and help muscle contraction.

Potassium is required for enzymatic reaction which takes place within the cell. Sodium and Potassium are chemicals commonly found in soil and rocks. Both are often associated with Chloride and Bromide.

Sodium in drinking water regularly introduces no wellbeing dangers, as around 99 percent of the salt admission per day is from nutrition and just around one percent from water. People on a low sodium diet because of a hypertension or other therapeutic issues are frequently confined to water containing less than 20 milligrams for every liter of sodium.

In the above back drop, the present study has been carried out in South Rourkela where the inhabitants are dependent on Dug well and Bore wells and there is always a potential risk of ground water contamination by agricultural chemicals. It is necessary to understand the quality analysis of ground water to assess the suitability for consumption.

Study Area

The study was conducted in the Rourkela region in Sundargarh district of Odisha. Sundargarh is one of the 30 districts of Odisha. It is located in the northern extremity of Odisha that lies between 21°32' and 22° 32' North latitudes and 83° 32' and 85° 22' East longitudes. Its total geographical area is 9, 71,200 Hectare. The population of the district is 2,080,664 out of which the tribal constitute around 51% (2011, Census).

The layout of Rourkela Township began in the 1950s, when the Government of India decided to locate its modern steel plant under the aegis of the public sector in that locality. The city came up on a spot which formerly consisted of 30 tribal hamlets and because of the existence of a small railway station, village Rourkela was more prominent among them. In Rourkela, the giant public sector steel plant is the pivot around which social, cultural, political and economic activities revolve. Apart from the above, there are many Small, medium and Large scale industries in and around Rourkela. Rourkela goes under tropical rainstorm atmosphere and is more similar to that of the Deccan Plateau. Being in the North Eastern corner of the Deccan Plateau, the atmosphere is milder than the atmosphere of the fundamental Deccan area. The

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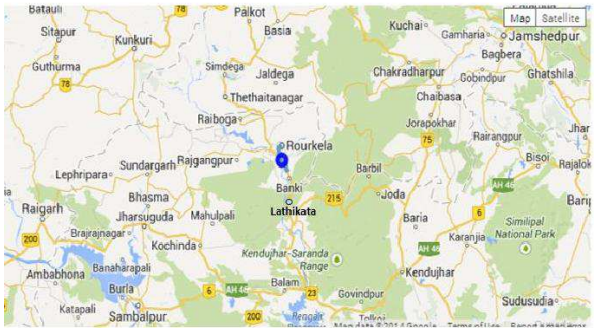
atmosphere is with hot and dry having high dampness (85 %) amid summer season. Normally, there is heavy rainfall during the South West monsoon and that of light rainfall during the pre-monsoon seasons. The South West monsoon usually onsets during second week of June and retreats by mid-September.



Overview of Rourkela

Layout of Sundargarh district

Methodology

The groundwater samples were collected from 45 bore wells/Dug Wells/Tube wells in selected stations of South Rourkela as shown in Table 1

Sl.No	Station Name	Sample Code
1	Balijodi (DG)	S1
2	Jalda (TW)	S2
3	Hanunamandir(TW)	S3
4	Deogaon (TW)	S4
5	RSP (Supply water)	S5
6	Dharmadihi (TW)	S6
7	Fertilizoer Township (TW)	S7

8	Tarkara,near Brahmani River (BW)	S8
9	IDL Colony (TW)	S9
10	Balijudi Lower(TW)	S10
11	Balijudi Upper (TW)	S11
12	Ramjhudi (TW)	S12
13	Kharuatoli (TW)	S13
14	Sana Sonaprabat, Near Dharamdihi (DG)	S14
15	Bada Sonaparbat	S15

Table 1: Table showing Sample codes and Station Names

Sample Collection and Analysis

The samples were collected according to the standard techniques prescribed by APHA. Before water testing, all the twofold stoppered polythene holders were cleaned and washed altogether with water samples to be analyzed .The chemical analysis was done utilizing the standard techniques. The samples were analyzed for different parameters such as Chloride, Sodium and Potassium. The groundwater samples are collected in the pre,- monsoon and post monsoon period in the year of 2015-16. All reagents utilized were of diagnostic evaluation. Samples were unfiltered and the concentration of the different parameters could relate to the aggregate concentration. Sodium (Na) and Potassium (K+) were determined by flame photometer and Chloride (Cl-) was determined by utilizing standard AgNO3 titration.

