INTRODUCTION

Water is the most essential commodity for all living creatures. Organisms can not survive without water. Water is one of the most essential constituents of the human environments. Man needs it, in the first place for his physiological existence. It is used for many purposes e.g. industrial water supply, irrigation, drinking, propagation of fish and other aquatic systems and generation of fish and hydro-powers. Water is the source of energy and governs the evolution and functions of the universe on the earth. Water, the most vital necessity of life, is in abundance 97.3% of the world’s water i.e. 1.45 billion cubic Kms, Ocean water is salty and cannot be used for agricultural, domestic and industrial purposes. Only $13 \times 10^6$ cubic Kilometers water is available in the form of stream, lakes, wells and tube wells i.e. 0.6%, $8.5 \times 10^{15}$ m$^2$ is groundwater, occurs in the depth of 80-135 m below the ground surface as water levels decreasing day-by-day. The run-off water has large number of substances e.g. silt, organic impurities.

The global environment is changing continuously due to unfavourable alteration of surroundings, wholly as a by product of man’s actions, through direct or indirect effects of changes in energy pattern, radiation levels, chemical and physical constitution of organisms. These changes may affect man directly or through his supplies of water and of agricultural and other biological products, the most common types of pollution and pollutants discharged, encountered in domestic and industrial waste waters, along with their possible effects on the water resources are discussed. Chemicals are a major source of water contamination that introduced during water movement through geological materials, manufactured chemicals may cause problems. Fertilizers and pesticides are major contributors to water pollution, Nitrates from fertilizers are a
common chemical pollutant of water. Heavy metals, sulphates, nitrates, chlorides, phosphates, carbonates, ammonia, pesticides, phenols, soaps, detergents are the common chemical pollutants. There are a number of pathogenic micro-organisms which cause water borne disease in man.

Among the metals the severe pollutants are lead, cadmium, arsenic, copper, zinc, manganese, iron, and calcium.

MATERIAL AND METHODS

Bhopal, the capital of Madhya Pradesh, is the largest state of India witnessed the world’s worst industrial disaster i.e. leakage of MIC gas form Union Carbide factory on 3rd Dec 1984. Bhopal is situated on 23°16’N Latitude and 77°25’ E longitude and is located on “hard pink red sand stone of Vindhyan region at 503m above the mean sea level (MSL) according to meteorological Deptt. of India. There are Three Seasons Monsoon (June to Sept.), Winter (October to February) and Summer (March to mid June) of the year.

Due to increasing trend of fast urbanization, industrialization there are fair chances of environmental and water pollution. Throughout the world, interest in the quality of ground water which is degraded by human activities, over exploitation, over pumping and percolation of effluents, sewage from factories and due to geological changes, it becomes very important to assess the groundwater quality of Berasia Road, Bhopal. The present district of Bhopal was carved out from Sehore district in 1972 with population of 10,63,662 (1991) Census and about 15 lac at present, out of this about 1.5 lac population is living presently in Berasia Road area of Bhopal.

Methods

About 10 sampling stations have been chosen for this present study area during 2009-10.

Sampling Stations

1. Near Sagar Institute of Technology
2. Institute of Aeronautics
3. Jatkhedi
4. Jhirinia
5. Essar Petrol Pump
6. Sonkachha Poultry Farm
7. Mama Ka Dhaba
8. Doraha
9. Sadabahar Dhaba
10. Shyampur Kurawar

Samples for analysis with standard procedure in accordance with standard method of American Public Health Association APHA (1988) and National Env. Engineering Research Instt. (NEERI) (1986) Nagpur. The instruments has used in the limit of precise accuracy and chemicals used of G.R. Grade. Temperature, pH, TDS has measured. The T-H, Ca-H, Mg-H has measured titrimetrically by using EDTA, Chloride by Mohr's Argentometric titration and $K_2Cr_2O_7$ as indicator, D.O. by Winkler's method, Total alkalinity has determined by titrimetric methods using phenolphthalein and methyl orange indicators. Nitrate, sulphate and phosphate measured by spectrophotometer.

RESULTS AND DISCUSSION

The results of the study has summarised in Table 1.

Temperature

Temperature is one of the most essential parameters in water. It has significant impact on growth and activity of ecological life and is greatly affects the solubility of oxygen in water. The temperature of Borewell’s water has found to be in the range of 22°-29°C. pH value is the best indicator of presence of acid or alkali in water samples. pH in the present study at BW, to BW9 varied from 6.4-7.3. The acceptable limit prescribed by drinking water standard is 6.5 – 8.5 EC and free CO₂ varied from 296-723 $\mu$ mhos/em and 6.0-7.7 ppm respectively at different sampling stations.

