Analysis of Quality of Ground Water and Its Suitability for Drinking Purpose in Visnagar Taluka, Mehsana District, Gujarat

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Abstract—Ground water is the principal source of drinking water in our country and indispensable source of our life. The quality of water is of vital concern for mankind, since it is directly linked to human welfare. The present work investigated various physicochemical parameters of villages of Visnagar taluka of Mehsana district, Gujarat. Because of north Gujarat is affected by various water quality parameters like fluoride is high in many parts of north Gujarat. A total of 50 water samples will be collected from the tube wells for post-monsoon season and analyzed for the various physicochemical parameters like pH, electrical conductivity (EC), nitrate (NO3-), magnesium (Mg2+), Calcium (Ca2+), hardness, and alkalinity, sulphates (SO42-), chloride (Cl-), sodium (Na+), potassium (K+), Fluoride (F-) and total dissolved solids (TDS). The result were compared with standards prescribed by IS: 10500(2012). It was found that the ground water contaminated at 16 sampling sites namely Khadalpur, Chhogala, Sunshi, Denap, Jetalvasana, Tarabh, Visnagar Rural, Bhalak, Kamalpur (GOT), Kamalpur (KHA), Kansa, Magaroda, Pudgam, Sadutala, Thalota, and Vadu while other 34 sampling sites showed physicochemical parameters within the water quality standards and quality of water is good so it is fit for drinking uses.

Key words: Electrical Conductivity, Physicochemical Parameters, Groundwater.

I. INTRODUCTION

Water is an important resource for the survival of any living object. Availability of the water itself and quality of water is getting more and more importance. Water is available in two forms as surface water and groundwater. Groundwater is present in permeable geological formation is known as aquifer. Groundwater is an essential and vital component of our life support system. More than 95% of the rural population depends on groundwater source for their domestic requirement and in urban area also about 30% to 40% of the population depends on groundwater for the requirement. The groundwater resources are being utilized for drinking, irrigation and industrial purposes. There is growing concern on deterioration of groundwater quality due to different natural and man-made activities. Groundwater is polluted in city mainly due to sewage, industrial waste and in the rural areas groundwater is contaminated due to sewage, industrial waste and application of chemical fertilizers in the agricultural fields. (Shirdhar S. Kumbhar, 2014)

The most of water bodies in India needs to be treated before using it in domestic applications by various means. Ground water contains high amount of various ions, salts etc. so if we were using such type of water as potable water then it leads to various water-borne diseases. The consequence of urbanization and industrialization leads to spoil the water. During last decade, this is observed that the ground water get polluted drastically because of increased human activities.

II. STUDY AREA

Visnagar taluka is located in Mehsana district of north Gujarat, India. It lies between 23°30'-23°55’ latitude and 72°20'-72°40’E longitude. It is located 21 KM towards East from District headquarters Mehsana. 63 KM from State capital Gandhinagar towards South. It is located 21 KM towards East from District headquarters Mehsana. 63 KM from State capital Gandhinagar towards South. Visnagar consist of 94 Villages and 65 Panchayats. It is in the 126 m elevation (altitude). Visnagar taluka is popularly known as ‘Shikshan Nagari’ and also known as Copper city. The climate of Visnagar is tropical arid to marginal semi-arid. It is strongly periodic and seasonal. The average rainfall is 626-875mm. The temperature ranges between max. 42°C and min10°C. Type of soil sandy loam to sandy soils. The Visnagar taluka is especially rich in sub soil water.

III. EXPERIMENTAL METHODOLOGY

Total fifty ground water samples of different tube wells were collected from Visnagar Taluka (Fig.1) each during post-monsoon seasons. The samples were collected in plastic containers of 2 liters capacity for physicochemical analysis after pumping out sufficient quantity of water from tube wells. The samples were analyzed as per the methods described by APHA methods. (APHA-1992) The experimental values were compared to standard values recommended by Indian Standard (2012).