Results and Discussion

Water naturally contains number of different dissolved inorganic constituents. The major cations are sodium, and potassium and the anions are chloride found in most of the groundwater. Higher concentration of Chloride is observed during post and pre mon-soon compared to Monsoon except three

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stations i.e Deogaon ,IDL Colony and Dharamdihi . . Concentration of Sodium in all sampling stations in all the seasons is observed within permissible limit except one station i.e. Bada Sonaparbat . However higher concentration of Sodium is found during post and pre monsoon as compared to monsoon .The increasing sodium in to groundwater is likely due to leaching of soaps influence and study area and owing to use of fertilizer in some villages near to agriculture areas. The value of Chloride in ground water in all the seasons under consideration is ranged between 4.82 mg per litre to 85.63mg per litre. The lowest value of Chloride in pre and post monsoon concentration is 9.57 mg at Station-9 and 8.74 mg per litre at station-7 respectively. But the lowest concentration of Chloride is observed during monsoon in Station-6.

As compared to Chloride the level of Potassium and Sodium are high because of presence of Salt in ground water. The Sodium concentration observed in the ground water in post monsoon comparatively higher than the pre monsoon. The lowest concentration of Sodium during post monsoon is 10 25mg at Station-2 and highest in Station-15 which 56.69 mg.Similar studies of well water of SAIL Township in Ranchi and Prakashan District of A.P. have been carried out and found to be polluted in nature . (10,14)

SL.No	Station Name	Sample Code	Chloride (Cl)			Sodium (Na)			Potassium (K)		
			POM	PRM	MON	POM	PRM	MON	POM	PRM	MON
1	Balijodi (DG)	S1	34.65	12.45	32.28	16.24	12.26	15	9.51	10.02	8.0
2	Jalda (TW)	S2	11.74	12.58	11.74	10.25	10.82	8.2	4.61	4.15	2.1
3	Hanunamandir(TW)	S3	11.74	12.62	9.43	18.52	16.96	17.2	12.64	12.25	10.6
4	Deogaon (TW)	S4	8.95	9.57	8.93	11.16	8.42	10.2	4.18	4.68	5.1
5	RSP (Supply water)	S5	10.25	12.68	9.57	10.26	14.25	6.8	6.85	10.26	0.4
6	Dharmadihi (TW)	S6	11.74	16.58	4.82	11.25	14.25	9.2	5.62	8.49	4.4
7	Fertilizoer Township (TW)	S7	8.74	10.26	7.71	12.62	10.82	11.9	8.45	6.45	10.8
8	Tarkara,near Brahmani River (BW)	S8	15.56	16.86	12.53	15.62	12.26	11.6	10.74	7.84	6.3
9	IDL Colony (TW)	S9	8.64	9.57	7.88	12.55	10.5	10.7	3.61	4.69	2.8
10	Balijudi Lower(TW)	S10	16.58	12.45	17.12	11.24	10.05	10.2	6.55	7.16	6.1
11	Balijudi Upper (TW)	S11	16.96	10.98	17.12	12.26	10.08	11.2	8.45	6.38	6.1
12	Ramjhudi (TW)	S12	16.62	12.36	15.54	14.25	13.15	11.6	6.88	7.05	6.3
13	Kharuatoli (TW)	S13	12.98	10.68	13.60	14.63	11.31	11.7	4.12	6.24	2.8
14	Sana Sonaprabat, Near Dharamdihi (DG)	S14	14.52	10.56	12.63	10.96	8.45	11.5	7.58	4.96	6.5
15	Bada Sonaparbat	S15	83.62	85.63	81.42	56.69	42.12	106.7	20.63	16.59	10.1

Table 1 : Data showing Various Concentration of Cl,Na,K in various periods.

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In the study area there is no significant changes in Chloride concentration and it ranges from 4.8 to 83.62 mg/l . From the graph 1,2 & 3, it can be seen that, the concentration of Chloride, Sodium and Potassium in the pre ,post and in monsoon concentrations are in definite limits. However, Potassium found in groundwater ranged between 3.61 mg/l to20.63 mg/l during post monsoon and between 6.15 mg/ l to 16.59 mg/l during pre-monsoon. The level potassium falls in between 0.4 mg at Station-5 to 10.8 mg at station-7. In maximum samples the concentration of Potassium exceeds the permissible limit. Thus, the excess amount of potassium present in the water sample may lead nervous and digestive disorder. Leaching of Potassium through soil profile in to ground water is possible and thus adding to the increase amount of Potassium. Excess Potassium if found in drinking water could be a general concern for health . Those who are suffering from kidney disease, heart disease, coronary artery disease, hypertension, diabetes should not drink water from a water softener that uses potassium chloride.

