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A study of ground water chemistry of Gundlav GIDC area, Valsad-Gujarat

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Industrialization is known as vehicle for any nation's fast economic growth. Due to industrialization, urbanization and drastic change in the lifestyle of most of the population there are some anthropogenic impact on the biosphere also found. We know that water is a basic need of our life, but its natural sources are being diminished by so called development. In this present study 21 water samples were collected from different hand pumps and bore wells in Gundlav, GIDC area and 12 parameters for each sample were analyzed for its biochemistry and physical chemistry by using standard techniques for ground water quality assessments. The results for all the samples were compared with WHO and BIS Standards. The comparisons show that most of the samples are near to the permissible limits or slightly higher than the limits.

Keyword: Ground water, Chemistry, GIDC, COD, BOD

1. Introduction

We know that water is the vital contain of all life on the earth. Groundwater is the water that exists below the surface of the ground in the spaces between particles of rock or soil, or in the crevices and cracks in rocks. Most groundwater is found within 100 meters of the surface of the Earth. Groundwater, which is used for domestic and industrial water supply and irrigation is the basic need of local people and industry in semi-arid and arid areas like Valsad, where groundwater is the main drinking water source.

The main sources of ground water pollution are domestic sewage waste, soluble or partially soluble refuses, industrial effluents and soluble solid wastes, pesticides and fertilizers, road salts, toxic substances from mining sites, used motor or machine oil also may seep into groundwater, leakages in underground chemical storage tanks, other liquids accidentally spilled, highly saline water originally trapped in the rocks, and sea water.

In the last few decades, there is tremendous increase in the demand for fresh water due to the rapid growth of population and the accelerated pace of industrialization [1]. Human health is closely related to the groundwater quality and is threatened by the poor quality of groundwater caused by excessive application of fertilizers and unsanitary conditions. Once groundwater is polluted, it is hard to stop the pollution and restore the water quality. Due to this, it becomes imperative to monitor the quality of groundwater regularly and means to protect it too [8].

The overall objectives of this work are threefold as follows:

1. To describe the chemistry related parameters in order to bring the groundwater quality problem to the attention of the population.
2. To examine unexplored aquifers for research or production purposes.
3. To identify the major pollutants in groundwater.

2. Study Area:
Gundlav GIDC is an industrial area of Valsad district, which is located at the southernmost tip of Gujarat. Valsad has an average elevation of 18 meters (59 feet) above sea level near the Gulf of Khambhat in the Arabian Sea. Gundlav GIDC is a medium size industrial area for small-scale industries, falls under Valsad district administration and is about 7 km northeast of Valsad. And it is well known for its production of mangoes. Focus industry sectors include chemicals, textiles, horticulture and paper industry

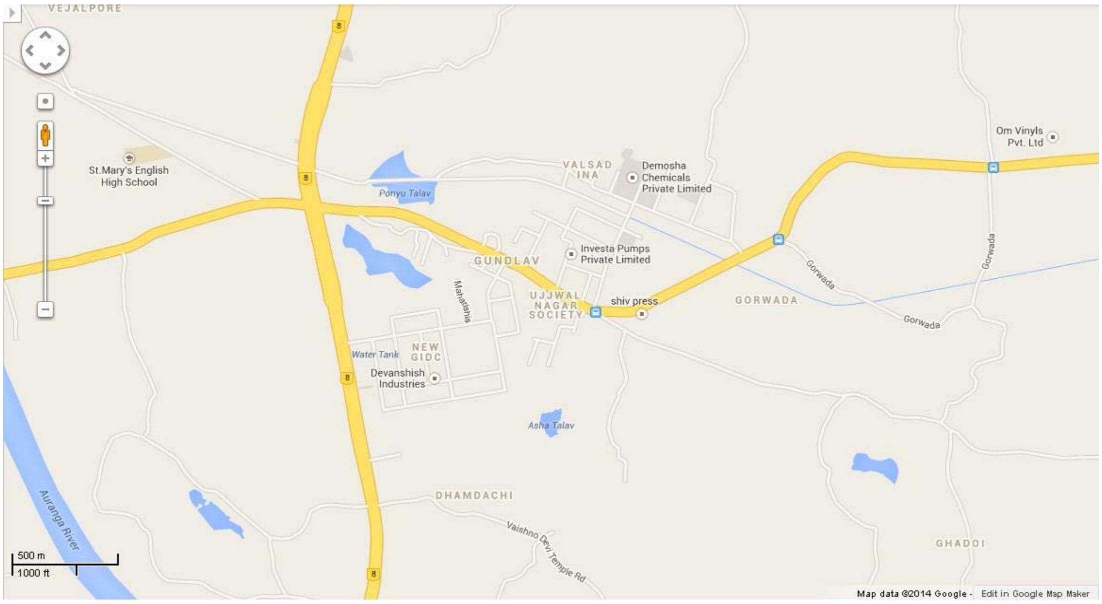

Fig 1: Location map of study area (a map from Google Maps)

