

Physico-chemical characteristics of ground water of Surat city

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ABSTRACT

Ground water samples were collected from different locations in the radius of 25 km. of Surat city, Gujarat(India). These samples of ground water from 12 sampling point of Surat for their physico-chemical studies were tested. Laboratory tests were performed for the analysis of samples for pH, Colour, Odour, Hardness, Chloride, Alkalinity, COD, Sulfate, TDS, SS, Fe, Cu, Boron and Chromium. On comparing the results against drinking water quality standards laid by Indian Council of Medical Research (ICMR) and World Health Organization (WHO), it is found that most of the water samples are non-potable for human being due to high concentration of one or the other parameter. Most of the samples have Total Alkalinity, Hardness, Chloride and TDS values much higher than the permissible level stipulated by ICMR and WHO. The high values of these parameters may have health implications and therefore these need attention.

Key words: Ground water quality, physico-chemical studies, TDS, COD, Surat.

INTRODUCTION

Increasing industrial activities result in deterioration of quality of natural water. Surface water has its own water purification capacity but if ground water once contaminated it can not restore itself again as natural water. The problems of groundwater quality are more acute in the areas, which are densely populated, thickly industrialized and have shallow ground water table. The rapid growth of urbanization further affected the ground water quality due to over exploitation of resources and improper waste disposal practices. Therefore, it is essential for protection and management of ground water quality.

Surat is one of the major cities of Gujarat. The radius under study consists of residential as well as industrial areas. Main aim is to assess the groundwater quality after the flood in Surat city and

to compare the result with drinking water standards. After collecting the samples physicochemical parameters of ground water were carried out. These water quality parameters are used to determine the quality of water and compared it with drinking water standards prescribed by WHO (1993) 1,2 and ICMR (1986)^{1,2}.

Study area

Topography

The city lies at a bend of the River Tapi, where its course swerves suddenly from the North-East to SouthWest. With the walled city at its centre, the city forms an arc of a circle, the bends enclosed by its walls stretching for about a mile and a quarter along the bank. From the right bank of the river, the ground rises slightly towards the north, but the height above mean sea level is only 13 metres. The topography is controlled by the river and the general slope is from North-East to South-West.

Temperature and rainfall

The summers are quite hot with temperatures ranging from 37.7°C to 44.4°C. The climate is pleasant during the monsoon while autumn is temperate. The winters are not very cold but the temperatures in January range from 10°C to 15.5°C. The average annual rainfall of the city has been 1143 mm.

Fig. 1 depicts the Surat city and the various sampling locations, Tapi River, Roads, Railway lines.

EXPERIMENTAL

The present study deals with ground water quality monitoring over the distance of 25 km radius of Surat city. Different samples of groundwater were collected from Barbodhan, Sachin, Uttran, Udhna, Varaccha, Adajan, Pandesara, Vesu, Parvat, Chalthan, Kadodara and Kawas. The results of respective places are given in table 2 and compared all results with the standards values given by WHO(1993)1,2 and ICMR(1986)1,2 in table 1. The ground water samples were collected in pre-cleaned new bottles of 2 lt. capacity and stored in

ice-box. AnalaR grade chemicals were used without further purification. The physicochemical analysis were done according to APHA(1989)4 standards method for examination of water and waste water. The various parameters were analyzed viz. pH, Color, Odour, Hardness, Chloride, Total Alkalinity, COD, Sulfate, TDS, SS, Fe, Cu, Boron, Chromium. Some parameters like pH, Colour, Odour were checked within 6 hrs. The obtained results were reproducible within $\pm 3\%$ error limit.

RESULTS AND DISCUSSION

Drinking water standards by ICMR(1986)1,2 and WHO(1993)1,2 are summarized in table 1. Average values of Physicochemical parameters of ground water from different locations are presented in table 1. It was observed from the pH values that water samples were slightly alkaline varying from 7.0 - 8.32 and this values are within the prescribed by WHO(1993)1,2 and ICMR(1986)1,2. Only slight less pH in Vesu sample was found which may change the taste and color. pH trend is plotted in fig 1.