<table>
<thead>
<tr>
<th>Sr.No</th>
<th>Parameter</th>
<th>Instrument/Methods used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Temperature</td>
<td>Thermometer</td>
</tr>
<tr>
<td>2</td>
<td>Colour</td>
<td>Platinum Cobalt Scale</td>
</tr>
</tbody>
</table>
Analysis of Quality of Ground Water and Its Suitability for Drinking Purpose in Visnagar Taluka, Mehsana District, Gujarat

Table 1: Parameter Studied

<table>
<thead>
<tr>
<th>No.</th>
<th>Parameter</th>
<th>Method/Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Turbidity</td>
<td>Jackson Turbidimeter / Nephelometric method</td>
</tr>
<tr>
<td>4</td>
<td>Test and Odour</td>
<td>Sense of test &amp; thresholdodour number</td>
</tr>
<tr>
<td>5</td>
<td>PH</td>
<td>PH meter</td>
</tr>
<tr>
<td>6</td>
<td>Electrical Conductivity (EC)</td>
<td>Conductivity meter</td>
</tr>
<tr>
<td>7</td>
<td>Total Dissolved Solids (TDS)</td>
<td>TDS meter</td>
</tr>
<tr>
<td>8</td>
<td>Total Alkalinity (TA)</td>
<td>Titration Method</td>
</tr>
<tr>
<td>9</td>
<td>Calcium</td>
<td>EDTA titration</td>
</tr>
<tr>
<td>10</td>
<td>Magnesium</td>
<td>EDTA titration</td>
</tr>
<tr>
<td>11</td>
<td>Total Hardness (TH)</td>
<td>EDTA titration</td>
</tr>
<tr>
<td>12</td>
<td>Chloride (Cl⁻)</td>
<td>Argentometric Titration</td>
</tr>
<tr>
<td>13</td>
<td>Fluoride (F)</td>
<td>U.V. Spectrometer</td>
</tr>
<tr>
<td>14</td>
<td>Sodium (Na⁺)</td>
<td>Flame photometric method</td>
</tr>
<tr>
<td>15</td>
<td>Potassium (K⁺)</td>
<td>Flame photometric method</td>
</tr>
<tr>
<td>16</td>
<td>Sulphate, (SO₄²⁻)</td>
<td>U.V. Spectrometer</td>
</tr>
<tr>
<td>17</td>
<td>Nitrate(NO₃⁻)</td>
<td>U.V. Spectrometer</td>
</tr>
</tbody>
</table>

IV. RESULT AND DISCUSSION

The physic-chemical parameters of the Visnagar taluka were analyzed and it is described as below. The values of various parameters were listed in the Table 2.

A. pH

The pH value of various water sample of the study area varies from 6.8 (minimum) to 8.5 (maximum) and these values are within the limits of IS (6.5 - 8.5). The pH value less than 7 makes water acidic and pH value more than 7 makes water alkaline. The result indicates that the region is alkaline in nature for pH.

![Fig. 2: pH Distributions in the Study Area](image)

B. Electrical Conductivity (EC)

Electrical conductivity is a measure of water capacity to convey electric current from it. EC values were range between 740 micro-ohms/cm - 5820 micro-ohms/cm. High EC values were observed for five villages like Bakarpur, Chhogala, Sunshi, Khadalpur and Valam.

![Fig. 3: EC Distributions In The Study Area](image)

C. Total Dissolved Solids (TDS)

Total dissolved solids indicate the salinity behavior of groundwater. Most of the groundwater samples show the high concentration of TDS in the study area. Maximum and minimum TDS value observed range 272-3560 mg/l. About 92% of the samples fall below the permissible limit of TDS while 8% of the samples are unfit for drinking purpose. High TDS value observed in the villages Chhogala, Sunshi, Denap, Khadalpur.

![Fig. 4: TDS Distributions In The Study Area](image)

D. Total Alkalinity

Alkalinity values for all the water samples of the study area were found in between 160mg/l to 548mg/l. All the water samples within the permissible limit of 600mg/l. (IS: 10500).

