ASSESSMENT OF GROUNDWATER QUALITY FOR DRINKING PURPOSE IN SELECTED AREAS OF BHAVNAGAR DISTRICT, GUJARAT

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Abstract

Water has become an emotional issue with the people and policy makers of our surroundings. Quality of water especially groundwater, which is one of the major sources of drinking water in India plays a vital part of health status of any populace and thus very important to look at. Excessive groundwater extraction for agriculture, industries and domestic utilization made it liable deterioration. Going on these considerations, the physico-chemical parameters of water samples collected from various twenty places of Bhavnagar district from three talukas were assessed for colour, temperature, pH, conductivity (EC), Total hardness (TH), Total alkalinity (TA), sulphate (SO_4^{2-}), chloride (Cl^-), fluoride (F^-), nitrate (NO_3^-), turbidity and total dissolved solids (TDS). The outcomes were associated with measures as dictated by the American Public Health Association (APHA), World Health Organization (WHO) and Bureau of Indian Standards (BIS). In the present work, potability of groundwater of some selected villages of Bhavnagar district (Gujarat) is examined in summer to find the quality for drinking purpose.

Key words: Groundwater quality assessment, Bhavnagar district, physico-chemical parameters, water quality standards.

Introduction

"No life without water'' is a common saying depending upon the fact that water is the ace of the naturally occurring essential requirements of whole life affirming activities. Water is a dynamic system containing living as well as goods as non-living inorganic and organic soluble as well as insoluble substances and therefore, its quality is likely to change day by day and from origin to root. Alteration in the natural quality may shake up the balance system and would become unfit for designated purposes. In the world, clean and usable abundant water appearance is less than 1%, which is available for drinking, farming, domestic power generation, industrial consummation, transportation, waste disposition, etc(Murhekar,2011). Groundwater is the most significant source of domestic, industrial and agricultural water supply in the macrocosm (Dharmaraja et al, 2012). Suitability of water for various practices depends on the character and concentration of dissolved minerals and groundwater has a more mineral composition than surface water. The character of groundwater is always shifting in response to daily, seasonal and climatic factors. Continuous monitoring of water quality parameters is extremely important because changes in the quality of water were far reaching results in terms of its effects on humans and biota. Contamination of water bodies as a result of metal toxicity has become a root of concern

among consumers. This concern has become alarming in response to increasing knowledge on their toxicity to human health and biological systems.

Materials and methods

Bhavnagar district of Gujarat having a vast coastal area of the bay of Khambhat and having semi-arid region. In this region, temperature becomes higher than 45 ºC in the month of May& June and people suffers lots of ground water quality problems in specially summer season. With consideration of human health aspects proposed research work have been carried out for three Taluka at Bhavnagar district for physico-chemical parameters. Twenty groundwater sample from well of three selected taluka of Bhavnagar district collected for physico-chemical analysis for pH, EC, turbidity, Total hardness, Total Alkalinity, chloride, sulphate, nitrate, TDS and fluoride and all the analysed values compared with standards given by APHA, WHO and IS (APHA,1998., WHO,1996.,BIS,1991).

Table 1. Methods and IS Limits*

Parameters	Experimental techniques	DL	PL
pH value	Digital pH meter	6.5-8.5	NR
Turbidity (NTU)	Turbidity meter	5	10
Total alkalinity, mg/L	Titration method	200	600
Total Hardness mg/L	Titration (EDTA-Titrimetric)	300	600
Chloride, mg/L	Mohr method(titration)	250	1000
Sulphate, mg/L	Spectrophotometric	200	400
Nitrate, mg/L	Spectrophotometric	45	100
Fluoride, mg/L	Ion-selective Electrode method	1.0	1.5
TDS, mg/L	Gravimetric method	500	2000
*As per IS: 10500, 1991; DL-Desirable limit, PL-Permissible limit, NR-No relaxation			

Results and discussions

The results of physico-chemical assessment of collected groundwater samples is summarized as under:

Color: There was no presence of any colour impurity found in any of the samples. All the water samples were colorless and transparent.

pH: pH is an index of presence of hydrogen ion in the solution. In this study, it was in the range of 7.21 (at Dakana) to 8.19 (at Budhel) indicating slight presence of alkalinity in all the samples, which is in desirable limit in all the samples.

Electrical conductance (EC): EC is a measure of salinity, which greatly affects the taste of water and thus significantly important parameter for study. Electrical conductance was recorded highest at Hathab (14.5 mS/cm) and lowest at Talaja (1.15 mS/cm). Dakana village sample was also showing very high range of EC, which was more than maximum permissible limit.

