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Physico – Chemical Characteristics of Ground Water of Coastal Villages of Olpad and Choryasi Taluka, Surat District

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Abstract: ***Ground Water is one of the most important natural resources for drinking water. To estimate quality of water in coastal region of Surat district, the study was made by us. Ground water samples were collected from different sampling stations of coastal villages of Olpad and Choryasi Talukas of Surat district, Gujarat (India). The ground water quality study of coastal villages of Olpad and Choryasi taluka of Surat district. During the monsoon season, the ground water samples were collected from 20 different locations and analyzed for physico-chemical characteristics. In this study different parameters like pH, TDS, TSS, Alkalinity, Bicarbonate, Hardness, Ca hardness, Mg hardness, Chloride, DO, Sulphate, Cr were estimated. The results are compared with water quality standards put down by ICMR and WHO. The results reveal that some of the samples were having high concentration causing deterioration in quality of drinking water.***

Keywords: Ground water, Physico-chemicals characteristics, Olpad and Choryasi Taluka

1. Introduction

Water is a wonderful gift of nature and it is unique liquid, without it life is impossible. 2/3 rd part of earth's surface is covered by ocean water [1] and that consist of 97% of water, rest 2.3% is covered by glaciers and polar ice caps and land surfaces like rivers, lakes and ponds occupying 0.6% of water. Water is essential for survival; 70% body weight of all living organisms is due to water, so it should be clean, fresh and potable.

Good quality of drinking water is the basic requirement of every human and is one of the human rights. Rural people who are living near the shore don't have generally municipal water purveyance in India and in many other countries. In many rural areas water is being used from bore well and well in most of all such cases this water is used directly for drinking purpose. Hence they render upon nearby groundwater sources for their daily needs which includes farming and bathing etc. Near seashore location due to seasonal fluctuations and faster withdrawal of groundwater makes sea-water intrusion possible in such areas [2]. High TDS (> 4000 ppm) and chlorides value (> 2000 ppm) clearly supports the sea-water intrusion at coastal aquifer [3].

Due to more industrialization, the population of coastal villages of Olpad and Choryasi Taluka has increased; as a result, demand of water is also increasing for industrial, agricultural as well as for domestic purpose. Therefore, it is essential for protection and management of ground water quality [4]. Main aim is to assess the groundwater quality and compare the results with drinking water standards. After collecting the samples physico-chemical parameters of ground water were assessed. These water quality parameters are used to determine the quality of water and compared it with drinking water standards prescribed by WHO (1993) [5, 6] and ICMR (1986) [5, 6].

2. Materials and Methods

2.1 Topography

Gujarat has area of 1, 95, 984 sq. km. The state consists of the longest coastline of 7, 516.6 kms in India [7]. Surat district is considered as developed district with pleasant climate. It is situated on the bank of Tapi river. Olpad is a Taluka in Surat district of Gujarat State, India. It is located 22 km towards North from district headquarters Surat. Choryasi is a Taluka in Surat district of Gujarat State, India. It is located 7 km towards west from district headquarters Surat. Olpad and Choryasi taluka covers the coastal track which is facing Arabian Sea. There is a chance of humidity in the weather. There are ample chances of sea water intrusion from Arabian Sea to Olpad and Choryasi taluka, if drinking water drawn at faster rate at SUDA area.

2.2 Study area

Different samples of ground water were collected from 20 sampling stations i.e. Junakavas, Hazira, Junagam, Suvali, Rajgari, Mora, Bhatlai, Damka, Vansva, Lavachha, Admor, Bhandut, Pinjarat, Tena, Motakosadiya, Chhini, Dhanser, Tunda, Maya and Dihen; Coastal villages of Olpad and Choryasi Taluka, Surat district situated in radius 35 km. this area has large scale industrial development. Geographical location of study area is shown in the Figure 1.

2.3 Temperature and rainfall

Summer temperature of Olpad and Choryasi taluka ranges between 30°C to 42°C. The climate is pleasant during the monsoon, average temperature ranges between 22°C to 26°C. The climate in winter is cool; the temperature ranges from 17°C to 21°C. The average rainfall in Olpad taluka is 977 mm and Choryasi taluka is 1274 mm.

