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Research Article

Ground water Quality Assessment for Some villages of Kalol Tahsil, Dist: Gandhinagar

R.P.Patel[1*], K. S. Nimavat[2] and J. A. Chaudhari [3].

[1*] C. U. Shah Science College, Ahmedabad. Gujarat, India - -380014.

[2] Government Science College, Gandhinagar. Gujarat, India - 382015.

[3] Shri R. K. Parikh Arts and Science College, Petlad. Gujarat, India - 388450.

ABSTRACT

A systematic investigation has been carried out to study Physico-chemical characteristics, nutrients and ground water quality of some villages of Kalol Tahsil, of Gandhinagar district, Gujarat, India, is determined by physico-chemical methods. The study was carried out by collecting ground water samples from further eighteen different villages of Kalol Tahsil. One sample from each village is under assessment of Physico-chemical solution. Various quality parameter are measured namely Turbidity, Temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), total hardness(TH), calcium (Ca^{+2}), magnesium(Mg^{+2}), total alkalinity, chloride (Cl^{-}), sulphate (SO_4^{-2}), Dissolve Oxygen(DO), Nitrate(NO_3^{-}) and Fluoride(F^{-}) concentration present in water. An attempt has been made to find the quality of the ground water is suitable for drinking and irrigation purpose. About 50% of water samples are poor in quality in chemical analysis of water samples and remaining 50% samples show considerable variations and also comply with WHO standards for the parameter measured. The results of physico-chemical analysis of bore well water are discussed.

Keywords: Groundwater, Bore-well water, physico-chemical parameters and TDS.

INTRODUCTION

Water is one of the indispensable natural resources on our environment. The fresh water present on the earth is only 2.8 percent out of the all the waters on the earth and 20 percent of the fresh water constitutes the ground water. Groundwater is water that occupies the pores or crevices in sand, lime stone, sand stone and other rocks. The crucial role which groundwater plays as decentralized source of drinking water for millions of urban and rural families cannot be overstated[1], studies of physico-chemical parameters of ground water of Gujarat states have been reported by various workers[2-8], In continuous of our earlier analysis on ground water[9], here we report the Physico-chemical analysis of ground water of some other villages of Kalol territory. Kalol is located at Gandhinagar district of Gujarat. Borewell water is generally used for Drinking, Irrigation, Industrial and other domestic purposes in the Kalol area. The use of fertilizers like manure, pesticides, lime, waste dump etc. are the main sources of bore well water pollution[10]. Some villages of south and west zone of Kalol Taluka are provided Narmada canal water for drinking purpose but it is not enough. People residing in this area forced to use bore wells water for their domestic, Industrial, drinking and irrigation purpose. In order to assess water quality of ground water, we have carried out the Physico-chemical analysis of bore wells drinking water.

MATERIALS AND METHODS

Ground water samples were collected from the Tube wells of 18 various places around the Kalol. Various samples were collected in clean and dry polyethylene bottle without air bubbles from Tube wells after running them from 5 minutes[11]. All the collection of samples are immediately preserved in dark boxes and processed for the different analysis within 6 to 12 hours after collection.

Climate of Kalol Tahsil is semi aired with high variation between summer (26 to 45^{o}C) and winter

(25 to 8^{o}C) temperature. Summer is long, from April to October, with the monsoon season in between. The samples have been analyzed in the Chemistry Department, C. U. Shah Science College, Ahmedabad by physico chemical analysis methods. The sampling points are given in Table-1.

The analysis is carried out for determination of physico-chemical properties such as: pH, Turbidity, Temperature, electrical conductivity (EC), total dissolved solids (TDS), total hardness(TH), content of calcium (Ca^{+2}), magnesium(Mg^{+2}), total alkalinity, chloride (Cl^{-}), sulphate (SO_4^{-2}), Dissolve Oxygen, Nitrate and Fluoride(F^{-}) were determined using standard method[12-15]. All the chemicals were used of AR grade and double distilled water was used for preparation of reagents and solutions.

