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Physico-Chemical Analysis of Ground Water Quality of Dhrol

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Abstract

Ground water samples were collected from diverse spaces of Dhrol taluka of Jamnagar district (India) for investigation of their physicochemical parameters. These Fifteen water samples from diverse spaces were analyzed for their physicochemical characteristics. Local community utilized this water for drinking and irrigation purpose. Laboratory investigations were carried out for analysis like, Temperature, Calcium-Magnesium hardness, pH, TDS, Chloride, Alkalinity, sulphate, phosphate and nitrate. These parameters are effectiveness in calculating quality of ground water. The results were compared with the drinking water guidelines of Indian Standard (IS) and World Health Organization (WHO). For the statistical studies, values of mean, standard deviations and correlation co-efficient (r) were calculated to determine the strength of relation between variables. The key plan of our study is to find the quality of ground water in and around Dhrol taluka and formulate it for drinking purposes after appropriate purification.

***Keywords:** Dhrol taluka; Physiochemical parameters; Ground water*

Introduction

The wander of the natural world is Water. In nature water is one of most vital requirement for all the living organisms. Therefore, it is true that "No water No life''. For sustain of life under ground and surface water are essential natural resources, which is available in large quantity and it is a complimentary reward of nature [1,2]. In diverse forms and from diverse resources the water use for the human beings. Primarily two resources of drinking water, among them one is a surface water which includes River, lakes and second one is under ground water which are mainly from the escape of surface water and is detained in the subsoil and in prior rock. Ground water contains approximately 94% of total available water all over world. Major resource of drinking water in villages is under ground water which is available in the form of wells, bore wells or hand pumps [3-6].

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As the population of world enlarges, the requirement for cleans water also increases constantly. Public in numerous parts of the world are survival for lack of the fresh, drinkable water, therefore more protected water supplies are required.

Here we reported the physicochemical analysis of bore wells drinking water of Dhrol territory. Dhrol is situated in Jamnagar district of Gujarat. Bore wells water is usually utilize for Drinking and additional household functions in this area. The main sources of bore wells water pollution are the use of fertilizers and pesticides manure, lime, septic tank, refuse dump, etc. [7-9] For this reason, locality of this area required to utilize bore wells water for their drinking, domestic and other utilization. With the aim to evaluate water quality index, we have carried out the Physico-chemical analysis of bore wells drinking water.

Experimental Procedure

Material and methods

The Bore wells underground water samples of drinking water of Dhrol taluka, were collected from 15 diverse villages in the morning between 10 am to 12 am in plastic sampling bottles with essential protections. For the preparation of reagents and solutions double distilled water was utilized. The main water quality parameters measured for the inspection in this study are temperature, pH, dissolved oxygen (DO), total dissolved solid (T.D.S), total alkalinity, calcium, and magnesium ions, sulphate, phosphate and nitrate contents [10]. Complex metric titration method was applied for estimation of Calcium and magnesium hardness of water [9,11]. Volumetrically Chloride and Sulphate contents were determined [11]. The Various Physico-chemical parameters of ground water samples of Dhrol taluka are shown in the TABLE 1.

TABLE 1. **Physico-chemical parameters of ground water samples.**

No.	Sample Station	Temp °C	pH	TDS	D.O. mg/L	Chloride mg/L	Total Alkalinity mg/L	Ca Hardness mg/L	Mg Hardness mg/L	SO_4^{-2} mg/L	PO_4^{-3} mg/L	NO^{-3} mg/L
1	Laiyara	30.2	7.4	210	6.5	92.42	635	11.36	12.80	323.48	7.45	264
2	Jaiva	29.8	7.1	830	8.3	115.42	568	13.68	29.66	71.86	9.95	354
3	Sagaliya	31.5	8.1	450	7.9	98.56	372	14.42	27.79	37.61	4.45	214
4	Sudhadhuna	31.2	7.5	390	7.6	83.79	327	33.29	64.20	275.38	5.95	109
5	Dharampur	29.4	7.2	990	6.7	145.29	642	23.15	31.36	164.92	6.95	124
6	Latipur	28.9	6.8	730	8.6	27.32	589	11.07	81.48	121.32	7.75	74
7	Modpar	30.3	7.9	690	7.9	78.59	479	15.87	95.72	167.92	10.95	129
8	Haripar	31.5	7.2	480	7.4	43.12	634	36.79	20.79	248.66	8.95	239
9	Gokulpar	30.6	7.5	1415	6.9	85.92	596	10.44	42.29	344.32	6.95	84
10	Sanosara	33.2	7.6	590	7.5	110.66	368	52.25	34.19	344.81	3.95	189
11	Sumra	34.1	8.1	660	6.2	126.74	447	43.63	16.86	235.42	4.95	309
12	Itala	32.2	7.5	390	8.6	36.84	526	17.22	27.91	118.62	7.45	244
13	Rajpar	28.7	7.8	550	7.1	119.46	618	8.12	30.22	83.56	15.45	106
14	Jabida	27.8	7.0	190	7.4	75.38	318	28.76	17.34	158.33	10.45	139
15	Dedakdad	29.8	7.4	820	8.8	53.58	464	33.39	79.64	53.47	7.45	130