Figure 1: Coastal villages of Olpad and Choryasi Taluka, Surat- Gujarat(Image source google map)

3. Experimental

The present study deals with ground water quality monitoring of coastal villages during the July 2015 to October 2015. Samples were taken from coastal villages of Olpad and Choryasi taluka nearby residential area and industrial area of the Surat district. The results of respective places are given in Table 2 and 3 and results are compared with the standard values given by WHO (1993) [5, 6] and ICMR (1986) [5, 6]. The ground water samples were collected by grab sampling method, for the further analysis samples were taken to laboratory in cleaned polythene bottles having capacity of 2 liter and labeled properly and stored in ice-box. Analytical grade chemicals were used without further purification [8].The physico - chemical analysis were done according to APHA standards [9] methods for examination of water and waste water. The various physico- chemical parameters like pH, TDS, TSS, Alkalinity, Bicarbonate, Hardness, Chloride, DO, Sulphate, Cr were measured by using standard methods [10, 11, 12].

4. Results and Discussion

In the studied localities ground water was free from color and odor. The values of physico-chemical characteristics of the analyzed ground water from different locations are presented in Table 2 and 3. The data revealed that there was a considerable physico-chemical variation and also water quality variation in the samples.

4.1 pH

The pH value of water sources is a measure of the hydrogen ion concentration in water and indicates whether the water is acidic or alkaline [13]. It was observed that pH values were slightly alkaline varying from 7.97 to 9.07 during the monsoon season and this values are within the admissible limit by WHO (1993) [5, 6] and ICMR (1986)[5, 6]. pH plays a major role in most chemical and biological reactions. pH trend is shown in Graph 1.

4.2 TDS

The total dissolved solids in water are due to presence of all inorganic and organic substances. During the monsoon season TDS values were measured and were found within the range of 211.25 to 1276.75 mg/L. Here sampling stations i.e. Junakavas, Hazira, Junagam, Suvali, Rajgari, Mora, Bhatlai, Damka, Vansva, Chhini and Dhanser contained more TDS than admissible by ICMR (1986)[5, 6] and WHO(1993)[5, 6]. The high value of TDS causes gastrointestinal irritation to the human beings but long time use of water with high TDS can causes kidney stones and heart diseases [14]. TDS concentrations are shown in Graph 2 represents values of TDS. More TDS forms scale in boiler and corrosion in pipelines in industrial operations.

4.3 TSS

There is no limit for suspended solid in WHO [5, 6] and ICMR [5, 6] standards. It is physical property of water and more suspended solid is not acceptable as it is aesthetical asset of water. During monsoon season, values were observed within the range of 133.75 to 1100 mg/L. TSS values obtained are shown in Graph 3. All the ground water samples were having negligible suspended solids so there is no problem of suspended solid to the public for drinking purpose.

4.4 Alkalinity, Bicarbonates

Alkalinity of water is the measure of the ability to neutralize a strong acid. The bases like carbonates and bicarbonates are responsible for alkalinity of water [5]. Alkalinity provides an idea of natural salts present in water. It is not harmful to human beings. The admissible limit of total alkalinity in drinking water is 200 mg/L by WHO [5]. During monsoon season, alkalinity values were measured within the range of 128.75 to 843 mg/L from which most of the samples were containing higher alkalinity than standards. Here sampling station i.e. Junakavas, Hazira, Junagam, Suvali, Rajgari, Mora, Bhatlai, Damka, Vansva, Admor, Bhandut, Pinjrat, Tena, Motakosadiya, Chhini, Dhanser, Tunda, Maya and Dihen. More alkalinity needs more water softening during treatment of raw water. Alkalinity values obtained are shown in Graph 4. There is no limit for bicarbonate in WHO [5, 6] and ICMR [5, 6] standards. During monsoon season study, bicarbonates values were measured within the range of 161.68 to 569.62 mg/L from which most of the samples were containing higher bicarbonates than standards. Bicarbonates values obtained are shown in Graph 5.

4.5 Total hardness, Calcium and Magnesium hardness

Hardness in water is due to the natural accumulation of salts from contact with soil and geological formation or it may enter directly by industrial effluents.
During monsoon season study, Hardness values were measured and were found within the range of 211.25 to 1276.75 mg/L. Here sampling stations i.e. Junakavas, Bhatlai, Dihen, Suvali, Mora, Chhini and Dhanser contained more hardness than admissible by ICMR(1986)[5, 6] and WHO(1993)[5, 6]. So the adverse effects of such water

samples are (1) soap consumption by hard water causes economic loss due to water, (2) precipitation by hard water adhere to surface of tubes, sinks etc. and may stain clothing, dishes and other items, (3) $MgSO_4$ precipitates have laxative effect in persons unaccustomed to it [6]. Hardness concentrations are shown in Graph 6. Hardness of water mainly depends upon the amount of calcium and magnesium salts or both. Calcium and magnesium hardness causes by far the greatest portion of the hardness occurring in natural water. Calcium hardness values were obtained within the range of 34.855 to 387.46 mg/L. Here 4 sampling stations; Suvali, Mora, Chhini and Dhanser contained more hardness than limit as shown in Graph 7. Magnesium hardness values were obtained within the range of 52.2 to 732.08 mg/L. Here all sampling stations contained more hardness than admissible limit as shown in Graph 8.