The measure quality parameters are considered for examination in this study. Various methods were used for estimation of various physico-chemical parameters like temperature, turbidity, pH, electrical conductivity (EC), dissolve oxygen (DO) and total dissolved solids (TDS) are measured by water analysis kit. For analysis of Turbidity, use turbidity meter which included in water analysis kit, set the nephlometer at 100 using 40 NTU standard suspensions, take sample in nephelometer sample tube and find out the value of scale. For analysis of DO, dip the DO probe in 5% sodium sulphite solution with constant stirring. Set meter to zero mark. Now dip the DO probe in water sample being constantly stirred and record the dissolve oxygen in mg/L from scale.

Content of calcium (Ca^{+2}), magnesium (Mg^{+2}) and total hardness were estimated by complexometric titration method[9]. The chloride content of water sample is determined by volumetric method. The water samples titrate against 0.02M silver nitrate solution using potassium chromate as an indicator and calculated in terms of mg/l.

Sulphate and Alkalinity as $CaCO_3$ content were measured by volumetric method. The alkalinity of water sample is determined by titrating it against standard acid solution using indicators like phenolphthalein and methyl orange.

Nitrate content was measured by Phenol Disulphonic Acid Method. Nitrate in contact with sulphuric acid produced nitric acid which is in dry condition brings about nitration of phenol disulphonic acid. The nitrophoenolic product gives intense yellow colour in alkaline medium which is measured through colorimeter.

Fluoride content was measured by Alizarin Spectrophotometric Method. Take 100ml of sample in a flask and add 5ml each of alizarin red solution and zirconyl acid solution, wait for 1 hour and note the absorbance on spectrophotometer and determine the fluoride content of the sample by comparing absorbance with standard curve of standard solutions. The sulphate content is determined by volumetric method[11].

RESULTS AND DISCUSSION

The results are obtained from analysis of ground water samples of eighteen villages of Kalol Tahsil are given in Table-2. The results of the physico-chemical parameters of these samples were determined by using standard procedure[12]. All the water samples were collected during the period of March-2014 to January -2015. All the drinking ground water samples were clear, colourless, odourless and Turbidity is measured 0.0 NTU.

The monitoring started with collection and assessment of water sample from the site of collection by measuring the temperature. The measured temperature of samples range from 25.7°C-29.1°C were reported in Table-2. Temperature is the one of the most essential parameters in water. It has significant impact on growth and activity of environmental life and it greatly affects the solubility of such as dissolve oxygen in water.

The pH value of drinking water is an important index of acidity, alkalinity and resulting value of the acidic-basic interaction of a number of its mineral and organic components. pH below 6.5 starts corrosion in pipes. Resulting in release if toxic metals. The groundwater sample shows pH of drinking water varies from 7.41 to 8.31 in these locations. The acceptable limit prescribed by the drinking water standard[16-17] is 6.5 – 8.5. EC is measured of drinking water samples varies from 1.3 to 4.96 mS has shown in Figure-1. The acceptable limit prescribed of the drinking water standard is less than 1.4 mS.

DO is measured of drinking water samples varies from 4.2 to 5.4mg/l. The acceptable limit prescribed of the drinking water standard is more than 5 mg/l.

Total hardness of the samples falls in different categories. Majority of which belongs to very hard category having TH more than 201 mg/l except Bhavpura (95 mg/l). In the present study TH ranged from 95mg/l to 560mg/l. The Calcium ranged from 24 to 69mg/L The tolerance range for calcium hardness is 75 - 200 mg/L. Calcium contents in all samples collected in the limit prescribed. Calcium is needed for the body in small quantities, though water provides only a part of total requirements[18]. We see that value of Ca^{+2} is in permissible range(75 mg/l) but 65% samples have more values of Mg^{+2} compare to permissible value 30 mg/l. Magnesium is a beneficial meta but toxic at high concentration, cause hardness of exerts a cathartic and diuretic action. The

concentration of magnesium range from 3 to 81 mg/L with high in sample No. 11 and in some samples in exceed the desirable limit of 30 mg/L prescribed by ISI but lies within the maximum permissible limit at 75 mg/L.

Total alkalinity is the quantitative capacity of an aqueous media to react with H+ ions. The highest TA values was recorded at Karoli (370 mg/l) village lowest at Bhavpura (32mg/l). The ground water for 80% samples have more values of TA compare to permissible value 120 mg/l as shown in Figure-2.