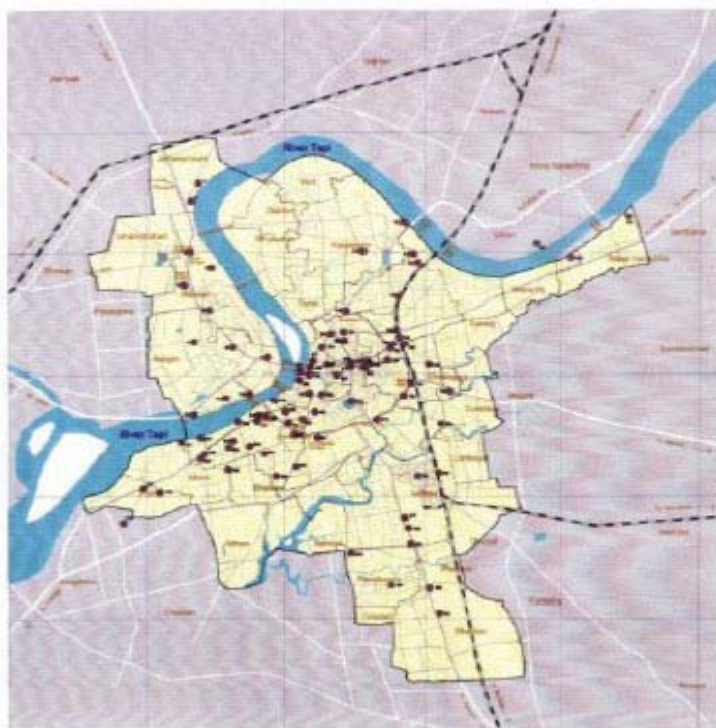


Fig. 1: Surat city and the various sampling locations, Tapi River, Roads, Railway lines

Table 1:

S. No.	Parameters	Prescribed limit by I.C.M.A.	Prescribed limit by I.C.M.A.	Vesu	Adajan	Kawas	Sachin	Bhe- stan	Pande- sara	Udhna	Varac cha	Barbo dahn	Chalt han	Par wat	Kado- dara
1.	pH	7.0 - 8.5	6.5 - 8.5	6.6	7.5	8.1	7.6	8.1	7.3	7.7	7.3	7.1	7.3	7.2	7.6
2.	Color 5 Hz (Co-pt)	15Hz	8	15	5	4	1	3	2	2	1	2	1	Nil	
3.	Alkalinity	-	200	900	1000	140	350	315	365	282	292	134	128	318	196
4.	Hardness	300	500	1230	500	150	350	320	600	300	334	230	141	200	296
5.	Chloride	200	250	1400	924	86.4	425	324	815	351	425	100	98	314	340
6.	Silica	-	-	48	34	36	19.6	20.1	18.5	20.3	21.3	41	24	34	48
7.	Sulfate	200	400	181	69	13	58.8	19.6	98	39.2	76.2	61	35	66	52
8.	TDS	500	1000	4000	2834	320	1120	900	2110	1143	1204	405	304	715	760
9.	Odour	-	-	Nil	Unpl- easant	Nil	Bad	Nil	Bad	Nil	Nil	Nil	Nil	Nil	Nil
10.	COD	-	-	50	Nil	Nil	Nil	Nil	10	3.21	5	2.42	Nil	Nil	Nil
11.	SS	-	-	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
12.	Fe	0.3	0.3	N.D	0.35	N.D	0.38	0.05	0.2	Nil	0.02	N.D	0.26	Nil	0.01
13.	Cu	1	1	0.008	Nil	Nil	0.01	Nil	Nil	0.02	Nil	0.02	Nil	0.02	Nil
14.	Cr	0.05	0.05	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
15.	Boron	-	0.5	0.5	0.02	Nil	0.001	Nil	0.01	Nil	Nil	0.02	0.01	Nil	0.001

In all the ground water samples color was checked in Hazen unit^{1,4}. From the analysis it seems that all water samples having acceptable color except Vesu and Adajan. Colour is not adversely affecting the water quality but color is aesthetically not acceptable. Trend of appearance plotted in fig. 2.