4.6 Chloride

Chloride in ground water can be caused by industrial or domestic waste. The chloride concentration serves as an indicator of sewage pollution. High chloride content in water bodies, harms agricultural crops, metallic pipes [15]. Chloride is the most abundant anion in the human body. Chloride is harmful to humans. Chloride values were observed within the range of 793.44 to 2516.92 mg/L. From the analysis ground water samples contained more chloride than the prescribed limit given by WHO and ICMR [5, 6]. Most of the ground water samples showed high chloride concentration. Chloride reacts with sodium and makes water salty in taste, which is unacceptable for human consumption [8, 16]. It also increases the TDS values there by affecting the quality of water [8, 16]. Chloride concentration found in the water samples are shown in Graph 9.

4.7 DO

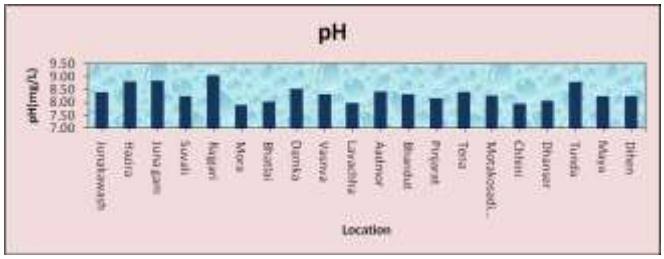
Dissolved oxygen in water is of great importance to all aquatic organisms. It reflects the physical and biological process taking place in the water body. In water, oxygen is generally reduced due to respiration of biota, rise in temperature, oxygen demanding waste and decomposition of organic and inorganic reactants [17]. DO values were within the range of 6.78 to 9.70 mg/L. The results were in agreeable limit. The values of DO are shown in Graph 10.

4.8 Sulphate

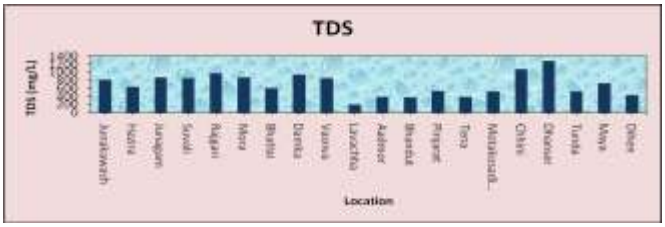
Sulphate is one of the least toxic anions. Sulphate is widely distributed in nature and may be present in natural waters in concentrations ranging from a few to several thousand milligrams per liter [18]. In all samples, sulphate concentrations were within the permissible limit. The range of sulphate found was 0.273 to 3.619 mg/L which was within the limit and therefore no more attention required for amount of sulphate. Sulphate content more than 200 mg/L is objectionable for drinking purpose, as water having more than 500 mg/L makes it bitter in taste and beyond 1000 mg/L has purgative effect. The sulphate concentrations are shown in Graph 11.

4.9 Cr

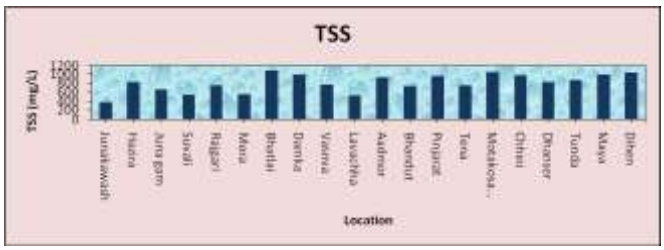
Chromium occurs as Chromium (0), Chromium (III) and Chromium (VI). In environment Chromium Compounds which are found are Cr (III) compounds. Chromium compound are free from odor and taste. Cr (III) is necessary micronutrient in our diet. For manufacturing chrome steel, chrome alloy brick in furnaces, pigments and dyes chromium is used, also in leather tanning, wood preserving and chrome plating [19, 20]. All forms of chromium are toxic above permissible limit, chromium (VI) is more toxic the chromium (III). Higher concentration of chromium (VI) can cause trouble with nose, lungs, stomach and intestines. Asthmatic attacks can be experienced by the people allergic to chromium. Exposures to lungs can cause cancer or lung diseases. Ingesting higher concentration of chromium may result in ulcers, damage to liver and kidney. During monsoon study, its values were within the range of 0.0142 to 0.121mg/L. Here all the samples showed higher limit of Cr as compared to permissible limit, so the consumption of such sample without treatment is harmful for health. The Chromium concentrations observed are shown in Graph 12.



