MINOR RESEARCH PROJECT

1. Name of Principal Investigator: **Limbachiya Maheskuhmar Chandulal**

2. Deptt. Of PI: **Chemistry Department**

Name of College: **Chemistry Department, R.R. Mehta College of Science & C. L. Parikh College of Commerce, Palanpur.(North Gujarat)**

3. UGC approval Letter No. and Date: **File No: 47-2098(WRO). Dated 20 Jun 2012**

4. Title of the Research Project: **"Physico-Chemical analysis of ground water Quality of selected talukas of mehsana District, north Gujarat."**

5. Effective date of starting the project: **20-10-2012**

6. a. Period of Expenditure: From: 20-10-2012 to 20-10-2014.

SUMMARY

The present research work deals with the quality of underground well/tube well water and inter-relationship within the properties of well/tube well water samples. Representative water sample were collected and analyzed using the standard procedures of water analysis. Following the methods listed by Richards (1954), the accuracy and precision of the analyses were checked up. The results obtained and conclusions derived are summarized as follows.

[1] In general, underground water was slightly alkaline to moderately alkaline in reaction. The overall pH values ranged from 7.02 to 8.21 with the mean value of 7.67.

[2] The EC values ranging between 0.259 dSm^{-1} and 7.7 dSm^{-1}. The minimum value was recorded in Vijapur taluka and maximum in Bechraji taluka. The frequency distribution of underground water samples in relation to EC showed that overall 5, 20 and 75 percent water samples falls under C_2, C_3 and C_4 classes of EC respectively in Bechraji taluka, 63.64 and 36.36 percent water samples falls under C_3 and C_4 classes of EC respectively in Mehsana taluka 10, 70 and 20 percent samples falls under C_2, C_3 and C_4 classes of EC respectively in Kadi taluka and in Vijapur taluka 9.1, 86.37 and 4.55 percent water samples falls under C_2, C_3 and C_4 classes of EC respectively.

[3] Total Dissolved Solid (TDS) values ranged from 190 to 1970 ppm with mean value of 981 ppm, minimum value of TDS was found in groundwater sample of andudra Village of Kadi taluka and maximum value of TDS was found in Saduthala village of Bechraji taluka of Mehsana district.

[4] The underground water of Kadi and Vijapur taluka was marginal to harmful quality, while, the ground water of Bechraji and Mehsana taluka of Mehsana district was classified under harmful to very harmful categories.

[5] The concentration of Ca^{+2} and Mg^{+2} ion varied from 2.8 to 30.5 me/L with an average value of 8.33 me/L in ground water samples of Mehsana district Highest value of Ca^{+2} and Mg^{+2} was recorded in Mehsanataluka and the lowest in Kadi taluka.

[6] Amongst cations, Na^{+} is dominant while, concentration of other cations follows this order: Mg >Ca> K. The overall concentration of Ca^{+2}+ Mg^{+2}, Na^{+} and K^{+} varied from 2.8 to 30.5, 2 to 49, and 0.0006 to 0.0179 me/L, respectively.

[7] The concentration of CO_3^{-2} varied from 0.0 to 0.8, 0 to 1.2, 0.2 to 2.6 and 0 to 1.8 me/L in Bechraji, Mehsana, Kadi and Vijapur taluka respectively. The minimum value of carbonate ion was recorded in velakui, Becher and Saduthala villages of Bechraji taluka and the maximum values of carbonate ion was recorded in Suraj village of Kadi taluka.

[8] The studied samples of ground water are found to have Bi-carbonate values ranging between 3.4 to 9.7, 5.6 to 9.9, 3.6 to 12.6 and 4.2 to 9.4 me/L in Bechraji,Mehsana,Kadi and Vijapurtaluka, respectively. Highest values of HCO_3^{-1} was recorded in Kaditaluka. Carbonates were generally present at very low levels in ground water of Mehsana districts.

[9] Chloride ion was generally found in all ground water samples. The minimum values of Cl^{-} ion was 4.0 me/L and the maximum value of Cl^{-} ion was 70.0 me/L. Very high concentration of chloride ion was present in ground water sample of Mehsanataluka.