3. Sampling of Water:
A total of twenty one groundwater samples was collected from manually operated wells and private borings. The samples were collected in clean polyethylene bottles and prior to collection, the sample bottles were rinsed thoroughly with the sample water. The temperatures of the samples were measured in the field itself at the time of sample collection. In order to avoid any contamination from the surface, the water samples were taken through pumping so the sample would be a representative. The samples were analyzed for pH, EC, turbidity (TB), total solids(TS), total dissolved solid (TDS), total hardness (TH), total suspended Solids (TSS), Chloride (CL), Sulphate(SL), dissolved oxygen (DO), chemical oxygen demand (COD), biological oxygen demand (BOD), The water samples were taken through pumping so the sample would be a representative and in order to avoid any contamination from the surface. The proper numbering were given the samples *viz*.: GG_1 to GG_{21}.

4. Experimental
All the twenty one water samples were examined for electrical conductivity, pH, TB, EC TDS, TSS, CL, SL, DO, COD, BOD and the proportion of various parameters. The chemical and biochemical analysis were carried out using standard operating procedures given below for water analysis [09-11].

a) Estimation of pH
pH measurements of the water samples are performed with the help of a pH meter and the values are expressed in pH scale.

b) Estimation of Electrical conductivity (EC)

Electrical conductivity of all the samples was measured on the spot of the sources by electrical conductivity meter.

c) Estimation of Turbidity (TB)
The turbidity of all samples was measured by Nephelometer in the unit NTU.

d) Estimation of Solids (TS)
All the samples were evaporated in preheated, cooled, dried and weighted porcelain dish and TS calculated using Gravimetric Method.

e) Estimation of Total Dissolved Solids (TDS)
According to (TS) determination method.

f) Total Suspended Solids. (TSS)
By mathematical method (TS-TDS).

g) Estimation of Total Hardness (TH)
Total hardness of the water samples is estimated by titration with standard ethylene diamine tetra acetic acid (EDTA) using standard indicator.

h) Estimation of Chloride (CL)
The Volhard method was used for all samples where chlorides were first precipitated with excess silver nitrate, and then excess silver is titrated with potassium thiocyanate. To detect the end point we used Fe^{3+} cations.

i) Estimation of Sulphate (SL)
The sulfate content of the samples was determined by titration with aqueous barium chloride, $BaCl_2$. The titrant was usually standardized using sodium sulfate.

j) Estimation of Dissolved Oxygen (DO)
Do for all the samples were calculated by standard Winkler Method.

k) Estimation of Chemical Oxygen Demand (COD)
COD for all the samples were calculated by standard Lab Line COD Analyzer.

l) Estimation of Biological Oxygen Demand (BOD)
BOD for all the samples were calculated by standard 5 days BOD Test.

Table 1: Results of different physicochemical and biochemical tests

Parameter / Sample	pH	EC µS/cm	TB NTU	TS	TDS	TSS	TH	CL	SL	DO	COD	BOD
GG_1	6.9	105	2.84	411	424	13	249	194	114	4.4	18	4
GG_2	7.1	108	2.93	432	445	13	253	200	133	5	22	1
GG_3	6.9	89	2.00	374	385	11	210	219	148	6.1	21	2
GG_4	6.8	100	2.80	387	400	12	231	183	93	3.9	18	4
GG_5	6.8	92	2.76	353	365	12	205	165	82	4.1	17	5
GG_6	7.5	114	3.20	487	501	14	310	231	121	4.3	23	2
GG_7	7.6	126	3.13	528	542	14	339	252	137	4.2	22	2
GG_8	8.0	122	3.30	532	554	22	329	253	166	5.9	22	0
GG_9	6.9	96	2.84	376	389	13	223	157	100	4.6	18	5
GG_{10}	6.8	105	3.20	448	461	13	283	212	124	4.3	21	3
GG_{11}	6.8	104	2.80	468	490	22	289	223	179	5	15	2
GG_{12}	7.3	120	3.01	488	502	13	308	232	161	5.1	21	4
GG_{13}	7.5	111	3.09	462	475	14	289	219	128	4.9	22	3
GG_{14}	7.9	120	3.26	520	535	14	334	247	116	4.2	24	0
GG_{15}	7.8	119	3.22	509	523	14	325	242	194	7	24	2
GG_{16}	7.0	107	2.89	421	434	13	257	199	134	5.1	19	5
GG_{17}	7.4	113	2.98	456	469	13	283	216	119	4.4	21	4
GG_{18}	7.6	116	3.13	486	500	14	307	231	147	5.3	22	4
GG_{19}	7.4	115	3.05	473	487	14	297	225	149	5.2	21	4
GG_{20}	8.1	123	3.34	544	565	21	340	259	155	5.6	23	1
GG_{21}	7.3	111	3.20	474	488	14	301	225	110	3.8	22	2