Chloride

Chlorides are common constituents of all natural waters. Higher value of it imparts a salty taste to water, making it unacceptable for human consumption. As per ISI the desirable limit of chloride for drinking water is 250 mg/l and the permissible limit is 1000 mg/l. The chloride value in this study varied from 78.4-132 ppm. Total alkalinity is the quantitative capacity of an aqueous media to
react with H+ ions. Desirable limit is 200 mg/l and maximum permissible limit 600 mg/l. In the present study it varied from 128-230 ppm.

Total hardness of water is caused by the presence of Ca & Mg salts. Hardness of BW1-BW9 samples varies from 70.4-154, Ca-H 46.2-114 & Mg-H 24.2-44 ppm respectively. Desirable limit of T-H for drinking water is 300 mg/l & permissible limit in the absence of alternate source is 600 mg/l. So, all the water samples have values within the permissible limits.

D.O., B.O.D. and C.O.D. in the presence study ranges from 1.28-1.98, 2.06-3.24 and 28.4-88.4 ppm respectively. Lower value of these parameters recorded at BW1, BW3, BW2, BW9 and BW5 while higher values at BW6, BW7 and BW8 respectively. The findings are similar with those of Kataria (1990, 1995, 2000) and Kataria et al., (2006), (2008) and (2010).

Table 1: Analysis of borewell’s water of Gandhinagar, Narsinghgarh Road, Bhopal During 2009-10

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Unit</th>
<th>BW1</th>
<th>BW2</th>
<th>BW3**</th>
<th>BW4</th>
<th>BW5</th>
<th>BW6</th>
<th>BW7</th>
<th>BW8</th>
<th>BW9</th>
</tr>
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<tbody>
<tr>
<td>Temperature</td>
<td>°C</td>
<td>26.8</td>
<td>26.0</td>
<td>23.2</td>
<td>22*</td>
<td>28.2</td>
<td>28.8</td>
<td>29**</td>
<td>26</td>
<td>27.2</td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td>6.5</td>
<td>6.9</td>
<td>6.4*</td>
<td>6.5</td>
<td>6.9</td>
<td>7.1</td>
<td>7.0</td>
<td>7.2*</td>
<td>7.3**</td>
</tr>
<tr>
<td>Electr. Cond.</td>
<td>µhos/cm</td>
<td>490</td>
<td>532</td>
<td>482</td>
<td>480</td>
<td>540</td>
<td>412</td>
<td>304</td>
<td>296*</td>
<td>723**</td>
</tr>
<tr>
<td>Free CO2</td>
<td>ppm</td>
<td>6.0*</td>
<td>6.4</td>
<td>7.2</td>
<td>7.0</td>
<td>7.7**</td>
<td>6.4</td>
<td>6.2</td>
<td>6.0</td>
<td>5.8</td>
</tr>
<tr>
<td>Chloride</td>
<td>ppm</td>
<td>104.2</td>
<td>116.4</td>
<td>102.8</td>
<td>98.6</td>
<td>78.4*</td>
<td>126.2</td>
<td>128</td>
<td>132**</td>
<td>130.4</td>
</tr>
<tr>
<td>Total Alkalinity</td>
<td>ppm</td>
<td>152</td>
<td>160</td>
<td>142</td>
<td>136</td>
<td>148</td>
<td>212</td>
<td>230**</td>
<td>128</td>
<td>134</td>
</tr>
<tr>
<td>Total hardness</td>
<td></td>
<td>74.6</td>
<td>70.4*</td>
<td>124</td>
<td>138.4</td>
<td>142</td>
<td>154**</td>
<td>146</td>
<td>138</td>
<td>142</td>
</tr>
<tr>
<td>Ca-H</td>
<td></td>
<td>50.4</td>
<td>46.2*</td>
<td>86</td>
<td>102.0</td>
<td>100</td>
<td>110**</td>
<td>103</td>
<td>102</td>
<td>108</td>
</tr>
<tr>
<td>Mg-H</td>
<td></td>
<td>24.2*</td>
<td>24.2</td>
<td>38</td>
<td>36.4</td>
<td>42</td>
<td>44**</td>
<td>43</td>
<td>36</td>
<td>34</td>
</tr>
<tr>
<td>D.O.</td>
<td>ppm</td>
<td>1.28*</td>
<td>1.64</td>
<td>1.48</td>
<td>1.54</td>
<td>1.64</td>
<td>1.72</td>
<td>1.8</td>
<td>1.92</td>
<td>1.98**</td>
</tr>
<tr>
<td>B.O.D.</td>
<td>ppm</td>
<td>2.8</td>
<td>2.24</td>
<td>2.36</td>
<td>2.68</td>
<td>3.24**</td>
<td>2.72</td>
<td>2.5</td>
<td>2.74</td>
<td>2.06*</td>
</tr>
<tr>
<td>C.O.D.</td>
<td>ppm</td>
<td>64.2</td>
<td>66.8</td>
<td>88.4**</td>
<td>82.8</td>
<td>28.4*</td>
<td>36.4</td>
<td>32</td>
<td>52.8</td>
<td>80.4</td>
</tr>
<tr>
<td>Nitrate</td>
<td>ppm</td>
<td>4.4</td>
<td>3.8*</td>
<td>8.0</td>
<td>5.6</td>
<td>12.3</td>
<td>14.2</td>
<td>13</td>
<td>17.4**</td>
<td>9.4</td>
</tr>
<tr>
<td>Sulphate</td>
<td>ppm</td>
<td>42.8</td>
<td>56.2</td>
<td>40.0</td>
<td>42.4</td>
<td>34.6</td>
<td>78.2</td>
<td>84</td>
<td>86.4</td>
<td>92.4**</td>
</tr>
<tr>
<td>Phosphate</td>
<td></td>
<td>0.80*</td>
<td>0.90</td>
<td>1.2</td>
<td>1.4</td>
<td>2.0</td>
<td>2.1**</td>
<td>1.8</td>
<td>1.60</td>
<td>1.8</td>
</tr>
<tr>
<td>Fluoride</td>
<td>ppm</td>
<td>1.04</td>
<td>1.20</td>
<td>0.08*</td>
<td>0.05</td>
<td>1.0</td>
<td>1.1</td>
<td>1.2</td>
<td>1.4</td>
<td>1.24**</td>
</tr>
<tr>
<td>Copper</td>
<td>ppm</td>
<td>0.010*</td>
<td>0.018</td>
<td>0.030</td>
<td>0.06</td>
<td>0.064</td>
<td>0.07</td>
<td>0.08**</td>
<td>0.05</td>
<td>0.60</td>
</tr>
<tr>
<td>Zinc</td>
<td>ppm</td>
<td>0.030*</td>
<td>0.04</td>
<td>0.032</td>
<td>0.02</td>
<td>0.03</td>
<td>0.08</td>
<td>1.2**</td>
<td>0.06</td>
<td>0.052</td>
</tr>
<tr>
<td>M.P.N.</td>
<td>No/100ml</td>
<td>48</td>
<td>44.2</td>
<td>18.2</td>
<td>16.4*</td>
<td>54**</td>
<td>32</td>
<td>19.4</td>
<td>20.8</td>
<td></td>
</tr>
</tbody>
</table>