Determination of alkalinity varied from 140-1000 ppm from which most of the samples containing higher alkalinity than the standards^{5,8}. More alkalinity needs more water softening during treatment of raw water¹. Fig 3 shows total alkalinity trend in samples. Determination of hardness varied from 155 to 1230 ppm. Here except 3-4 location

every sample contained more hardness than prescribed limit. So the adverse effects of such water samples are^{1,(1)} soap consumption by hard water causes economic loss to water (2) precipitation by hard water adhere to surface of tubes, sinks etc. and may stain clothing, dishes and other items. (3) MgSO₄ precipitates have laxative effect in persons unaccustomed to it. So all these samples fall into category of hard water. Trend of hardness is plotted in fig. 4.

It was found that the amount of chloride present in analyzed samples were beyond the limit except Kawas and Chalthan. High chloride reacts with sodium and makes water salty in taste, which

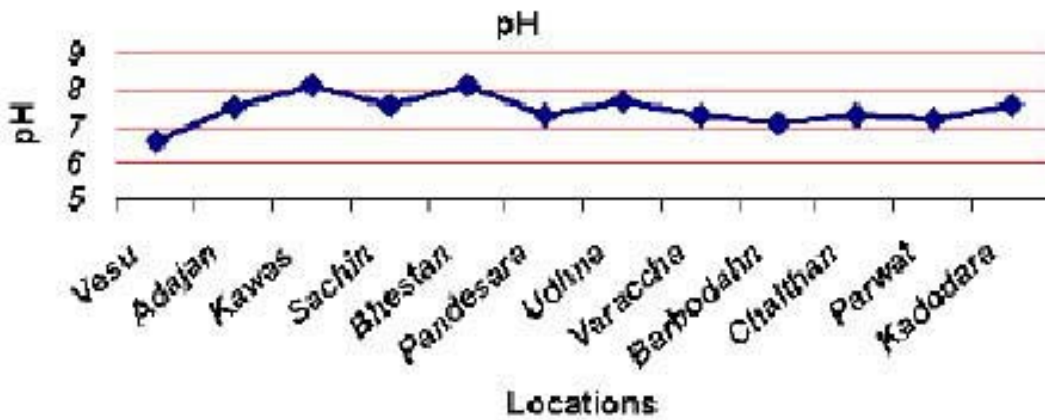


Fig. 2:

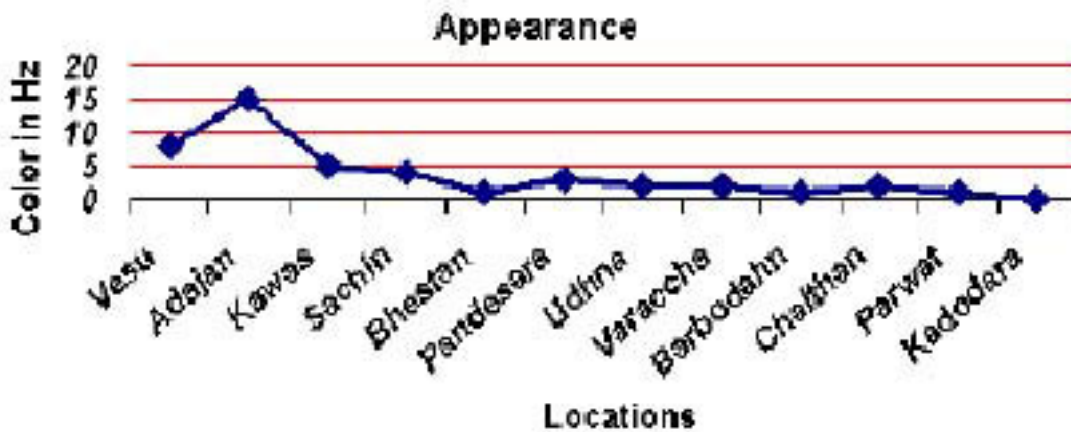


Fig. 3:

is unacceptable for human consumption. It also increases the TDS values there by affecting the quality of water. Trend of chloride is plotted in fig 5. Same were the results with TDS, while increasing Chloride and other salt content TDS increases accordingly. From the analysis of most of the samples except Kawas, Barbodhan and Chalthan all ground water samples contains more TDS than the prescribed limit given by WHO1,2 and ICMR1,2. TDS concentration beyond 500 ppm decreases potability and may cause gastrointestinal irritation. Trend of TDS is plotted in fig 6.