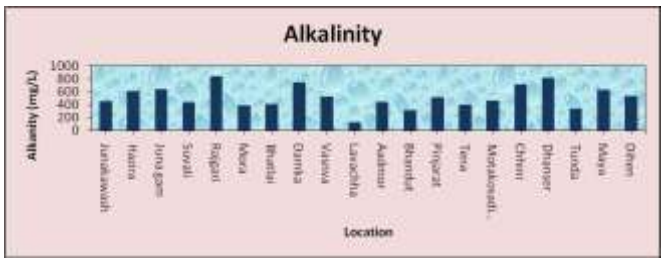
Graph 1



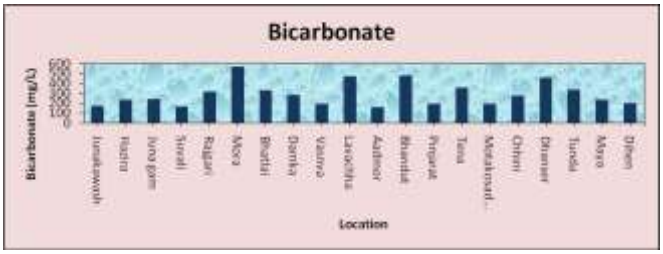
Graph 2



Graph 3



Graph 4

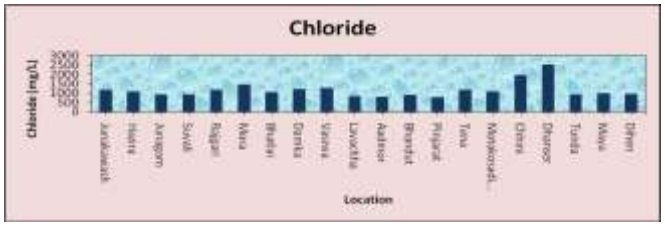


Graph 5

Graph 6

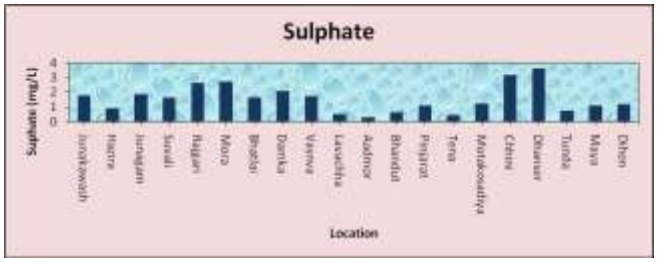
Graph 7

Graph 8

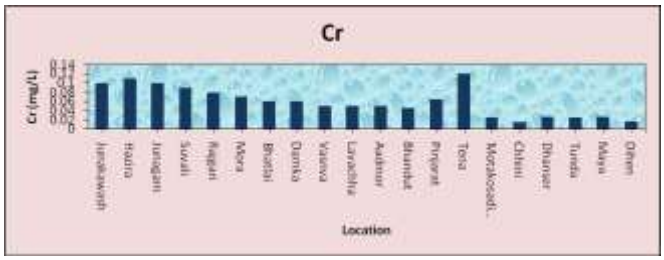


Graph 9

Graph 10



Graph 11



Graph 12

Table 1: Standards of drinking water quality by WHO and ICMR

Sr. no.	Physico-chemical Parameter	Method/ instrument used	Permissible limit as per WHO (Aesthetic quality)	Permissible limit for Drinking water as per Indian Council of Medical Research(1963)	
				Desirable conc.	Maximum permissible
1.	pH	pH meter	6.5 – 8.5	7 -8.5	6.5 – 9.2
2.	TDS	Gravimetric	1000	500	
3.	SS	Gravimetric	--	--	
4.	Alkalinity	Titrimetric	200	--	
5.	Bicarbonate	Calculation from alkalinity	--	--	
6.	Hardness	Titrimetric	500	300	600
7.	Calcium hardness	Titrimetric		75	200
8.	Magnesium hardness	Titrimetric		50	150
9.	Chloride	Titrimetric	250	200	1000
10.	DO	Prob	No guidline	--	
11.	Sulphate	Titrimetric	200	200	400
12.	Chromium	AAS	0.005	0.005	