A large number of solids are found dissolved in natural water the common ones are carbonates, bicarbonates, chloride, sulphate, phosphate, iron, etc. In other words TDS is sum of the cations and anions concentration. A high contents of dissolve solids elevates the density of water, influences solubility of gases (like oxygen) reduces utility of water for drinking irrigation and industrial purpose. The upper limit of TDS recommended for drinking water is 500mg/l by USEPA and 1000mg/l by WHO[14]. In the present study TDS ranged from 150mg/l to 1900mg/l. According to TDS classification, 45% samples are fresh water with less than 1000 mg/l. The 55% samples are of brackish type with TDS greater than 1000 mg/l. A relation of between TDS and chloride anion was observed in the performed experiment which is shown in Figure 3.

Chlorides are common constituents of all natural water. Higher value of it impacts a salty taste of water, making it unacceptable for human consumption. Chloride was found higher in 45% samples. Chloride ion was found high in samples of Vansajada, Khatraj and Kalol-west villages as more than 500 mg/l. TDS value was also found very high in samples of Karoli, Khatraj and Kalol-west as more than 1500ppm. At Bhavpura Chloride and TDS were reported as 7 mg/l and 150 mg/l respectively. The values of Chloride ion and TDS are under desirable limits of 240 mg/l and 1000 mg/l respectively.

The highest sulphate value was recorded at Khatraj (125 mg/l) village lowest at Bhavpura (7mg/l). The desirable limit of sulphate is 240mg/l.The high concentrations of sulphate may induce diarrhoea and intestinal disorders. The highest Fluoride value was recorded at Kalol-west (1.09mg/l) village lowest at Himmatpura-veda (0.12mg/l). The desirable limit of Fluoride is 1 mg/l.

Nitrate nitrogen is one of the major constituents of organisms along with carbon and hydrogen as amino acid, proteins and organic compounds present in bore wells water. In the present study value of nitrate[19] nitrogen varies from 1.05 to 70.05 mg/l as shown in Figure-4.

Table-1
Sampling locations around villages of Kalol

S. No.	Sample locations (Viilage Name)	Source	Sample Number	Side from Kalol
1	bhavpura	Bore Well	S_1	North
2	Himatpura (veda)	Bore Well	S_2	North
3	Jamra	Bore Well	S_3	North
4	Veda	Bore Well	S_4	North
5	Nava	Bore Well	S_5	North
6	Balva	Bore Well	S_6	East
7	Kalol(east)	Bore Well	S_7	East
8	Dhedhu	Bore Well	S_8	East
9	Limbodra	Bore Well	S_9	East
10	Golthara	Bore Well	S_{10}	East
11	Khataraj	Bore Well	S_{11}	South
12	Bhimasan	Bore Well	S_{12}	South
13	Motibhoyan	Bore Well	S_{13}	South
14	Jethalaj	Bore Well	S_{14}	South
15	Karoli	Bore Well	S_{15}	South
16	Kalol(west)	Bore Well	S_{16}	West
17	Ramnagar	Bore Well	S_{17}	West
18	Vansjada	Bore Well	S_{18}	West

