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STUDY ON SOME PHYSICO–CHEMICAL CHARACTERISTICS OF BORE–WELL WATER OF CHANASMA TALUKA

J. D. JOSHI[a], J. J. VORA, S. S. SHARMA, OJAS KOTHARI, NAVIN PATEL and K. N. SALVI

[a]Department of Chemistry, Sardar Patel University,
VALLABH VIDHYANAGAR–388 120 (Guj.), INDIA
Department of Chemistry, Hemchandracharya North Gujarat University,
PATAN – 384265 (Guj.), INDIA

ABSTRACT

Physico–chemical analyses of bore wells of some villages of Chanasma taluka of North Gujarat for drinking pupose has been carried out. The ground water of Chanasma taluka was contaminated by various chemical ions. The analysis was carried out for the parameters like pH, conductance, D.O., B.O.D., C.O.D., Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Al^{3+}, Fe^{2+}, HCO_3^-, CO_3^{2-}, Cl^-, SO_4^{2-}, NO_3^-, PO_4^{3-}, SiO_3^{2-}, F^-, TDS and the out come of the results is discussed.

Key words: Physico–chemical studies, Bore–well water, Chanasma taluka.

INTRODUCTION

Ground water is a sustainable source of fresh water and its popularity is growing day by day. As vital source for drinking and domestic use, it has to meet all physical and chemical parameters for safe use. Ground water is liable to contamination through anthropogenic and other sources like different land conditions; different rain conditions, use of different chemical pesticides and different depths of bore wells. The present study has been carried out to evaluate the physico–chemical characteristics of ground water of Chanasma taluka. Over 98% of the fresh water on the earth lies below surface waters that fall on porous terrains such as sand or sandy zone and it drains or percolates into the ground. Ground waters are relatively free from suspended contaminants, because they are filtered as they move through ground. Some ground water with high iron content contain sulfate–reducing bacteria. Today, human activities are constantly adding industrial, domestic and agricultural wastes to ground water contamination. It is difficult to restore the orginal water quality of the aquifer.

EXPERIMENTAL

In the present study, 55 bore well water samples were collected from Chanasma and near by villages. Samples were collected in sterilized bottles with necessary prequation with standard methods. All the chemicals and glasswares used were of the analytical position.[1,2].

Table 1.

Sr. No.	Parameters of water analysis	Method used
1.	pH	pH Metry
2.	Conductance	Conductivity meter
3.	T.D.S.	Evaporation modified (180°C)
4.	D.O. and B.O.D.	Winklers modified method
5.	C.O.D.	Dichromate reflux method
6.	HCO_3^- and CO_3^{2-}	Titrimetric
7.	Cl^-	Argentometric
8.	SO_4^{2-}	Turbidity meter
9.	NO_3^-, PO_4^{3-}, SiO_3^{2-}	Spectrophotometric
10.	Fe^{+2}, Al^{3+}	Spectrophotometric
11.	Ca^{2+} and Mg^{2+}	Complexomattic titrimetric
12.	Na^+ and K^+	Flamephotometric
13.	F^-	Ion selective electrode

RESULTS AND DISCUSSION

The Physico–chemical data of the bore well water samples were collected in July 2003. The results of these samples are presented in the tables 2 and 3. The results indicate that the pH values of the water samples are found to be slightly alkaline varying from 7.01 to 8.73. The results indicate that the pH values of the samples are within the WHO prescribed range. The electrical conductivity is varying from 1.55×10^{-3} mhos cm^{-1} to 6.30×10^{-3} mhos cm^{-1} while the bicarbonate varying from 212 mg/L. to 491 mg/L. and carbonate varies from 8.71 mg/L. to 26.13 mg/L.

Dissolved oxygen and B.O.D. is one of the most important parameters in assessing water quality and reflects the physical and biological process prevailing in the water. Good water should have the solubility of oxygen, 7.6 and 7.0 mg/L at 30°C and 35°C respectively[3]. D.O. varies from 1.17 mg/L to 3.06 mg/L and B.O.D. is in the range of 0.08 mg/L to 0.46 mg/L. The

Table 2.