*Minimum ** Maximum values

BW1 = Near Sagar Instt. of Technology
BW2 = Inst. of Aeronautics
BW3 = Jatkhedi
BW4 = Jhirinia
BW5 = Essar Petrol Pump
BW6 = Sankachha Poultry farm
BW7 = Near Mama Ka Dhaba
BW8 = Doraha
BW9 = Sadabahar Dhaba

Nitrate, sulphate, phosphate and fluoride has ranged in the present study from 3.8-17.4, 34.8-92.4, 0.80-2.1 and 0.08-1.24 ppm respectively. The concentration of different forms of nitrogen gives a useful indication of the level of micro-nutrients in the water and hence their ability to support plant growth. The prescribed limit of WHO is 50 mg/l for domestic water. The presence of sulphate has less effect on the taste of water compared to the presence of chloride. The desirable limit of sulphate in drinking water prescribed by ICMR is 200-400 mg/l. The high concentration of sulphate may induce diarrhea and intestinal disorders. Phosphate in water occurs in the form of orthophosphate, polyphosphate and organic phosphate. Excess amount of sulphate in water has cathartic effect of human health. The findings are similar with Bindhu and Selvamohan (2009) fluoride is essential for human beings as a trace element and higher concentration of this
element causes toxic effects. Concentration of fluoride between 0.6-1.0 mg/l in potable water protects tooth decay and enhances bone development (Kundu et al., 2001).

Copper and Zinc found in the range of 0.010-0.08, 0.030-1.2 ppm respectively and MPN 16.4-54 No/100ml.

In the present study most of the parameters are found within the prescribed limits of IS : 10500 e.g. pH, EC, Chloride, alkalinity, T-H, Ca-H, Mg-H, D.O., C.O.D. While some are beyond the limits free CO₂, BOD, Nitrate, Fluoride, and MPN.

REFERENCES

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