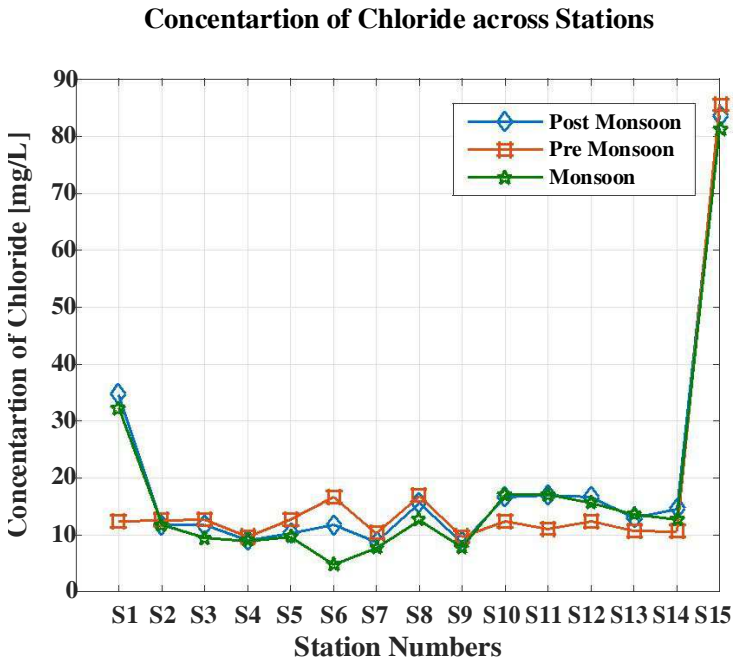

Figure 1: Concentration of Chloride

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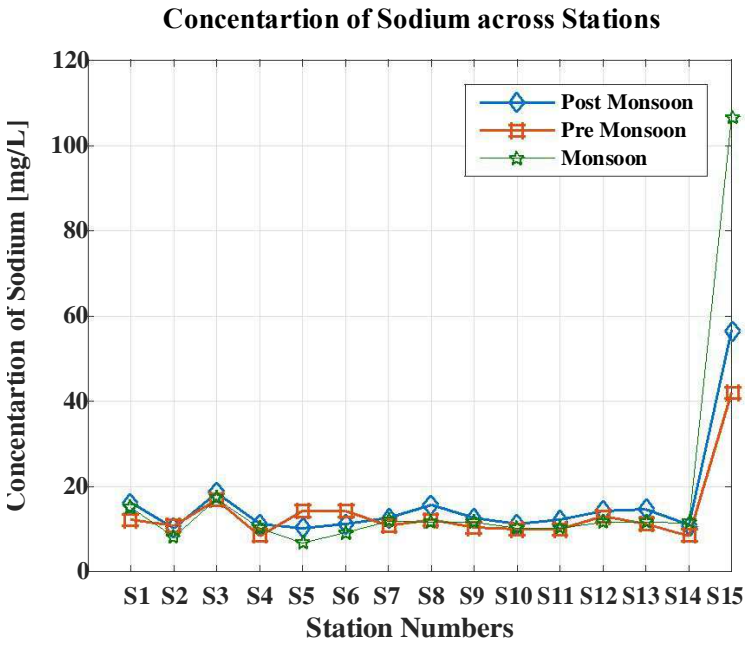

Figure 2: Concentration of Sodium

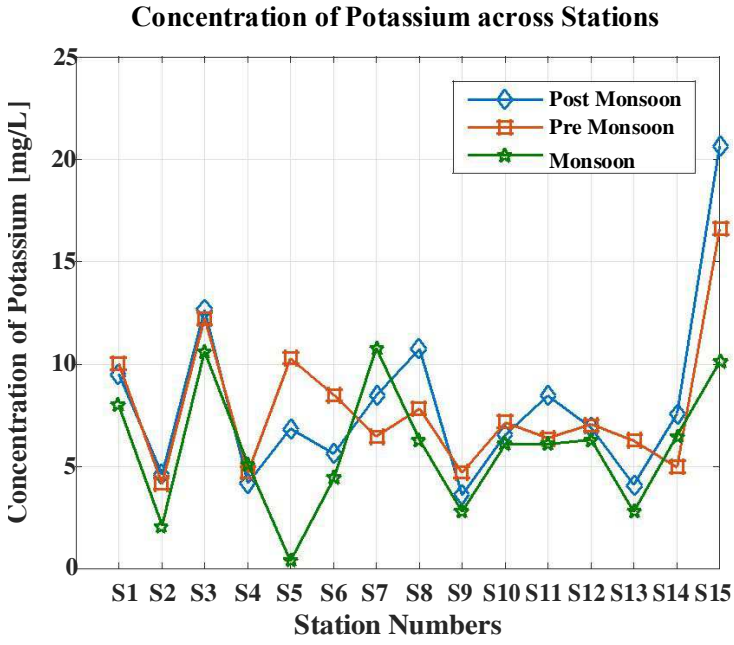

Figure 3: Concentration of Potassium

Conclusion

In conclusion, the concentrations of the investigated major ions like chloride, sodium and potassium in the ground water samples from South Rourkela are within the permissible limits except the Potassium which is above the permissible limits for drinking water recommended by BIS (1991) and WHO (1984).

Above cited results shows that the overall water quality of South Rourkela is suitable for drinking purpose as well as domestic purpose in absence of other sources

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