(All the units are in mg/L except TB, EC and pH)

5. Results and Discussion

All the 21 groundwater samples from the study area had found color within the limit; odor and turbidity were also found according to stipulation. The taste of the water showed some brackish water at some locations. The results of the physical-chemical and bio-chemical analysis of groundwater from the study are given in Table-1. So, it is necessary to make a comparison of groundwater quality of the study areas with drinking water standards (WHO).

The pH values are found near to the standard range 6.8-8.1, the highest value of EC is found 126 µS/cm and the lowest one is 89 µS/cm which is within the permissible range. Turbidity is also found in low level indicating that there are not more suspended solids or color matter present in the samples. TDS amounts for some samples are beyond or near to the limit. Highest TDS is 565 mg/L in sample GG_{20} while the lowest is 365 mg/L in sample GG_5. TSS is very low in all samples, indicating that there are no more particulates suspending in the ground water. The amounts of total hardness are ranging between 205 mg/L and 340 mg/L which also in the proper limit. The highest concentration of chloride contains was recorded in the sample GG_{20} (259 mg/L) and the lowest in GG_9 (157 mg/L). High chloride content in groundwater can be attributed to leaks of underground drainage systems and bad maintenance of the environment around the sources [8]. Sulphate amounts were found between 82 mg/L and 197 mg/L which indicate not more harmfulness of the ground water salts. The amounts of DO in these samples were found minimum 3.8 mg/L ppm to highest 5.1 ppm and it is in the good source limit. The COD and BOD levels of most of the samples were quite low and below the permissible limit.

The results of the statistical correlation data analysis, which are shown in Table 2 gave an indication that the EC has a positive and significant correlation with *TB, TDS, TS, TH* and *CL*, TH has positive and significant correlation with *TB, TDS, TS, TSS,* and *CL*, TDS are also significantly correlated with TS, TSS, TH, CL, and SL too..

The high correlation between TS, EC, TDS and CL indicates that chloride tends to increase in concentration as the water salinity is increased. The negative high correlations of the BOD with CL and some other parameters indicate that these are inversely proportional to the concentration of chloride and these parameters contaminants.

Table-2. Correlation data between all parameters

	pH	*EC*	*TB*	*TS*	*TDS*	*TSS*	*TH*	*CL*	*SL*	*DO*	*COD*	*BOD*
pH	1.000											
EC	0.854	1.000										
TB	0.679	0.804	1.000									
TS	0.868	0.949	0.768	1.000								
TDS	0.863	0.941	0.765	0.999	1.000							
TSS	0.451	0.422	0.404	0.588	0.622	1.000						
TH	0.843	0.951	0.802	0.992	0.988	0.531	1.000					
CL	0.815	0.825	0.508	0.925	0.922	0.516	0.900	1.000				
SL	0.437	0.482	0.154	0.593	0.602	0.545	0.547	0.672	1.000			
DO	0.377	0.185	-0.082	0.266	0.272	0.305	0.202	0.392	0.822	1.000		
COD	0.793	0.670	0.521	0.669	0.646	-0.019	0.662	0.700	0.284	0.303	1.000	
BOD	-0.597	-0.470	-0.327	-0.639	-0.647	-0.531	-0.579	-0.710	-0.409	-0.259	-0.574	1.000

6. Conclusion

The higher proportion of some dissolved constituents is found in ground water, in some samples because of greater interaction of ground water with various materials in geologic strata or contamination from the surface area. In some samples the TDS and TH is in the slightly higher range, although in most part the groundwater has not been severely polluted, from the groundwater conservation view of point, the groundwater still needs protection and long term monitoring in case of future rapid industrial development.

7. Acknowledgements

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