In all the samples sulfate were with in the limit. The range of sulfate found was 13 to 181 ppm which was within the limit and therefore no more attention to be given for sulfate values. Trend of sulfates is plotted in fig. 7.

In all the samples silica was within the limits. The results vary from 18.5 to 48 ppm. All samples contained acceptable silica content so there was no problem of potability where silica is concerned. Trend of Silica is plotted in fig 8. Odour is physical property of water and from the results it

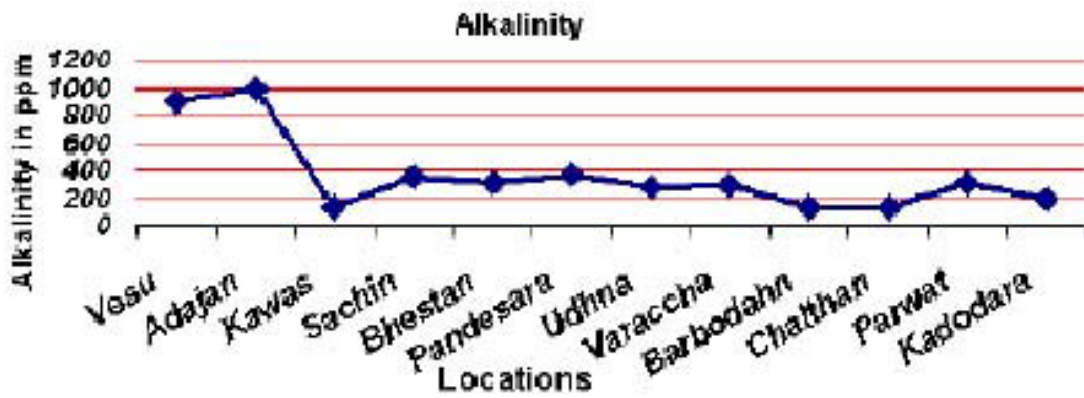


Fig. 4:

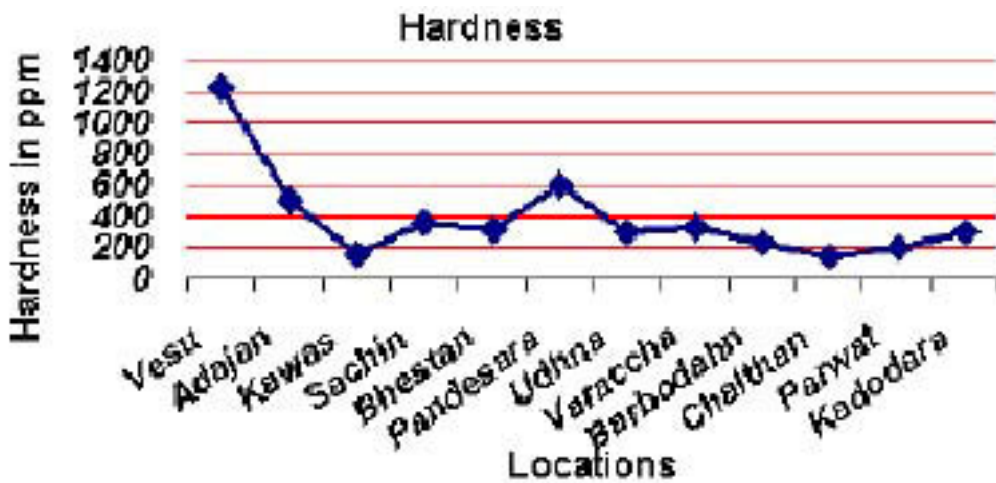


Fig. 5:

was found out that the samples from Adajan, Sachin and Pandesara were having slight unpleasant odour, which is undesirable for drinking purpose. So such ground water needs more purification to remove odour from the water. Except these three samples all are having no odour so those water samples are acceptable for drinking purpose.

COD is the main parameter to assess the quality of wastewater. In water there is no standard mentioned it means all the water source should be

COD free but during the analysis we found that sample from Vesu contained more COD i.e. 50 ppm which is too high and indicate that water quality is very bad. Rest of all ground water samples contained negligible COD which can not harmful to human health. There is no limit for S.S in WHO1,2 and ICMA1,2 standards. It is a physical property of water and more S.S is not acceptable as it is aesthetical asset of water. All the ground water samples having negligible S.S so there is no problem of S.S to the public for drinking purpose.