[10] The minimum and maximum values of sulphate ion in the ground water sample of study area were 0.0 to 10.5 me/L. The highest value in Saduthala village of Bechrajitaluka and nadasa village of Mehsana taluka in Mehsana district.

[11] The relative proportion of anions showed that the highest overall mean value of 15.27 me/L was recorded for chloride ion and it was followed by Bicarbonate (7.43 me/L), Sulphate(1.69 me/L), Carbonate (0.55 me/L). The concentration of CO_3^{-2}, HCO_3^{-1}, Cl^- and SO_4^{-2} were in the range of 0.00 to2.6, 3.4 TO 12.6, 4 to 70 and 0 to 10.5 me/L, respectively.

[12] The overall mean value of soluble sodium percentage was 62.47, which varied from 32.14 to 99.47. The highest mean value of SSP was recorded in Kaditaluka. It was 68.56 and the lowest mean value of SSP was recorded in Vijapurtaluka, it was 47.74. Overall 17.9, 33.3 and 48.8 percent ground water samples of representative area were found under I, II and III classes of SSP, respectively as per Eaton (1935) classification.

About 20.00 percent ground water samples of Bechrajitaluka fall under good (safe) categories and only 80.00 percent ground water samples fall under unsafe categories, while, in Mehsanataluka only 13.63 percent water samples fall under safe and about 86.36 percent samples fall under unsafe categories of SSP class.

[13] The overall residual sodium carbonate (RSC) values ranged from -22.2 to 8.2 me/L with a mean value of -0.35 me/L. The highest mean value of RSC was recorded in Kaditaluka, it was 3.92 me/L and the lowest mean value of RSC was recorded in Mehsanataluka. It was -22.2 me/L. The result shows that about 60.71, 13.1 and 26.19 percent ground water samples were found under safe marginal and unsafe classes of RSC, respectively.

[14] As per value of RSC, ground water of Bechraji and Mehsana taluka was mostly found free from RSC hazards and maximum quantity of underground water of Kadi taluka of Mehsana district was found unsafe for irrigation purpose.

[15] The overall mean value of sodium adsorption ratio (SAR) was 7.50 and it was varied from 1.61 to 21.69 in ground water samples of Mehsana district. The highest mean value of SAR (9.76) was recorded in Bechraji taluka and the lowest mean value of SAR (3.69) was recorded in ground water sample of Vijapur taluka. Overall 78.57, 20.53, 1.2, and zero percent water sample fall under S_1, S_2, S_3 and S_4 classes of SAR, respectively.

[16] In general, the ground water samples of representative area of Mehsana district, none of the sample had SAR value grater than 26.0, which suggested that ground water of the Mehsana was free from alkali hazards as per USSL classification.

[17] The pH of irrigation water was positively correlated with $CO3^{-2}$ and CO_3^{-2} + HCO_3^{-1} of irrigation water of Mehsana district, but the degree of significance is different. In Bechrajitaluka, positive correlation (r = 0.175) was observed between pH and CO_3^{-2} + HCO_3^{-1} of irrigation water; while, low level Negative significance were observed between pH and CO_3^{-2} (r = -0.211) and pH and HCO_3^{-1} (r = 0.202).

[18] The SAR of irrigation water was positively correlated (r = 0.0.0649) with RSC at low level of significance but SAR was highly positively correlated (r = 0.366) with SSP.

[19] A significant positive correlation (r = +0.096) was observed between RSC and pH and also significant positive correlation (r = +0.116) between EC and CO_3^{-2} +HCO_3^{-1} of irrigation water. However, only low value of positive correlation was observed between EC and pH of irrigation water. In general, highly significant and positive correlation was observed between EC and HCO_3^{-1}, SAR and SSP.

[20] The Na^+/Ca^{+2} + Mg^{+2} ratios varied from 0.5 to 4.95 with the mean value of 1.51 in the ground water samples of Mehsana district. The result shows, that the highest value of Na^+/Ca^{+2} + Mg^{+2} ratios was observed in Kadi and Mehsanataluka.

[21] Na^+/K^+ ratio varied from686 to 25000 with the mean value of 4503. The highest mean value of Na^+/K^+ ratio was recorded in the ground water sample of Bechrajitaluka and the lowest value of this ratio was obtained in ground water samples of Mehsanataluka.