Results and Discussion

Values of different physicochemical characteristics of water samples are shown in TABLE 1. Quality of these water samples is compared with the Indian Standard (IS: 10500) specifications for drinking water and guideline suggested by the World Health Organization (WHO: 1993). These agencies drew up directives for the purity of water intended for human consumption.

The standard or guideline prescribes the requirements for the essential and desirable characteristics to be tested for ascertaining the appropriateness of water for drinking purpose. IS: 10500(1991)–Drinking Water Specification was originally published in 1983 with the idea of assessing the quality of water resources and verifying the effectiveness of water treatment. Its first revision was published in 1991. Values of variables in excess of those mentioned under 'Desirable' make the water not acceptable, but still may be tolerated in the absence of alternative source. Beyond the 'Permissible limit in the absence of alternate source', the sample have to be rejected i.e. it is not fit for drinking purpose. Drinking water guideline of IS: 10500 (1991) (reaffirmed: 1993) and WHO (1993) are shown in TABLE 2.

Due to diverse nature of soil contamination the results of the bore wells water samples varies [12]. Water temperature are generally influenced the entire metabolic, physiological activities and life of aquatic organisms.

Temperature

Temperature range was situating between 27.8°C to 34.1°C for present analysis.

pH

The acidity, alkalinity and resulting value of the acidic basic interaction of a number of its mineral and organic components are depends on the pH value of drinking water. The corrosion in pipes starts when pH less than 6.5. Presences of Toxic metals in water increase the pH. The acceptance pH limit is 6.5 to 8.5. In the present study pH ranged from 6.8 to 8.1 which are suitable according to APHA1.

TABLE 2. **Drinking water specifications.**

Parameter	**Drinking Water Guideline**		
	Indian Standard (IS): 10500 (1991)		**World Health Organization (WHO)'s Guideline (1993)**
	Requirement (Desirable limit)	**Permissible limit in the absence of alternate source**	**Acceptable limit**
pH	6.5 to 8.5	No relaxation	6.5 to 8.5
TDS (mg/l)	500	2000	-
Chloride (mg/l)	250	1000	-
Total Alkalinity (mg/l)	200	600	-
F1- (mg/l)	1.0	1.5	1.5

Ca hardness (mg/l)	75	200	-
Mg hardness (mg/l)	30	100	-
NO_3^{-1} (mg/l)	45	-	50(Total nitrogen)
SO_4^{-2} (mg/l)	200	400	-
$PO4^{-3}$	0.025	0.2	0.2

TDS (Total Dissolved Substance)

TDS value should be below than 500 mg/L for drinking water according to WHO and Indian standards [12,13]. TDS ranged from 190 mg/L to 1415 mg/L are found in the present study.

D.O. (Dissolved Oxygen)

In the present analysis, dissolved oxygen (D.O) found in between 6.2 mg/L to 8.8 mg/L. and the minimum tolerance range is 4.0 mg/L for drinking water.

Chlorides

The tolerance range for chloride is 200 to 1000mg/L. In present study, it found in between 27.32 mg/L to 145.29 mg/L.

Total alkalinity

We found total alkalinity range was from 318 mg/L to 635 mg/L.

Water hardness due to Calcium ion (Ca^{2+})

The calcium ion ranges from 8.12 mg/L to 52.25 mg/L with the tolerance range is 75 mg/L to 200 mg/L. Water provides total requirements Calcium in the body.

Water hardness due to Magnesium ion (Mg^{2+})

Magnesium ion ranges from 12.80 mg/L to 81.48 mg/L, their tolerance range is 50 mg/L to 100 mg/L.

Sulphate ion (SO_4^{2-})

Sulphate ion ranges from 37.61 mg/L to 344.81 mg/Land their tolerance range is 200 mg/L to 400 mg/L. The diarrhea may induce due to high concentration of sulphate.

Phosphate ion (PO_4^{3-})

In the present study phosphate ranged from 3.95 mg/L to 15.45 mg/L, which is much higher than the prescribed values. It may be due to exploit of fertilizers and pesticides by the people of this area. Excess phosphate consumption could lead to the death of consumer.

