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ANALYSIS OF WATER QUALITY PARAMETERS OF GROUND WATER NEAR AUTONAGAR INDUSTRIAL AREA, GUNTUR, ANDHRA PRADESH, INDIA

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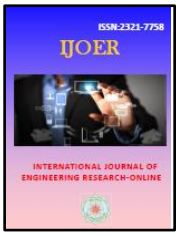

ABSTRACT

The seasonal variations of ground water parameter were studied in 2015 by collecting the samples from three locations near to Autonagar industrial area Guntur district, AP, India and were analysed for various parameters like PH , Electrical conductivity, Turbidity, Total dissolved solids, Total hardness, Sodium , Potassium, Fluoride and Chloride. From the overall analysis, it was observed that there was a slight fluctuation in the physic-chemical parameters among the water samples studied. Comparison of the physic-chemical parameters of the water samples with WHO and BIS limits showed that the ground water is highly contaminated the water samples collected from the Autonagar industrial area compared with other two locations and account for health hazards for human use.

Key words: Ground water, Autonagar, Electrical conductivity.

Introduction:

Ground water is considered as one of the purest forms of water available in nature and meets the overall demand of rural as well as urban population. With the growth of industry the ground water is made susceptible for contamination due to addition of waste materials. Waste materials from the factories percolate with rain water and reach aquifer resulting in erosion of ground water quality. Groundwater is used for domestic, industrial, water supply and irrigation all over the world. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population, unplanned urbanization, industrialization and too much use of fertilizers and pesticides in agriculture (Joarder et al., 2008). Ground water meets domestic needs of more than 80 % rural and 50 % urban population besides irrigation. Around two fifth of India's agriculture output is contributed from areas irrigated by groundwater (Anita and Gita, 2008). Over exploitation of ground water through the bore well and their improper handling resulted in very low ground water levels besides contamination of even bore waters at some places. The addition of various kinds of pollutants and nutrients through the agency sewage, industrial effluents, agricultural runoff etc. in to the water bodies brings about a series of changes in the physicochemical characteristics of water, which have been the subject of several investigations (Mahananda et al., 2010). The availability of ground water depends upon the rate at which it is recycled by hydrological cycle than on the amount that is available for use at any moment in time. According to WHO organization, about 80% of all the diseases in human beings are caused by water. Once the groundwater is contaminated, its quality cannot be restored back easily and to device ways and means to protect it (Maniyar, 1990).

The toxicity of trace metals in water depends on the concentration of the metal below a certain level, which could be considered as essential for biochemical processes. However, in certain cases, high levels could bioaccumulate raising

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toxicity concerns. Water quality data is essential for the implementation of responsible water quality regulations for characterizing and remediating contamination and for the protection of the health of humans and the ecosystem. Regular monitoring of groundwater resources thus play a key role in sustainable management of water resources.

The quality of water is of vital concern for the mankind since it is directly linked with human welfare. Therefore, monitoring the quality of water is one of the essential issues of drinking water management Considering the above aspects of groundwater contamination, the present study was undertaken to investigate the impact of the groundwater quality water samples at Autonagar industrial area Guntur district, A.P, India.

Materials and Methods

The study site the research work was conducted in Autonagar industrial area which is being located between Guntur and Vijayawada. There are different industries being located in the area such as chemical industries, hazardous waste reprocessing industry, re-cycling/ reprocessing used oil industry, lead acid storage batteries industry, animal feeds industries and some other agro based industries. With this regards present study is a taken assessment of groundwater quality in the region of Autonagar industrial area, Guntur.

Study area

Guntur district is one of the central coastal districts of Andhra Pradesh. It comprises 57mandals under administrative control of 3 divisions namely Narasaraopet, Guntur and Tenali. The district has 729 villages and 1036 hamlets. it has a geographical area of 11,328 sq. kms. It lies between north latitudes 15o18' & 16o50' and east longitudes 79o10'00" & 80o55'00. The annual normal rainfall of the district is 889.1 mm. southwest and northeast monsoon contributes 59% and 26% respectively. Krishna, Nagulleru, Chandravanka and Gundlakamma rivers drains the district. The district has been gifted with the vast surface and ground water resources. about 3.01 lakh ha area is irrigated by canals and it has ground water recourses of 1.72 lakh ham. Out of the total geographical area of 11,328 sq. km, 10.27% of the area is covered by forests. Similarly, barren and uncultivable land is 3.04% and cultivable waste and current fallows put together is 4.8%. The net area shown is 56.81%.