[22] Regarding the proportion of anions, the Cl^-/CO_3^{-2} ratio varied from 0.0 to 160 with mean value of 27.41 in ground water of Mehsana district. The highest mean value of Cl^-/CO_3^{-2} ratio was recorded in Mehsanataluka and the lowest value of this ratio was recorded in ground water of Vijapurtaluka. The Cl^-/HCO_3^{-1} ratio varied from 0.0to 9.86 with an average value of 2.29 in ground water of Mehsana district. The highest mean values of this ratio were recorded in groundwater samples of Bechrajitaluka.

[23] The result showed that the Cl^- was more associated with Na^+ as compared to Ca^{+2}, Mg^{+2} and K^+ in ground water of representative area.

Generally, the proportion of Ca^{+2} and Mg^{+2} were increase with the increase in salinity range of water in all four talukas of Mehsana district. In case of anions, Cl^- and SO_4^{-2} were proportionately more in water of high salinity range while, water samples of low EC had relatively more CO_3^{-2} and HCO_3^{-1} ions.

THEMATICS
PUBLICATIONS PVT LTD
www.thematicsjournals.org

THEMATICS JOURNAL OF CHEMISTRY
ISSN 2250-382X
Vol 3. Issue 2. Mar 2013. pp. 32-35.
Paper ID: 40022013010
Available online at http://www.thematicsjournals.org/TJChemi
Paper received: 01 Jan 2013. Paper accepted: 15 Jan 2013.

PHYSICO-CHEMICAL ANALYSIS OF GROUND WATER SAMPLES OF SELECTED VILLAGES OF BECHRAJI REGION OF GUJARAT STATEINDIA

M. C. Limbachiya, D. N. Joshi & M. R. Solanki

Abstract:

The present work is aimed at assessing) for the ground water of Bechraji region. This has been determined by collecting ground water sample and subjective the samples to a comprehensive physico-chemical analysis. the following 9 parameters have been considered; pH, total hardness, calcium, magnesium, bicarbonate, chloride, carbonate, sodium, total dissolved solids. The results of analysis have been used to suggest models for predicting water quality. The analysis reveals that the groundwater of the area needs some degree of treatment before consumption.

Key Words:

Groundwater, Water quality standards, Water quality index, India.

Introduction:

Understanding the groundwater quality is important as it is the main factor determining its suitability purposes [1]. In developing countries like India around 80% of all diseases are directly related to poor drinking water quality and unhygienic conditions [2]. Water is extremely essential for survival of all living of all living organisms. The quality of water is vital concern for mankind since it is directly linked with human welfare .In India most of the population is dependent on groundwater as the only source of drinking water supply. The ground water is believed to be comparatively much clean and free from pollution than surface water. But prolonged discharge of industrial effluents, domestic sewage and solid waste dump caused the ground water to become polluted and created health problems. As the assessment of ground water quality has not been given due importance, water borne disease have become very common. About 80 percentages of the disease in the world are due to poor quality of water [3].

The problems of groundwater quality are much more acute in the areas which are densely Populated, thickly industrialized and have shallow groundwater tables. The rapid growth of urban areas has further affected groundwater quality due to overexploitation of resources and improper waste disposal practices. Hence, there is always a need for and concern over the protection and management of groundwater quality [4].

Much of the current concern with regards to environmental quality is focused on water because of its importance in maintaining the human health and health of the ecosystem. Fresh water is finite resource, essential for agriculture, industry and even human existence, without fresh water of adequate quantity and quality, sustainable development will not be possible [5]. Fresh water resource is becoming day-by-day at the faster rate of deterioration of the water quality is now a global problem [11].

Discharge of toxic chemicals, over pumping of aquifer and contamination of water bodies with substance that promote algae growth are some of the today's major cause for water quality

M. C. Limbachiya: RR Mehta College of Science & CL Parikh College of Commerce, Palanpur (Gujarat) India.
D. N. Joshi: RR Mehta College of Science & CL Parikh College of Commerce, Palanpur (Gujarat) India.
M. R. Solanki: RR Mehta College of Science & CL Parikh College of Commerce, Palanpur (Gujarat) India.

degradation. Direct contamination of surface water with metals in discharges from mining, smelting and industrial manufacturing, is a long-standing phenomenon. Today there is trace contamination not only of surface water but also of groundwater bodies, which are susceptible to leaching from waste dumps, mine tailings and industrial production sites [6-7].