Sample No.	Name of village	Depth in feet	pH	Cond. mili mhos/cm	TDS mg/L
1	Ruppur	890	7.72	3.70	1902
2	Jitoda	900	7.23	2.60	1402
3	Jakhana	1080	7.12	1.90	1069
4	Islampura	700	7.17	2.95	1555
5	Frinchal	1000	7.22	1.80	977
6	Vasaipura	800	7.15	3.50	1786
7	Vasai	800	7.10	3.35	1774
8	Sarsav	800	7.01	2.80	1550
9	Pipal	930	8.01	2.80	1549
10	Kharadharva	800	7.94	3.65	1892
11	Jiliya	1100	7.99	2.60	1468
12	Gangate	1000	7.57	2.50	1416
13	Jasalpur	750	7.82	2.60	1386
14	Mandiop	100	7.66	1.55	958
15	Bhramanwada	800	7.58	3.69	1832
16	Panchsar	700	8.02	5.03	2350
17	Manipura	800	7.80	5.15	2611
18	Vadavali	900	7.90	3.00	1629
19	Ambicapura	720	8.04	2.65	1469
20	Karoda	950	8.10	2.80	1513
21	Dhanodharda	1000	8.07	1.60	1025
22	Chanasma–1	1000	7.92	3.76	1774
23	Chanasma–2	1000	7.98	3.10	1647
24	Chanasma–3	1000	8.01	2.11	1290
25	Chanasma–4	1000	8.00	2.52	1385
26	Chanasma–5	1000	8.19	2.50	1350
27	Chanasma–6	1000	7.81	2.52	1370
28	Shedha	700	7.79	2.40	1220
	D.L.		6.5 to 8.5	–	500.0
	P.L.		–	–	2000.0

D.L. = Desirable limit by IS; P.L. = Permissible limit by IS

Table 2. Cont.

Sample No.	Name of village	Depth in feet	pH	Cond. mili mhos/cm	TDS mg/L
29	Sevala	800	8.13	2.53	1386
30	Galolivasna	825	7.89	2.58	1432
31	Jiliyavasna	1000	7.79	4.39	2291
32	Keshni	700	8.36	2.68	1457
33	Dhinoj	1000	8.17	4.02	2508
34	Railwaypura	1150	8.15	2.83	1505
35	Palasar	700	8.04	4.13	2227
36	Merwada	800	8.17	3.70	1953
37	Sunsara	680	8.00	3.63	1860
38	Danodarda	700	7.82	6.30	3147
39	Lanva	1000	8.39	4.32	2154
40	Pindharpura	925	8.10	3.00	1539
41	Mithadharva	500	7.70	4.91	2478
42	Datkarodi	1090	7.76	3.77	1843
43	Ranasan	600	7.58	4.74	2357
44	Chavali	750	7.94	3.45	1720
45	Dharpuri	800	8.14	2.31	1241
46	Mithighariyal	800	7.54	4.79	2379
47	Manyari	800	7.99	4.31	2187
48	Khorsam	890	7.44	4.42	2141
49	Gokharva	850	7.75	3.68	1818
50	Delmal	670	8.25	3.27	1711
51	Kamboi	900	8.75	2.74	1450
52	Ramgadh	800	7.93	3.77	1889
53	Kharighariyal	1000	7.69	2.77	1521
54	Dharmoda	1000	8.08	2.70	1372
55	G.E.B.	800	7.63	2.90	1611
	D.L.		6.5 to 8.5	–	500.0
	P.L.			–	2000.0

D.L. = Desirable limit by IS; P.L. = Permissible limit by IS

value of C.O.D. ranges in between 0.0 mg/L to 6.4 mg/L. The maximum permissible limit of C.O.D is 10 mg/L for drinking water[4] (De 1985). All the samples were free from C.O.D. hazards.

TDS indicates the general nature of water quality as good or saline. In the present study, TDS value varies from 958 mg/L to 3147 mg/L. TDS standards for drinking water are given in the Table 2. Excess amount of TDS may cause palatability decrease and gastrointestinal irritation.[5] The analyzed data show that the 21% samples contain more TDS than suggested limits.

Very high chloride contents cause corrosion and pitting of the pipes. Chloride standards for drinking water are given in the Table 4. In the present study, the chloride ion varies from 202 mg/L to 1281 mg/L. The analyzed data show that the 9% samples contain more chloride than suggested limits.