5. Conclusions

The present study was undertaken with an aim to analyze certain physico-chemical characteristics of the ground water samples of Olpad and Choryasi Taluka, Surat district. It revealed that pH value agreed with permissible limit except for few locations. TDS was quite higher than permissible limits. Total Hardness, Ca and Mg hardness were higher in most of the sampling locations as compared to permissible limit. Most of the ground water samples showed higher chloride concentration. In majority of samples DO was below

the permissible limit but few samples showed higher value. Sulphate was under the permissible limit in all ground water samples. Cr was present in all samples of ground water. As, all parameters are affecting to the human health, therefore water to be used for drinking purpose requires treatment before using directly.

Table 2: Physico-chemical characteristics of groundwater samples (Monsoon Season)

Parameter	Junakavas	Hazira	Junagam	Suvali	Rajgari	Mora	Bhatlai	Damka	Vansva	Lavachha
pH	8.40	8.82	8.84	8.26	9.07	7.92	8.05	8.53	8.32	8.00
TDS(mg/L)	815.75	644.50	880.50	853.50	977.25	880.25	609.00	946.25	864.00	211.25
TSS(mg/L)	396.75	843.50	670.25	550.50	762.50	577.50	1100.00	1010.00	779.75	540.50
Alkalinity(mg/L)	456.75	615.25	643.25	443.50	843.00	384.75	406.75	744.75	522.50	128.75
Bicarbonate(mg/L)	169.50	231.94	242.38	166.19	315.56	569.63	333.88	282.63	194.06	478.13
Hardness(mg/L)	438.12	231.93	131.47	547.18	223.39	686.23	419.95	369.11	388.36	136.18
Calcium hardness(mg/L)	192.80	76.38	63.23	200.59	38.20	318.69	167.94	79.18	138.42	83.98
Magnesium hardness(mg/L)	245.32	155.58	68.24	346.59	185.19	367.50	252.01	289.93	250.45	52.20
Chloride(mg/L)	1201.96	1092.30	944.74	950.04	1188.33	1455.01	1051.96	1232.57	1271.90	852.32
DO(mg/L)	8.00	8.22	7.63	8.10	8.13	7.48	8.45	7.45	8.21	8.89
Sulphate(mg/L)	1.77	0.91	1.85	1.65	2.62	2.73	1.62	2.09	1.73	0.49
Chromium(mg/L)	0.10	0.11	0.10	0.09	0.08	0.07	0.06	0.06	0.05	0.05

Table 3: Physico-chemical characteristics of groundwater samples (Monsoon Season)

Parameter	Admor	Bhandut	Pinjarat	Tena	Motakosadiya	Chhini	Dhanser	Tunda	Maya	Dihen
pH	8.435	8.3475	8.1675	8.4025	8.2725	7.9725	8.0825	8.7975	8.2675	8.25
TDS(mg/L)	395.5	378.75	535.25	392	528.25	1075.75	1276.75	526.5	734.25	441
TSS(mg/L)	947.25	744	971	758	1064.5	987.25	833.75	880	1005	1055
Alkalinity(mg/L)	440.5	316	515.25	400.5	458	716	816.25	338.75	633	541.25
Bicarbonate(mg/L)	161.688	485	191.313	355.31	191.563	273.688	462.188	337.5	236.063	201.875
Hardness(mg/L)	247.233	208.18	259.16	152.64	219.788	711.383	857.333	140.00	297.74	448.288
Calcium hardness(mg/L)	114.265	114.843	136.198	92.157	132.138	387.468	125.233	34.855	144.398	157.483
Magnesium hardness(mg/L)	132.17	93.3375	122.963	60.49	87.65	323.165	732.085	105.108	153.343	240.815
Chloride(mg/L)	820.56	921.6	793.44	1175.3	1105.62	1973.88	2516.92	934.813	1005.72	972.27
DO(mg/L)	8.63	8.78	8.4575	9.6675	8.3525	6.785	6.965	8.305	6.8475	9.7025
Sulphate(mg/L)	0.273	0.6415	1.08375	0.398	1.22725	3.16375	3.619	0.7435	1.0815	1.182
Chromium(mg/L)	0.0497	0.0462	0.0652	0.121	0.025	0.0142	0.027	0.0247	0.0272	0.0167

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