Table-2
Average results of the physico-chemical parameters

S. No.	Temp.	pH	EC	TDS	Ca^{+2}	Mg^{+2}	TH	Cl^{-}	SO_4^{-2}	TA	DO	NO_3^{-}	F^{-}
WHO Stand.	--	7.0 -8.0	1.4	1000	75	150	100	240	240	120	>5	50	1
ISI	--	6.5- 8.5	--	500	75	30	300	240	200	200	5	45	1
S_1	25.7	7.67	1.3	150	37	3	95	16	7	32	5.3	13.02	0.14
S_2	26.2	8.01	3.34	1200	58	64	431	370	49	232	5.01	32.02	0.12
S_3	27.3	8.32	1.42	450	31	61	325	123	27	265	5.2	21.02	0.18
S_4	29.1	8.19	2.3	550	45	24	225	95	12	280	5	33.04	0.25
S_5	26.9	8.1	3.12	950	51	26	240	236	16	200	4.9	55.12	0.34
S_6	27.8	7.95	1.61	600	39	31	245	101	24	245	5.3	29.3	0.18
S_7	26.9	7.64	3.71	1200	24	35	201	264	29	101	4.8	63.02	0.4
S_8	28.1	8.05	3.21	900	56	34	290	170	32	320	5.1	50.17	0.21
S_9	28.4	8.31	3.02	950	29	36	210	195	34	165	4.8	12.06	0.23
S_{10}	26.8	7.41	2.49	750	31	28	201	140	28.8	70	5.4	27.02	0.31
S_{11}	29.1	8.26	4.42	1600	69	81	560	503	125	293	4.2	23.08	0.39
S_{12}	27.9	7.94	3.16	1100	50	45	325	290	65	301	4.5	15.01	0.42
S_{13}	27.1	8.1	3.31	950	60	40	332	240	72	305	5.2	1.05	0.46
S_{14}	26.4	8.14	3.46	1150	62	61	395	365	81	238	4.7	18.95	0.4
S_{15}	27	8.02	4.61	1550	64	71	470	485	71	370	4.5	14.3	0.39
S_{16}	26.5	7.51	4.96	1900	41	41	294	502	81	160	4.3	70.05	1.09
S_{17}	27.8	8.02	3.42	1250	30	56	306	390	72	80	4.2	53.01	0.32
S_{18}	27.1	8.35	4.31	1500	67	50	392	525	46	270	4.9	25.06	0.54

All Parameter are in mg/l except Temperature, pH, Turbidity and EC(EC in mS, Temperature in ^{o}C, pH in units and Turbidity in NTU).

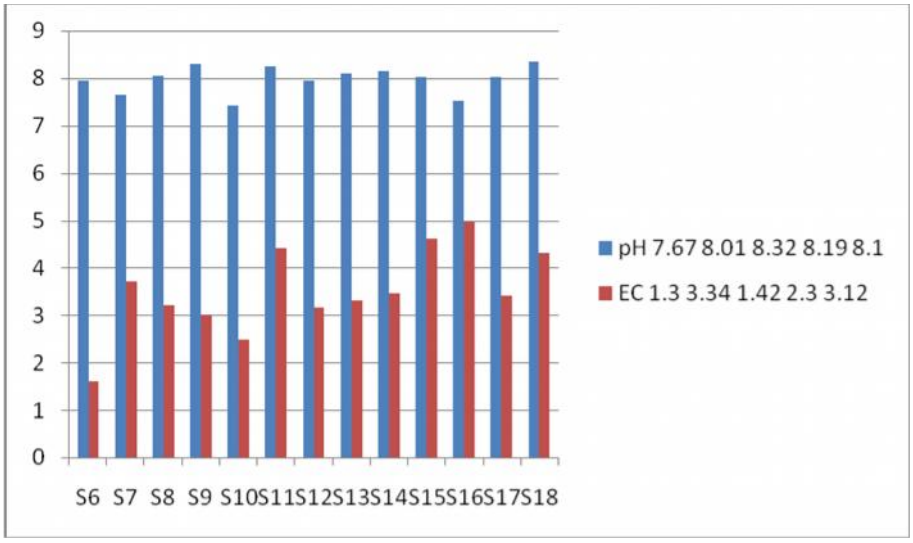

Figure 1
pH and conductance of various groundwater samples of Kalol.

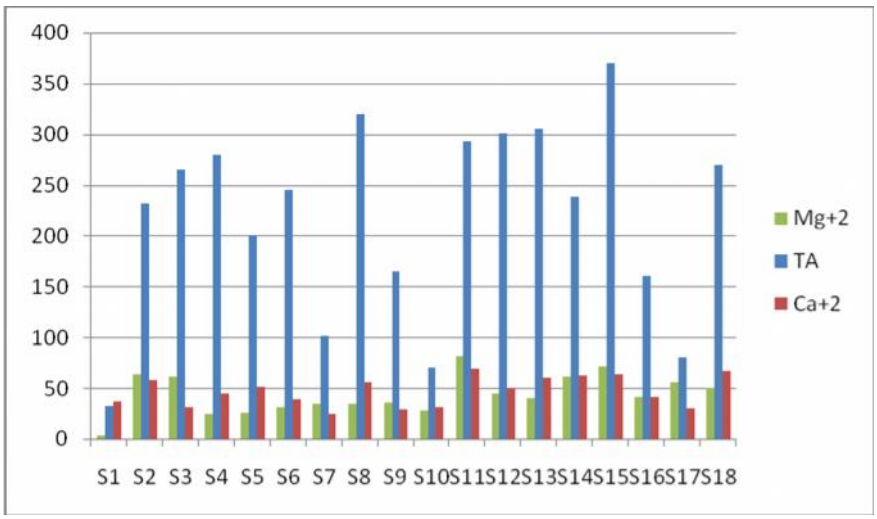

Figure 2
Total Alkalinity, Ca^{+2} and Mg^{+2} of various groundwater samples of Kalol.