In the present study, sulphate varies from 54.0 mg/L to 270.0 mg/L. Maximum permissible limit (IS) is 400 mg/L. The excess amount of sulphate causes diarrhoea. All samples are within the suggested limits of sulphate.

The nitrogen contaminant in ground water occurs in the form of nitrate (NO_3–). Nitrogen is one of the major constituents of organisms along with carbon and hydrogen, as amino acid, protein and organic compounds and it enters as NO_3– in the bore–well[6]. The excess amount of nitrate causes methemoglobinemia. In the present study, nitrate varies from 1.96 mg/L to 45.67 mg/L.

The presence of Ca^{2+} in drinking water is due to natural geological source, mining by–product and agricultural wastes. Calcium salts are non–toxic except at very high doses. (100 mg for 20 days). In human body, hyper calcemia causes coma and death, if serum calcium level rises to 160 mg/L. The suggested limits of calcium are given in the Table 4. Calcium content in all experimental water samples is varying from 1.76 mg/L to 147.2 mg/L.

Sodium enters in drinking water from natural geological sources, detergents, domestic industrial discharges and mining wastes. It controls inter–cellular and intra–cellular osmosis, maintains pH balance of blood within the body and controls normal activities of muscles and nerves. The suggested limit of sodium in drinking water is given in the Table 4. In present study, it varies from 13 mg/L to 814 mg/L. Total 84% samples contain excess sodium.

Potassium enters in drinking water system from natural geological sources, detergent, mining, and agricultural wastes. It carries CO_2 in the blood system as $KHCO_3$ and also

Table 3.

Sr.No.	D.O.	BOD	COD	HCO_3^-	CO_3^{2-}	Cl^-	SO_4^{2-}	NO_3^-	PO_4^{3-}	SiO_3^{2-}	F^-	Ca^{2+}	Mg^{2+}	Na^+	K^+
1	2.57	0.26	0.0	304	23.23	749	95.0	17.60	14.30	26.55	3.08	76.4	45.8	528	1.95
2	2.64	0.19	0.0	287	14.52	437	72.0	21.50	56.65	27.64	3.89	65.2	63.7	361	2.34
3	2.47	0.14	0.0	269	26.13	297	62.0	15.50	11.19	19.19	6.46	1.76	2.4	13	0.05
4	1.84	0.08	0.0	311	17.42	554	59.0	15.22	23.63	21.73	6.06	78.4	39.3	401	2.43
5	2.50	0.21	0.0	217	20.33	259	92.0	13.55	18.66	21.61	5.92	36.0	20.6	262	2.34
6	2.70	0.42	0.0	239	20.33	755	82.0	20.39	13.06	17.17	5.09	60.8	38.8	512	1.95
7	2.90	0.42	0.0	366	17.42	661	68.0	18.57	14.92	21.90	5.02	88.0	37.9	464	2.34
8	2.50	0.36	0.0	362	14.52	464	148.0	6.7	18.70	21.80	4.21	57.2	25.2	410	3.12
9	1.98	0.29	0.0	378	14.52	485	102.0	17.18	14.92	19.35	5.09	40.8	33.6	428	2.73
10	3.06	0.42	0.0	319	17.42	704	136.0	12.01	21.14	25.62	2.85	63.2	44.6	533	3.12
11	2.83	0.46	0.0	370	23.23	422	87.0	18.30	15.65	23.11	6.05	43.2	30.2	401	2.73
12	1.17	0.29	0.0	367	23.23	427	54.0	19.55	18.66	18.60	7.17	56.0	24.9	372	2.34
13	2.23	0.27	0.0	262	17.42	456	116.0	6.42	27.36	20.43	4.20	56.8	30.7	367	1.95
14	1.32	0.22	0.0	303	17.42	190	70.0	5.86	9.95	20.43	0.38	88.8	29.7	142	14.0
15	2.28	0.14	0.0	257	14.52	749	150.0	4.05	2.49	33.88	1.73	116.8	52.8	440	4.29
16	2.52	0.10	0.0	271	8.71	1073	109.9	8.24	23.63	27.71	3.42	92.8	49.92	676	2.34
17	2.08	0.41	6.4	367	14.52	1102	175.0	5.45	4.97	17.71	2.72	104.8	76.8	702	2.73
18	2.14	0.38	0.0	321	17.42	532	154.0	13.27	3.73	18.04	3.35	72.8	24.0	440	2.73
19	2.33	0.46	0.0	380	20.33	432	144.0	6.56	9.95	13.68	5.82	53.6	34.0	390	1.56
20	1.61	0.28	0.0	327	17.42	498	104.0	6.42	24.25	20.59	5.46	56.0	34.5	400	2.34
21	2.14	0.50	0.0	351	14.52	202	75.0	10.19	4.97	19.34	7.75	33.6	18.2	256	1.17
22	2.59	0.22	0.0	354	17.68	614	121.0	14.94	27.98	28.02	3.66	67.2	48.96	467	2.34
23	2.65	0.28	0.0	321	20.62	585	92.0	12.99	14.92	20.27	3.76	52.8	43.2	438	1.95
24	2.37	0.38	0.0	295	20.62	354	144.0	4.61	19.90	31.67	4.05	44.8	28.8	332	2.34
25	1.74	0.22	0.0	307	17.68	426	121.0	8.80	17.41	32.45	3.83	52.0	34.0	357	1.56
26	2.12	0.38	0.0	301	14.73	376	135.0	5.87	42.29	29.35	3.88	48.0	30.2	358	1.56
27	1.83	0.38	0.0	300	20.62	414	137.0	4.33	17.41	33.07	3.16	48.8	39.3	342	1.56
28	1.30	0.28	0.0	332	17.68	385	118.0	8.38	6.22	32.30	3.96	52.0	30.2	345	1.17
D.L.	–	–	–	–	–	250	200	45	–	–	1.0	75	–	–	–
P.L.	–	–	–	–	–	1000	400	100	–	–	1.5	200	–	175	–