Nitrate ion (NO^{3-})

In the present study nitrate ranged from 74 mg/L to 354 mg/L and their tolerance range for 20 mg/L to 45 mg/L., which are higher than the prescribed values it may be due the excess use of fertilizers and pesticides.

Statistical Analysis

Statistical analysis can be applied to represent the data of the water research work and useful in understanding the internal relations of various parameters used for the physicochemical analysis. Many research workers have applied statistical analysis to their results. As initial part of statistical analysis, mean and standard deviation for the values of different parameters were calculated and are shown in TABLE 1.

Correlation is a broad class of statistical relationship between two or more variables. Hence, it can be considered as a normalized measurement of covariance. The correlation study is useful to find a predictable relationship which can be exploited in practice. It is used for the measurement of the strength and statistical significance of the relation between two or more water quality parameters.

Hence, it is helpful for the promotion of research activities. It can put forward possible causal or mechanistic relationships of research work. The correlation coefficients(r) were calculated and correlation matrix was obtained. Here, r is a dimensionless index which is in the range of -1.0 to +1.0 inclusive 0. It exhibits the extent of a relation between variables. The values of r from 0 to 1 and its indications are shown in TABLE 3. The values of correlation coefficients for different variables are listed in TABLE 4.

TABLE 3. **Indications of values of coefficient r.**

Value of r	Indication of the relation
0 - 0.2	Very poor correlation
0.2 - 0 .4	Slightly significant correlation
0 .4 - 0.6	Moderate correlation
0 .6 - 0.8	High correlation
0.8 - 1	Very high correlation

TABLE 4**. Correlation matrix for various parameters.**

Parameter	Temp	pH	TDS	D.O.	Chloride	T.A.	C.H.	M.H.	SO_4^{-2}	PO_4^{-3}	NO^{-3}
Temp	1	--	--	--	--	--	--	--	--	--	--
pH	0.580	1	--	--	--	--	--	--	--	--	--
TDS	-0.027	-0.039	1	--	--	--	--	--	--	--	--
D.O.	-0.196	-0.297	-0.029	1	--	--	--	--	--	--	--
Chloride	0.116	0.395	0.201	-0.646	1	--	--	--	--	--	--
T.A.	-0.248	-0.290	0.381	-0.173	-0.007	1	--	--	--	--	----
C.H.	0.575	0.112	-0.164	-0.151	0.096	-0.509	1	--	--	--	--
M.H.	-0.217	-0.060	0.306	0.563	-0.397	-0.113	-0.114	1	--	--	--

SO_4^{-2}	0.399	0.016	0.066	-0.598	0.114	0.012	0.370	-0.199	1	--	--
PO_4^{-3}	-0.666	-0.169	-0.079	0.068	-0.037	0.373	-0.489	0.076	-0.367	1	--
NO^{-3} mg/L	0.488	0.166	-0.277	-0.112	0.213	0.054	0.177	-0.581	-0.027	-0.192	1
Temp.: Temperature, T.A.: Total Alkalinity, C.H.: Ca hardness and M.H.: Mg hardness											

Very high positive correlation was found between temperature and pH, High negative correlation was found between Temp and $PO4^{-3}$.

Very poor negative correlation was found with PO_4^{-3}, T.A. pH with T.A., D.O., TDS with NO^{-3}. D.O. with Chloride, SO_4^{-2}. Chloride with Mg hardness, T.A. with Ca hardness, Ca hardness with PO_4^{-3}, Mg hardness with NO^{-3}, SO_4^{-2} with NO^{-3}, PO_4^{-3} with NO^{-3}.

Very poor positive correlation was found with Chloride, pH with Ca Hardness, SO_4^{-2} and NO^{-3}, TDS with SO_4^{-2}, D.O. with PO_4^{-3}, Chloride with Ca hardness, SO_4^{-2}, T.A. with SO_4^{-2}, Ca hardness with NO^{3-}, Mg hardness with PO_4^{-3}.

Conclusion

In present research paper we describe the study of various Physico-chemical analysis of bore wells water like, temperature, pH, dissolved oxygen, total dissolved solids, chloride, total alkalinity, calcium and magnesium hardness, sulphate, phosphate nitrate ions. TDS value should be less than 500 mg/L for drinking water. All the sample shows suitable ranged prescribed by WHO and Indian standards except than sample 9 ,which was found higher. It can affect living organisms. The present study has led to conclude that the quality of water samples studied were acceptable from the majority of the physicochemical parameters but as TDS values of all the samples were violating the desirable limit suggested by IS, the water should be treated properly before its usage as drinking water to avoid probable adverse effects. Therefore, public should be made aware of drinking water quality. Management of precious natural liquid asset is essential need of today's time. For the welfare of the human being, water quality should be assessed on the regular basis.

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