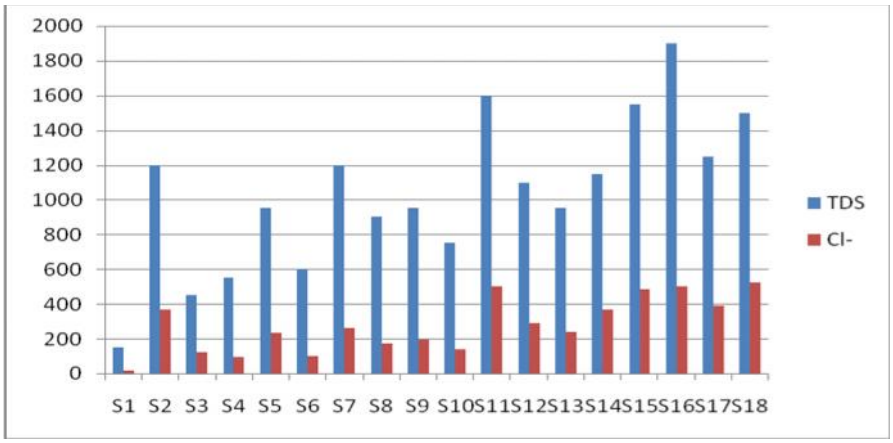

Figure 3
TDS and Chloride of various groundwater samples of Kalol.

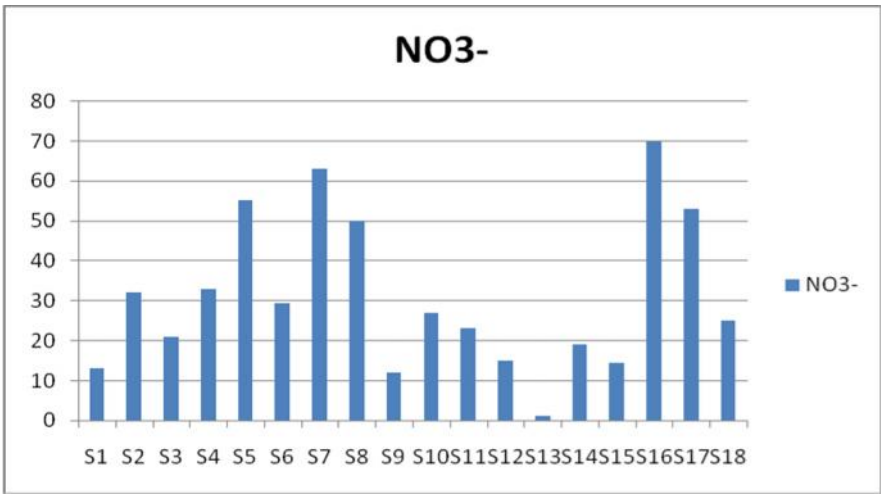

Figure 4
Nitrate of various groundwater samples of Kalol.

CONCLUSION

The inputs obtained from suitability of groundwater for domestic and irrigation purposes indicate that there is a marked difference in physico-chemical characteristics of ground water obtained from different villages. The ground water for 45% samples showed high EC and TDS than the prescribed limits given by WHO standards. About 65% samples have more values of Mg^{+2} compare to permissible value 30 mg/l. The ground water for 80% samples has more values of TA compare to permissible value 120 mg/l. The ground water for 25% samples showed high nitrate than the prescribed limits given by WHO standards indicating poor water quality and water from these sites is unfit for drinking purpose. About 50% of water samples are poor in quality. In this part the ground water quality may improve due to inflow of freshwater during rainy season by percolating well.

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