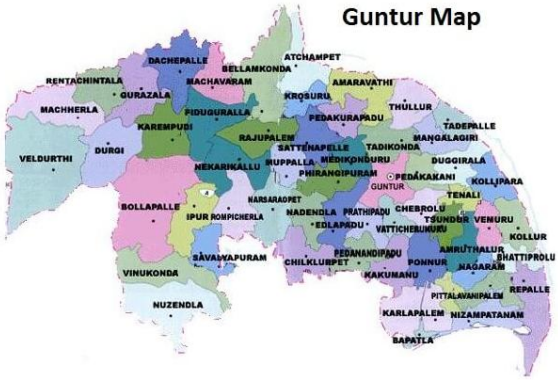

Fig.1 Guntur District, A.P

Sample collection and Analysis

Main objective of the research work is to study the impact of industries on groundwater quality. The groundwater pollution might occur due to intrusion of effluents discharges from the industries, rock deformations, agricultural returns and application of fertilizers during farming. The site selection was divided into 2 zones namely at the industrial area and domestic borewells. The ground water samples were collected from different areas of near to Auto nagar industrial area, such as (S-1)- Yerrablem, (S-2)- Dullas nagar, (S-3)- Autonagar mosque. The water sample were collected in monthly intervals of 3 trials in sterilized polyethylene cans (2-l capacity) and was transported to the laboratory for chemical analysis. The samples were analyzed as per the procedure laid down in APHA (1998). The results are given in Table 2,3 and 4.

Table 1: Standard Methods used for Physico-Chemical Analysis

Sl. No.	Parameters	Methodology	References
1	pH	Electrometric method Digital pH meter (Hanna make of model PHEP)	APHA (1998)
2	Electrical Conductivity (µmhos/cm)	Electrometric method Conductivity meter (Hanna make with model number DiST-4)	APHA (1998)
3	Turbidity	Nephelometer	
4	Total Alkalinity	Volumetric analysis,	Grasshoff (1999)

	(mg/L)	Titrimetric	
5	Total Dissolved Solids (mg/L)	Electrometric, (Hanna make with model number DiST-4)	APHA (1998)
6	Calcium Hardness (mg/L)	Titrimetric method	APHA (1998)
7	Magnesium Hardness (mg/L)	Titrimetric method	APHA (1998)
8	Total Hardness (mg/L)	Titrimetric method	APHA (1998)
9	Sodium (Na^+) (mg/L)	Flame Photometer (ELICO make)	APHA (1998)
10	Potassium (K^+) (mg/L)	Flame Photometer (ELICO make)	APHA (1998)
11	Fluorides (mg/L)	SPADNS Method, Colorimeter (ELICO make)	APHA (1998)
12	Chlorides (mg/L)	Argentometric, Titration	APHA (1998)

The average concentration of Physicochemical parameters of GW samples and its percentage compliance with drinking water quality standards BIS (10500, 1991).

Parameter	**Indian Standards (Desirable Limits)***
pH	6.5-8.5
TURBIDITY	5NTU
EC	-
TOTAL DISSOLOVED SOLIDS	500
TOTAL HARDNESS	300
SODIUM	200
POTASSIUM	2-4
Ca++	75
Mg++	35
Cl	250
FLOURIDE	1.5
TOTAL ALKALINITY	100-200

*All units except pH , Turbidity and EC are in mg/L , Turbidity in NTU, EC in umohs/cm

Results and Discussion

PH: PH is measure of intensity of acidity or alkalinity of water . All chemical and biological reactions are directly dependent upon the PH of water system .In the collected samples the values of PH were in the permissible limits prescribed by WHO (1993).

Electrical conductivity: Electrical conductivity is used to indicate the total ionized constituent of water. It is directly related to sum of the cations and anions (Maruthi and Rao, 2004). The sample No 1 shows the values ranges from 1150-1630, 1950-2300 (sample -2) and Sample -3 shows 18450-19320 mmhos/cm. In all the collected samples EC values were present in permissible limits Except Sample No 3.

Turbidity: Generally water turbidity is due to colloidal and extremely fine dispersions. In the present study the turbidity values varied between 0.3-0.4 NTU, and the values were in permissible range in pre monsoon and post monsoon.