![Fig. 5: TDS Distributions In The Study Area](image)
Analysis of Quality of Ground Water and Its Suitability for Drinking Purpose in Visnagar Taluka, Mehsana District, Gujarat

Fig. 5: Alkalinity Distributions in the Study Area

E. Calcium
Calcium is directly related to hardness. Calcium concentration ranged between 18 mg/l - 245 mg/l in the study area. The permissible limit of calcium for drinking water is 200 mg/l (IS: 10500). About 98% of the samples fall below the permissible limit of calcium and only one Khadalpur village sample fall above the permissible limit of calcium.

Fig. 6: Calcium Distributions in the Study Area

F. Magnesium
The permissible limit of magnesium in drinking water is 100 ppm (IS10500-2012). Magnesium is directly related to hardness. The magnesium value of various water samples in the study area various from 15 mg/l(minimum) to 123 mg/l (maximum) and 49 villages are within the permissible limit of magnesium and only Khadalpur village is above the permissible limit of magnesium prescribed by IS:10500 is 100mg/L.

Fig. 7: Magnesium Distributions in the Study Area

G. Total Hardness
Hardness is the property of water which prevents the lather formation with soap and increases the boiling points of water. (Trivedy R, K & Goel P.K et, al. 1986) Hardness of water mainly depends upon the amount of calcium or magnesium salts. The total hardness in the study area ranged from 118 mg/l to 695 mg/l. Out of total 50 water samples from the study area only 3 water samples fall above the prescribed limit of Indian Standard (200mg/l-600mg/l) for total hardness.

Fig. 8: Total Hardness Distributions in the Study Area

H. Chloride
Chloride concentration is varying from 88 mg/l to 1480 mg/l in the study area which are lower than prescribed by IS. About 96% of the samples fall below the permissible limit of TDS while 4% of the samples are unfit for drinking purpose. Chloride salts in excess of 100 mg/l give salty taste to water. When combined with calcium and Magnesium may increase the corrosive activity of water. It is recommended that chloride content should not exceed 250 mg/l. (R.K.Tatawat et, al, 2007)

Fig. 9: Chloride Distributions in the Study Area

I. Fluoride
Probable source of high fluoride in Indian waters seems to be that during weathering and circulation of water in rocks and soils, fluorine is leached out and dissolved in ground water.(Murhekar G.H. et.al.,2011) Fluoride content in the study area ranged from 0.22 mg/l - 2.14 mg/l. Fluorides samples which exceeded the acceptable limit are not recommended for consumption without treatment. Fluoride is considered as an essential element through health problems may arise from either deficiency or excess amount. (Gopal et al, 1985) About 47 villages from the study area fall below the permissible limit of fluoride while
3 villages fall above the permissible limit of fluoride which are unfit for drinking purpose (1mg/l-1.5mg/l).

**Fluoride**

Fluoride occurs naturally in water as a result of leaching from gypsum and other common minerals. (Manivaskam N.et al., 2005) The permissible limit of sulphate in drinking water is 400 ppm (IS-10500). The sulphate value of various water samples in the study area various from 24mg/l to 608mg/l. Out of 50 water samples only 4 water samples fall above the permissible limit which are unfit for drinking purpose in the study area.

**Sulphate**

The permissible limit of nitrate in drinking water is 45 ppm (IS-10500). Nitrate concentration found range between 0.34 mg/l (minimum) to 123 mg/l (maximum) in the study area.

**Nitrate**

Considering all the eleven parameter of drinking water for the Visnagar Taluka, it is found that 34 water sample collected from the study area have all the constituents well within either acceptable or permissible limits of IS:10500 and hence these villages safe for drinking purpose. Total 16 water samples are fall above the permissible limit of IS:10500 and the water samples from the Khadalpur site is not fit for drinking because parameter like EC, TDS, Ca$^{2+}$, Mg$^{2+}$, SO$_4^{2-}$ are above the permissible limit of IS. All the water samples for pH value is within acceptable or permissible limits of IS: 10500. Fluoride concentration is higher than permissible limit of IS: 10500(2012) in the villages like Jetalvasana, Tarabh and Visnagar Rural. It is concluded that from above 16 villages which has poor ground water quality are not used without purification.

**REFERENCES**