D.L. = Desirable limit by IS; P.L. = Permissible limit by IS

Table 3. Cont.

Sr.No.	D.O.	BOD	COD	HCO_3^-	CO_3^{2-}	Cl^-	SO_4^{2-}	NO_3^-	PO_4^{3-}	SiO_3^{2-}	F^-	Ca^{2+}	Mg^{2+}	Na^+	K^+
29	1.96	0.35	0.0	319	11.78	420	125.0	3.07	16.17	32.61	3.26	63.2	32.64	351	1.17
30	1.83	0.44	0.0	340	17.68	394	154.0	5.03	22.39	29.66	2.33	63.2	36.48	355	1.17
31	1.55	0.28	0.0	421	23.57	883	144.0	11.17	1.24	30.28	3.27	91.2	56.64	615	2.34
32	2.09	0.25	0.0	339	20.62	474	93.0	15.50	6.22	29.66	6.40	48.0	34.56	386	0.39
33	2.37	0.28	0.0	425	11.78	919	270.0	13.13	2.49	33.23	2.01	123.2	69.60	631	1.17
34	2.21	0.28	0.0	319	14.73	491	130.0	11.03	1.24	30.90	3.91	78.4	42.24	358	1.56
35	1.86	0.27	0.0	491	17.68	767	144.0	36.03	2.49	31.67	3.76	84.0	59.04	583	0.78
36	2.17	0.22	0.0	373	17.68	685	180.0	20.53	2.49	27.80	3.96	61.6	56.24	520	1.56
37	1.58	0.25	0.0	309	20.62	717	138.0	13.97	3.73	29.35	3.96	73.6	53.76	490	1.56
38	2.07	0.30	0.0	470	17.68	1281	233.0	45.67	3.73	30.28	1.91	142.4	100.8	814	1.56
39	2.26	0.25	0.0	293	11.78	885	189.0	12.01	11.19	27.02	1.47	115.2	74.88	527	1.56
40	2.09	0.22	0.0	250	23.57	547	135.0	20.81	23.63	27.48	5.67	52.8	32.64	414	1.17
41	1.56	0.30	0.0	383	17.68	1038	105.0	32.54	22.39	25.08	3.98	78.4	65.28	695	1.17
42	2.15	0.25	0.0	270	17.68	732	149.0	1.96	16.17	31.06	2.30	106.4	75.56	428	3.12
43	1.33	0.21	0.0	310	17.68	1043	107.0	13.96	16.79	26.16	4.01	80.0	58.56	669	1.17
44	2.02	0.17	0.0	242	20.62	680	130.0	10.89	21.14	27.95	4.81	62.4	57.12	454	1.17
45	2.05	0.16	0.0	268	23.57	344	88.0	8.93	40.42	24.14	7.29	20.8	19.20	387	0.0
46	2.97	0.24	0.0	282	11.78	1010	164.0	8.93	34.83	24.30	3.68	65.6	57.80	712	1.17
47	1.90	0.21	0.0	261	17.68	899	205.0	4.19	17.41	30.59	2.33	96.8	49.92	594	2.34
48	1.49	0.22	0.0	222	11.78	907	222.0	1.96	9.95	30.28	1.57	147.2	65.28	511	3.90
49	2.02	0.38	0.0	259	17.68	701	154.1	3.91	27.98	30.90	2.02	108.0	60.00	448	2.73
50	2.81	0.28	0.0	249	17.68	610	173.1	4.91	23.63	30.59	2.31	88.0	45.12	455	3.51
51	1.55	0.35	0.0	266	23.51	420	198.1	4.61	21.14	31.37	3.08	56.8	35.52	378	1.56
52	1.58	0.32	0.0	270	14.13	714	156.0	2.78	37.31	30.42	1.21	137.6	59.56	456	4.29
53	1.14	0.25	0.0	371	23.62	428	142.0	4.89	26.12	30.14	2.16	84.8	38.40	361	2.34
54	1.74	0.44	0.0	212	17.68	461	142.0	4.19	34.82	31.68	2.79	66.4	38.88	348	2.73
55	2.09	0.19	0.0	434	20.62	441	123.0	10.05	42.91	26.83	3.02	48.0	49.92	401	3.12
D.L.	–	–	–	–	–	250	200	45	–	–	1.0	75	–	–	–
P.L.	–	–	–	–	–	1000	400	100	–	–	1.5	200	–	175	–