Total alkalinity: Alkalinity of water is the measure of its capacity to neutralize acids. This is due to the salts of weak acids or strong bases. Carbonates and bi carbonates represent the measure of alkalinity Bicarbonates are formed in considerable amount from the action of carbon dioxide upon basic materials fin soil and other salts of weak acids (APHA, 1998, Ansa- Asare et al., 2000). In all sample sites values were within permissible limits, S-1 (328-400), S-2 (384-408) and S-3 (252-300). The values of total alkalinity were comparatively moderate. The water for domestic use having alkalinity less than 100 mg/l is safe. The high content of alkalinity is shown in the Table 2,3 &4.

Total Dissolved Solids: This is the important parameter for the use of water. The water with high TDS value indicates that water is highly mineralized. Desirable limit for TDS is 500 mg/L and maximum limit is 2000 mg/L prescribed for drinking purpose. High levels of TDS may aesthetically be unsatisfactory for bathing and washing. The concentration of TDS in present study is observed in the range of 759-1076 mg/L it was observed in sample No 1. In the sample No 2 concentration of TDS values 1200-1452, where as in the sample No 3 the values are very high (12408-12738). It is indicating that this water is unsuitable for drinking purpose.

Calcium Hardness: Calcium content is very common in groundwater, because they are available in most of the rocks, abundantly and directly related to hardness. The concentration of calcium value present in the sample No 1(180-200) S-2 (150-200) and S-3 (1600-1640). The study revealed that in sample No 3 consist of higher amount of Ca levels. It is indicating that water is unsuitable for drinking. The high concentration of calcium levels may be due to discharge of various chemical hazardous substances from the industries percolated into the ground water. The results showed that in all locations the calcium values were not permissible limits.

Magnesium hardness: The presence of major ions such as Ca, Mg and HCO_3 in water causes hardness and makes it unsuitable for drinking purpose (Jain et al., 2005). According to the Indian standards the permissible limits of Mg is 30 mg/L, but in the present study, in all the ground water samples showed exceeding limits (180-200, 120-128 and 2300-2800) in S1, S2 and S3. In the S3 samples concentration of Mg ions were present in exceeding limits, it is due to the discharge of industrial effluents in to the ground water. This study revealed that ground water collected from the industrial area unsuitable for drinking purpose.

Total hardness: The major sources of hardness in water are dissolved calcium and magnesium ions from sedimentary rocks, whereas minor contribution to the hardness of water is made by ions of aluminum, barium, manganese, iron, zinc etc . The permissible limits prescribed by WHO is 300 mg/L. In the present study the ground water samples collected from the sample no 1 values ranges 360-400 both in pre and post monsoon. The values in S2 consist of 280, where as in the ground water collected from the S3 (3925-4400). The results showed that S1 has moderate value and S3 consist of exceeding limits and is not suitable for drinking purpose.

Sodium: Sodium concentration is important in water. Excess of Na in water is unsuitable for patients suffering from hypertension or congenital heart diseases and also from kidney problems (Rao et al., 2012). It is dangerous for human health, particularly for infants causing Methaemoglobinemia. As per WHO (1993) 200 mg/L sodium is the permissible limit. In the present study the concentration of Na inS1 (144-150), S2 (90-92) and S3 (360-370). Here in this study S1,S2 except S3 showed permissible limits.

Potassium: The main reason for the increase in the potassium concentration in ground water is due to agricultural activities. The excess amount of potassium present in the water sample may leads to nervous and digestive disorders (Tiwari, 2001). In the present study all the samples contain excess limits than the permissible limits (10-12, 9-10 and 20-22 in pre and post monsoon season) . From this results indicating that all the ground water samples unsuitable for drinking purpose it causes neurological problems.

Fluoride: According to BIS and WHO standards the limit of fluoride is 1.0 to 1.5 mg/L. The table 2,3 & 4 showed that the concentration of fluoride lies between 0.5-1.5 mh/L. in pre and post monsoon seasons. From this study indicates that sample 3 only consist of slightly higher values than the sample 2 and 3. Fluoride concentration exceeds the level of 3 mg/L, it causes skeletal flourosis (Kalwale et al., 2012).

Chloride: Chloride content in fresh water is generally influenced by evaporation and precipitation (Dhuley et al., 2000). Chloride in the form of Cl is one of the major inorganic anions in water. High concentration of Cl produce hypertension, Effect on metabolism of body and increase the electrical conductivity of water. High concentration of Cl indicate organic pollution in the water. (Tripati et al., 1989). According to BIS standards the limit of chloride is 250 mg/L. In the present study the concentration of Cl in the sample 1 (160-180), S2 (232-280) and S3 (5300-5700). The present study showed that sample 3 contain Cl concentration is exceed than the normal value. It indicate that he ground water sample collected from Autonagar industrial area is highly contaminated and unsuitable for drinking.