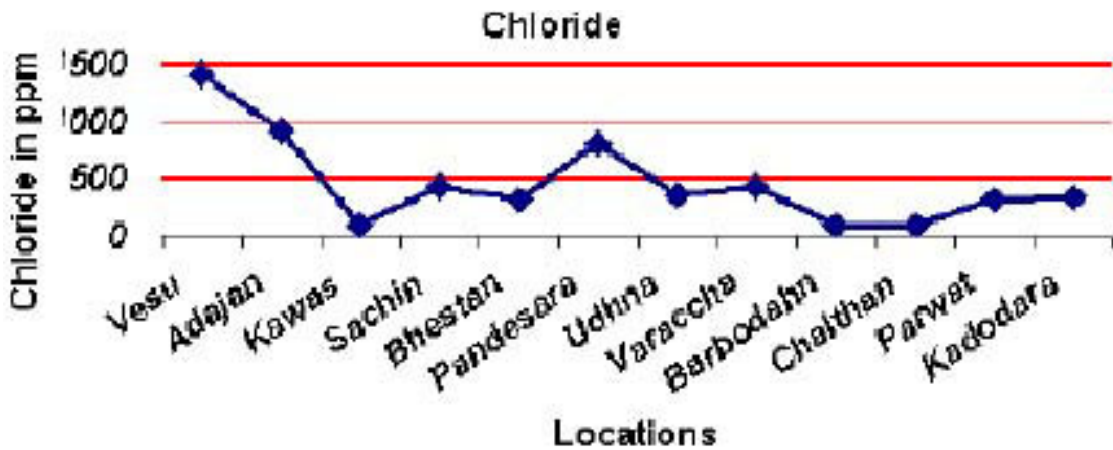


Fig. 6:

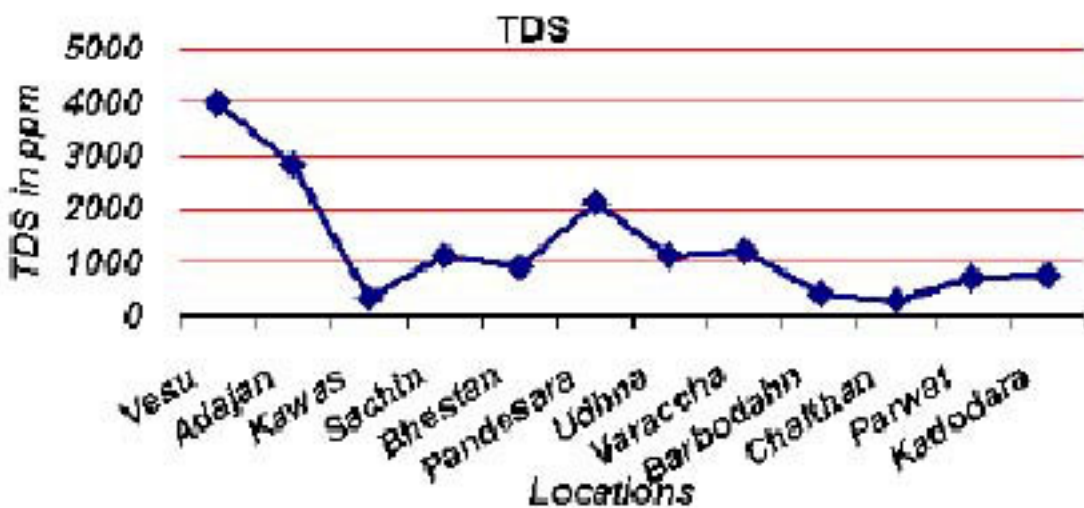


Fig. 7:

Amount of Iron in all the samples were within the prescribed limit except Adajan and Sachin. Iron found very less in surface water while ground water contains more Iron than the surface water. Water containing Iron > 2 ppm causes staining on clothes and sanitary wares and imparts bitter astringent taste. Taste and odour are problems that may be caused by filamentous organisms that prey on iron compounds (Frenothrix, Galionella). So such problem may arise in case of these two samples.

aquatic life. It can produce lung tumor when inhaled and readily induces skin sensitization. But here there was no chromium found so there was no such problem arose from the collected samples. Copper salts are used in water supply system to control biological growth in reservoir and distribution pipes and also to catalyze oxidation of Manganese. But here from all the ground water samples, copper is in trace amount which is negligible and there by in water treatment copper salt to be added.