Electrical conductivity of water is a direct function of its total dissolve salts[8]. Hence it is an index to represent the total concentration of soluble salts in water[9]. The permissible total dissolved salts for drinking water is 500mg/L. In the absence of potable water source the permissible limit is up to 2000 mg/L. High values of TDS in groundwater are generally not harmful to human beings but high concentration of these effect persons, who are suffering from kidney and heart disease[10]. Water containing high solids may cause laxative of constipation effects [11].

Our nation is an agro based country. Agriculture is very essential for economical development of the nation. Quality of irrigation water is directly related to crop production so farmers must have knowledge of quality of irrigation water which they use for irrigation purpose and must to know its effects on soil and crop growth.

Quality of irrigation water is one of the main factors to be understood in irrigation agriculture.

All the water (well/Tube well water) used for irrigation purpose always contain soluble salts irrespective of their source, but total concentration and the kind of salts present in any irrigation water are important in deciding whether the water will be suitable for irrigation or not. The investigation in groundwater resources in any region in primarily concerned with its utility for irrigation. The quality of water is influenced by nature the rock. Minerals through which it passes, it may undergo changes due to ion exchange, dissolution of salts and hydrolysis of the material of the rocks as well as surface soils. The ground water resources are generally classified on the basis of total dissolved salts (TDS) as measured by electrical conductivity (EC), as well as the ratio to total Cations, ration of chloride to bicarbonate and the excess of bi-carbonate over calcium plus magnesium.

All irrigation waters that have been used successfully for a long period have a conductivity value less than 2250 micro mhos.per centimetre. High TDS ground water may be used for irrigation purpose, with suitable condition and precautions, but under normal conditions they are harmful to be soil structure and their continuous use will result in salinity hazard, with ultimate effect on plant growth. Usually the surface water are relatively free from electrolytes but the ground water applied for irrigation, create some problems of either salinity and/or alkalinity in the soil due to use to dissolved salts. Salinity hazard which is associated with high soluble salts in water and measured in terms of Electrical conductivity (EC). The Alkali hazard is related to the development of alkalinity in the soil and is expressed as SAR(sodium adsorption ratio).Residual sodium carbonate (RSC) is an indirect expression of $CO3^{-2}$ and HCO_3^{-1} of sodium in ground water. Various workers have suggested the criteria of irrigation waters on the basis of analysis made (Richards 1954, Paliwal and Yadav 1976, Agers and Westcott 1976). Some important acceptable ratings are given below.

Parameter	Permissible	Moderately Safe	Moderately unsafe	Unsafe
RSC(Meq/L)	<1.25	---	1.25 to 2.50	>2.50
SAR	<10	10 to 18	18 to 26	>26
EC mmho/cm	0.0 to 0.75	0.25-0.75	0.75-2.25	>2.25

Materials and Methods:

The area under study lies between 23° 29' 53" N and 72° 02' 35" E.

In all about ten samples of ground water were examined for electrical conductivity, pH, TDS and the proportion of various cations and anions the chemical analysis was carried out following standard procedures. Chemical analysis of some typical samples is given in Table I and Table II presents different ration of judge the quality of these waters from irrigation viewpoints.

Results and Discussion:

As per results of chemical analysis, PH of most of the ground water samples is nearly7.81.All ground water samples may be classified as Very high EC value. As per RSC value 100% of the ground water samples may be classified as per permissible safe water. None of sample found as doubtful to unsafe (UN suitable) for irrigation purpose. As per Sar value Fourty percent ground water samples may be classified as per permissible safe water. As per Sar value Fifty percent ground water samples may be classified as per Moderately safe water. On the whole, the ground water of Bechrajiregion may be considered suitable for irrigation.