Conclusion

From these results, it may be concluded that quality of ground water in pre and post monsoon varies from place to place. The ground water of Autonagar industrial area region possessed higher values of all parameters compared with other

sample sites. The higher levels of parameters can cause the some health problems. Periodical assessment of ground water quality and characterization provide an overall scenario about the source of ground water contamination. The result of the study would be helpful in identifying the source of GW contamination and open avenue for better planning to achieve sustainable management of GW.

TABLE 2. WATER QUALITY DURING THE SOUTH-WEST AND NORTH-EAST MONSOON PERIOD AT YERRABALEM, GUNTUR DISTRICT

Sampling month	pH	EC	Turbidity	Total Alkalinity	TDS	Ca Hard-Ness	Mg Hard-ness	Total Hard-ness	Sodium	Potassium	Fluorides	Chlorides
Jun 2015	7.3	1580	0.3	370	1050	200	190	400	144	10	0.9	175
July 2015	7.31	1450	0.3	345	1007	200	200	400	148	12	1.3	180
Augt 2015	7.30	1320	0.4	360	970	200	190	400	146	11	1.2	170
Sept 2015	7.35	1630	0.4	400	1076	200	200	400	150	10	0.7	160
Oct 2015	7.28	1150	0.3	328	759	200	200	400	149	10	1.3	180
Nov 2015	7.28	1330	0.4	380	878	180	180	360	149	11	0.5	180
SD	0.02582	179.444	0.05477	25.5376	119.099	8.16497	8.16497	16.3299	2.25093	0.8165	0.33714	8.01041
Mean ±	7.30333	1410	0.35	363.833	956667	196.667	193.333	393.333	147.667	10.6667	0.98333	174.167

Table 3 . Water Quality during the South-West and North-East Monsoon period at Dullas Nagar

Sampling month	pH	EC	Turbidity	Total Alkalinity	TDS	Ca Hard-Ness	Mg Hard-ness	Total Hard-ness	Sodium	Potassium	Fluorides	Chlorides
Jun 2015	7.0	2100	03	395	1200	160	126	280	91	9	1.3	266
July 2015	7.1	2300	03	400	1417	150	125	280	92	10	1.3	240
Augt 2015	7.0	2100	04	390	1450	200	122	280	90	9	1.3	250
Sept 2015	7.1	2200	03	384	1452	170	122	280	91	10	1.3	260
Oct 2015	7.1	1970	04	408	1200	152	128	280	91	9	1.3	232
Nov 2015	7.0	1950	04	400	1287	160	120	280	90	9	1.3	280
Mean ±	7.05±	2103.33±	0.35	396.167	1334.33	165.333	123.833	280	90.8333	9.33333	1.3	254.667
SD	0.05477	133.666	0.05477	8.44788	120.324	18.4029	2.99444	0	0.75277	0.5164	0	17.603

Table 4: . Water Quality during the South-West and North-East Monsoon period at Autonagar Mosque, Guntur City

Sampling month	pH	EC	Turbidity	Total Alkalinity	TDS	Ca Hard-Ness	Mg Hard-ness	Total Hard-ness	Sodium	Potassium	Fluorides	Chlorides
Jun 2015	7.2	18580	0.3	290	12611	1610	2400	3930	360	22	1.4	5600
July 2015	7.4	18450	0.3	277	12645	1600	2400	3925	366	21	1.4	5600
Augt 2015	7.3	19320	0.4	270	12547	1620	2500	3930	370	20	1.3	5500
Sept 2015	7.4	19300	0.4	300	12738	1640	2300	3940	367	22	1.4	5600
Oct 2015	7.3	18800	0.3	252	12408	1600	2800	4400	365	21	1.3	5300
Nov	7.6	18800	0.3	280	12408	1600	2800	4400	366	22	1.5	5700

2015												
Mean ±	7.38	18875	0.33333	278.1667	12559.5	1611.67	2533.33	4087.5	365.6667	21.33333	1.383333	5550
SD	0.148324	362.6431	0.051964	16.57005	132.5787	16.0208	216.025	242.11	3.265986	0.816497	0.075277	137.8405

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