Table 2. Mean of Physico-chemical data of groundwater samples

Station Name	pH	EC mS/cm	Turbidity NTU	Total Hardness mg/L	Total Alkalinity mg/L	Chloride mg/L	Sulphate mg/L	Nitrate mg/L	Fluoride mg/L	TDS mg/L
Thalsar	7.5	1.59	1.4	352	360	199	65	21.86	0.13	1020
Hoidad	7.46	6.85	1.01	1840	226	1673	228	1.44	0.15	4640
Kobdi	7.48	1.76	5.81	464	380	184	111	63.85	0.21	1080
Kuda	7.79	3.75	0.27	400	580	448	302	23.11	0.60	1840
Rampar	7.42	6.47	0.5	840	654	800	497	60.79	1.26	3580
Budhel	8.19	3.42	1.22	240	96	709	262	1.39	0.21	1500
Dakana	7.21	11.44	1.85	3640	192	2978	265	138.95	0.13	9140
Fulsar	7.31	8.28	1.85	1480	496	1390	562	13.67	0.37	4900
Ambla	7.76	1.54	1.65	176	360	210	114	5.79	0.36	840
Rajapara	8.09	2.21	0.84	760	272	227	182	189.29	0.17	1900
Kantala	8.16	2.06	0.41	640	144	312	213	43.48	0.34	1520
MithiVirdi	7.32	8.36	0.45	2440	212	2084	352	91.62	0.20	8080
Padva	7.89	3.44	0.2	640	416	510	281	143.07	0.52	1960
Koliyak	8.13	4.77	0.37	1180	520	851	262	114.19	0.80	3840
Bhumbhali	8.09	6.55	3.41	1280	320	1078	463	164.56	0.74	4320
Akwada	7.94	3.78	10.92	336	500	516	414	16.45	1.73	2260
Chhaya	7.41	1.94	0.41	680	288	182	231	120.62	0.25	1640
Hathab	7.56	14.5	0.62	3520	272	4112	404	44.48	0.17	9900
Talaja	7.33	1.17	0.15	248	330	128	157	12.64	0.17	380
Bhandariya	7.26	2.15	0.18	800	220	323	235	122.84	0.14	1020

Turbidity: Lowest turbidity was found at Talaja (0.15 NTU) and two samples were higher than desirable limit (5 NTU) at Akwada (10.92 NTU) and Kobdi (5.81 NTU) out of all the collected samples.

Total Hardness: Total hardness varied in the very high range. Out of them more than 50% of the sample were in too much high range than permissible limit. Lowest at Ambla (176 mg/L) village of Talaja taluka and highest at Dakana (3640 mg/L) village. Hardness below 300 mg/l is considered as potable but beyond this limit produce gastro intestinal irritation (ICMR. 1975).

Total alkalinity: It was ranged between 96 mg/L to 654 mg/L. Budhel village (96 mg/L) of Bhavnagar was showing total alkalinity in beyond desirable limit and higher (654 mg/L) at Rampar village. Total alkalinity of the samples were in permissible limit.

Sulphate: Sulphate concentration was found minimum at Thalsar (65mg/L) i.e. within permissible limit and maximum at Fulsar (562mg/L) i.e. higher than maximum permissible limit. Sulphate amount higher than permissible limit cause laxative effect, which is exceeded when it consumed with magnesium.

Chloride: Chloride usually occurs as NaCl, $CaCl_2$ and $MgCl_2$ and in widely varying concentrations, in all natural waters. It was varied between 128 mg/L at Talaja to 4112 mg/L at Hathab. It was also beyond desirable limit at Thalsar, Kobadi, Ambla, Rajpara, Gorkhi and Chhaya villages.

Nitrate: Now a days due to Morden agricultural applications of N- fertilizers and practices the amount of nitrate rapidly increases in groundwater (Ascott, 2017). Concentration of nitrate was minimum at Budhel (1.39 mg/L) and maximum at Rajapara (189.29 mg/L), in which 50% were showing higher amount of nitrate than maximum permissible limit (45 mg/L). The use of excessive nitrate contaminated water into potable water is considered as hazardous for infants causing methemoglobinaemia (Yadawe et al, 2011).

Total Dissolved Solids (TDS): A high value of TDS reduces water utility for irrigation and drinking purposes. Increase in TDS is mainly due to increase in sea water salts (carbonate, bicarbonate, chloride, sulphate, sodium and other salts) and intrusion. TDS was in range of 380 mg/L (Talaja) to 9900 mg/L (Hathab).

Fluoride: F^- ion concentrations of groundwater samples observed maximum at Akwada (1.73 mg/L) and minimum at Thalsar (0.13 mg/L). Excluding one sample (Akwada) all the sample were within permissible limit but some of the sample were lying exceeding desirable limit. In the case of fluoride, lower concentration causes dental caries and higher dental fluorosis, which means it is necessary to maintain fluoride concentration in potable water (0.8 – 1.0 mg/L) (Meenakshi et al, 2004, Ambade and Rao, 2012).

Conclusions

Assessment of groundwater in selected areas of Bhavnagar in present study shows that due to costal area there is an effect of sea water in ground water samples, which are alkaline thoroughly all samples and TDS is in high range. The amount of chloride, sulphate and nitrate is also exceeding than permissible limits given by IS. Water samples requiring some precautionary measurement to prevent adverse effects to the wellness of mankind.

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