D.L. = Desirable limit by IS ; P.L. = Permissible limit by IS

maintains pH balance of blood by controlling Na/K pool system within the body. It supports inter–cellular and intra–cellular osmosis and helps to activate various metalloenzymes. In experimental water samples, the amount of potassium varied from 0.05 mg/L to 4.29 mg/L, which is much lower than the maximum permissible limit as prescribe by WHO, so all water samples are having potassium below the maximum level.

Iron in the drinking water may be present as Fe^{2+}, Fe^{3+}, $Fe(OH)^{+}$ or $Fe(OH)_2+$ in suspended or filterable forms. Iron causes staining in clothes and imparts bitter taste. It comes into drinking water from natural geological sources and mining by products. Excess amount of Fe (more than 10 mg/L) causes rapid increase in respiration, pulse rate and coagulation of blood vessels, hypertension and drowsiness. The iron content in water samples found to be below detectable limits.

Magnesium enters in the drinking water system from natural geological sources. Too high Mg^{2+} causes nausea, muscular weakness and paralysis in human body when it reaches up to the level of about 400 mg/L[7]. The suggested limits of magnesium are given in the Table 4. In this area, magnesium concentration ranged from 2.4 mg/L. to 100.8 mg/L.

In the present study, phosphate ranges from 1.24 mg/L to 56.65 mg/L. Phosphate is consumed in excess. Phosphine gas is produced in gastro–intestinal tract on reaction with gastric juice. This could even lead to the death of consumer. In present study, silicate ranged from 13.68 mg/L to 33.88 mg/L.

High levels of fluoride lead to dental and/or skeletal fluorosis. The observed value of fluoride content in this area varied from 0.38 mg/L to 7.75 mg/L. According to WHO and ISI, the maximum permissible limit is 1.5 mg/L, so 52 samples are contaminated by excess fluoride contents.

CONCLUSION

The whole Chanasma taluka depends on ground water. Chanasma taluka has 52 samples having excess fluoride concentration, 12 samples having more than 2000 mg/L of TDS. In all, 52 water samples were found to be unsafe for drinking purpose, whereas 52 samples badly require proper chemical treatment to reduce the toxic levels of fluoride.

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