Table I: Chemical Properties of the Ground Water of Bechraji Region

S. No	Sample no	Location/ Village	Type (well /tube well)	Depth in foot. Tubewell	PH	EC	Total Dissolved Solids (PPM)	Categories (EC)
1	1	Lilapura	Tubewell	600	7.89	4.38	1580	Very high
2	2	Ratej	Tubewell	1000	7.87	2.87	1210	Very high
3	3	Asjol	Tubewell	1200	7.8	2.46	1180	High
4	4	Rajpura	Well	30	7.81	3.57	1480	Very high
5	5	Rantej	Tubewell	700	7.84	3.1	1230	Very high
6	6	Karansagar	Tubewell	750	7.88	3.99	1470	Very high
7	7	Saduthala	Tubewell	840	7.67	6.15	1970	Very high
8	8	Saduthala	Tubewell	900	7.76	3.53	1370	Very high
9	9	Pratapnagar	Tubewell	850	7.89	4.52	1630	Very high
10	**10**	**Devgath**	**Tubewell**	**900**	**7.75**	**4.83**	**1600**	**Very high**

Table II: Chemical Properties of the Ground Water of Bechraji Region

S. No	Sample No.	Millie equivalents per litre					
		$Ca^{+2}+Mg^{+2}$	Na^{+1}	K^{+1}	CO_3^{-2}	HCO_3^{-2}	Cl^{-1}
1	1	11.7	30	0.004	0.6	7.7	30
2	2	11.2	17.5	0.007	0.2	5.1	20
3	3	8.5	17.5	0.008	0.2	4.5	24
4	4	9.5	33.5	0.016	0.6	9	24
5	5	11.9	17	0.008	0	7.3	22
6	6	14.3	23.75	0.007	0.2	5.3	26
7	7	17.1	47.5	0.005	0	9.7	44
8	8	9.6	47.5	0.005	0.4	7.4	24
9	9	12.8	29.35	0.005	0.2	6	32
10	10	14.9	32	0.004	0.4	9.6	30

Table III: Chemical Properties of the Ground Water of Bechraji Region

Sr. No.	Sample No	SAR	SAR Classification	RSC	RSC Classification
1	1	12.4	S_2	-3.4	Safe
2	2	7.4	S_1	-5.9	Safe
3	3	8.49	S_1	-3.8	Safe
4	4	15.4	S_2	0.1	Safe
5	5	6.97	S_1	-4.6	Safe
6	6	8.88	S_1	-8.8	Safe
7	7	16.2	S_2	-7.4	Safe
8	8	21.7	S_3	-1.8	Safe
9	9	11.6	S_2	-6.6	Safe
10	10	11.7	S_2	-4.9	Safe

References:

[1] T. Subramani, L. Elango & S. R. Damodarasamy., *Environ. Geol*., 2005; 47, 1099.

[2] Olajire & Imeokparia., 2001., Prasad, 1984.

[3] R. E. Raja, Lydia Sharmila, J. Princy Merlin & G. Chritopher., *Indian J Environ Prot*., 2002, 22(2), 137.

[4] P. R. Patil, S. R. Badgujar & A. M. Warke., *Oriental J Chem.*, 2001, 17 (2), 283.

[5] N. Kumar., *Ecol. Env & Cons*., 1997, 3, 3.

[6] H. B. Mahananda, M. R. Mahananda, & B. P. Mohanty., *Ecol. Env & Cons*., 2005, 11(3-4), 537.

[7] P. D. Moore, Jr. T. C. Daniel, J. T. Gilmour, B. R. Shereve, D. R. Edward, & B. H. Wood., *J. Env.Qual.*, 1998, 27, 92.

[8] C. C. Harilal, A. Hashim, P. R. Arun & S. Baji & J. Ecology., *Envirionmental and Conservation.*, 2004, 10(2), 187.

[9] B. K. Purandara, N. Varadarajan & K. Jayashree., *poll Res*., 2003, 22(2), 189.

[10] S. Gupta, A. Kumar, C. K. Ojha & G. Singh., *J Environmental Science and Engineering.*, 2004, 46(1), 74.

[11] N. Kumarswamy., *J pllut Res*., 1999, 10(1), 13.

[12] APHA (American public Health Association) Standard methods for examination of water and waste water. NW, DC 1994, 20036.