There were no evidence of Chromium from the obtained samples of the ground water. Chromium is toxic to human health, animals and

Also all water samples contained negligible Boron content. The results obtained are within the limit given by WHO (0.5 ppm).

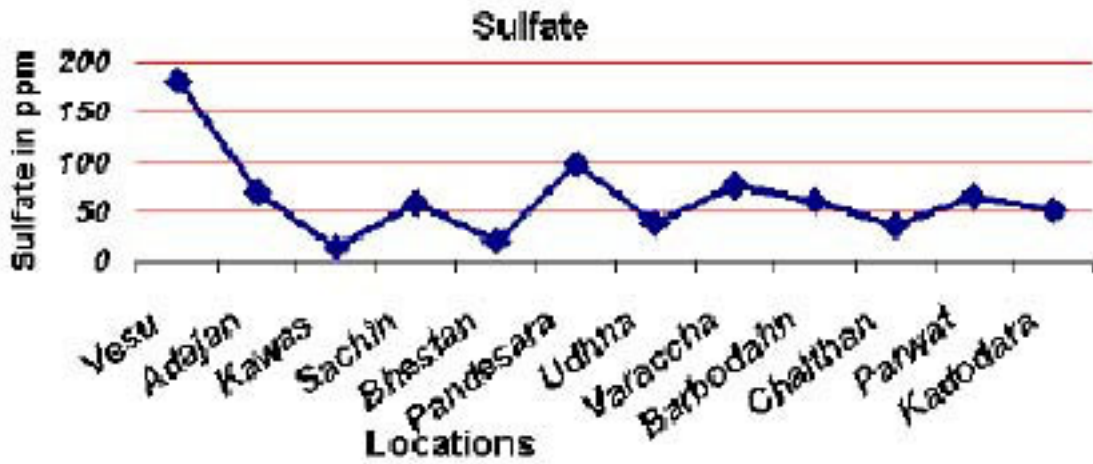


Fig. 8:

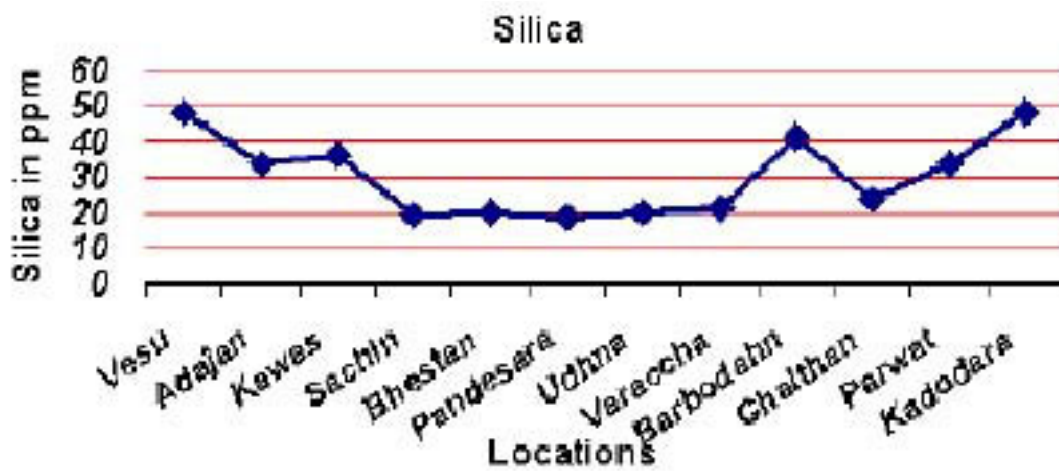


Fig. 9:

CONCLUSION

It can be concluded from the results that the groundwater in radius of 25 km in Surat city posses high value of Total Alkalinity, Total Hardness, Chloride and TDS etc. through all of these factors may pose health hazard (on long term), yet these degrade quality of drinking water and therefore require to be treated before directly using for drinking purpose.

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