Research Paper

Volume : 4 | Issue : 4 | April 2015 • ISSN No 2277 - 8179

Physico-Chemical Analysis of Ground Water of Ramganjmandi Tehsil of Kota District and Their Statistical Interpretation

Engineering

KEYWORDS : Ground water analysis, Ramganjmandi, statistical analysis

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ABSTRACT

Kota is fast growing and developing city of India, famous for Kota Stone Industries, Kota Doria Sarees and now-a-days it is also famous as a education city. It is situated on the bank of river Chambal. In the present study, we studied ground water for various domestic & industrial point of view in Ramganjmandi Tehsil of Kota. Ramganjmandi is famous for Kota stone industries. Hundreds of cutting, polishing and mining industries established in this area which are totally depend on ground water. In the present study we found that hardness and TDS (total dissolved solid) reached to a alarming level in same areas which need proper removing before using water. Fluoride is also higher than in comparison of normal value although it is lower than permissible limit. In the present paper, we also check and interpreted data by various statistical techniques.

INTRODUCTION

Kota district lies in south eastern part of the state, between 24°25¢ and 25°51¢ North latitude and 75°17¢ and 76°00¢ East longitude. It spread in a area of 5198 sq. km. Sawaimadhopur is situated in its north and north west, Bundi on West, Chittaurgarh and Baran on East and Mandsore of Madhya Pradesh is on south and Jhalawar on south east.

There are total five tehsil in Kota- Ladpura, Pipalda, Digod, Sangod and Ramganjmandi. Kota is dry climate district. Average maximum temperature is 45°C and minimum 9°C. Average rainfall is 680.07 mm.

Major part of district has shallow water level less than 10m except Itawa, Sangod and Ramganjmandi block. Ground water quality is a function of physical and chemical parameters which are affected by geological formations and anthropogenic activities [Subramani et. Al. 2005] . Quality of ground warer is deteriorate by excess use of fertilizers, seepage and industrial discharge [Jain et. Al. 2005; Sravanthi 1998]. Study of ground water is considered as important part of pollution studies on the environment [Kushwah et. Al. 2012].

EXPERIMENTAL

In the present study, we collect 10 ground water samples and kept then in properly rinse plastic bottles. All the samples collected after 10 min. of pumping of water [Shyam and Kalwania 2011]. All the samples analyzed as per the standard recommended by American Public Health Association [APHA 1989]. Electrical conductivity, pH, TDS (Total dissolved solids), were determined at the same day by water analyzer (systronic-371). Total hardness and calcium hardness were determined by complexiometric-EDTA method using EBT (Eriochrome Black-T) and murexide indicator respectively. Magnesium concentration is calculated from total hardness and calcium hardness. Total alkalinity, carbonate and bicarbonate concentrations are estimated by titrametric methods using Phenolphthalein and methyl-orange as indicator. Argentometric method with $K_2Cr_2O_7$ indicator is used to determine chloride concentration.

Fluoride, nitrate and sulphate concentrations were determined by double beam UV-VPS spectrophotometer (Systronic-2201) using zirconyl SPANDS dye, brucine and turbidimetric methods respectively. Sodium, potassium and calcium were carried out by flame-photometric method. (Systronic-128, Compressor-126).

RESULT & DISCUSSION

Various water quality parameters in the ground water were analysed and compared with standard permissible limit.

1. pH : It show acidic and basic character of given water sample, various biological and chemical reactions depends upon pH [Sreenivason 1967]. Acidic pH range gives corrosion while high basic range produce incrustation, sedimentation and difficulties in chlorination of water[Prasad 2003].

2. TDS : It is important parameter for drinking water maximum allowed limit is 1500 mg/lit. (ICMR).

3. Electrical Conductivity : Conductivity determine total amount of ionic substances in ground water. It can be reduces by reverse osmosis, desalination or electrodialysis.

4. Total hardness : It is main parameter for drinking water and due to presence of dissolved calcium and magnesium salts in water. High value of hardness is due to chemical and industrial effluent as well as excessive application of lime to the soil in agriculture areas [Ravikumar et. Al. 2011].

5. Calcium : It is most abundant natural element present in all ground water sources. It comes in ground water by erosion of rocks such as lime stone and minerals, such as calcite. Very high concentrations of calcium affect the absorption of other essential minerals in the body.

6. Magnesium : It comes in ground water by minerals such as dolomite, magnesite and erosion of rocks. It brings undesirable tastes in water.

7. Sodium : It is highly soluble element in water, its higher concentration may cause hypertension, heart disease and kidney problems.

8. Potassium : It comes in ground water mainly by leaching of fertilizers from surface. It gives kidney dysfunction, heart diseases, coronary artery disease, hypertension, diabetes, adrenal insufficiency, if present in higher amounts.

9. Chloride : Chloride comes in water by leaching of inorganic fertilizers, industrial effluents, irrigation drainage and weathering of various rocks. Chloride affects the rate of corrosion of steel and aluminium.

10. Sulphate : Sulphate comes in ground water from dissolution of minerals such as gypsum, acid rock drainage and industrial discharge. In higher amount it may give corrosion.

11. Nitrate : It comes in ground water by leaching of chemical fertilizers, leaching from animal manure and water from septic and sewage discharges. Higher amount of nitrate is responsible for blue baby syndrome and ability of blood to transport oxygen reduced.

12. Phosphate : Sources of phosphate in ground water is dissolution of minerals, fertilizers, leakage in septic tank, infiltration of waste water and industrial waste water. But generally concentration of phosphate in ground water are very low because phosphate is not readily transported to ground water [Jothivenkatachalam 2010].

Total 10 samples were taken and various data then analized by various statistical techniques.

Table-1 Physico-chemical analysis of ground water of Ramganjmandi tehsil of district kota

	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
pH	8.35	8.14	8.26	8.31	8.35	7.96	7.90	8.14	8.59	8.21
TDS (mg/ lit)	970	912	896	856	1008	762	819	674	924	1006
EC	480	612	494	523	478	604	574	490	376	402
CO_3^{-2}	36	38	41	44	40	32	33	33	58	41
HCO_3^-	168	165	186	192	171	152	159	153	203	186
TH	275	299	374	306	301	224	291	256	345	372
TA	490	476	456	512	524	504	424	541	514	476
Ca^{+2}	52	48	56	51	52	48	61	50	52	37
Mg^{+2}	28	32	31	22	23	27	34	44	29	26
Na^+	29	24	23	20	29	26	32	27	23	20
K^+	3.9	3.6	3.9	4.1	3.7	4.6	3.5	3.5	3.7	4.0
Cl^-	28	26	27	32	26	25	24	26	29	32
SO_4^{-2}	22	20	24	23	25	29	20	22	30	23
NO_3^-	35	37	41	31	29	37	35	44	30	32
PO_4^{-3}	0.26	0.30	0.24	0.25	0.26	0.31	0.34	0.19	0.20	0.24
F^-	0.94	0.87	1.1	0.76	0.92	0.69	1.2	1.0	1.1	0.94

STATISTICAL REPRESENTATION OF GROUND WATER PARAMETERS

[Richard 1954] has classified water on the basis of sodium absorption ratio (SAR). It is an important parameter for determination of soil alkalinity in ground water used for irrigation purpose[Kumaresan and Riyazuddin 2006].

$$SAR = \frac{Na}{\sqrt{\frac{(Ca+Mg)}{2}}}$$

[Doneen 1964] gives a formula to calculate permeability index (PI) to measure the soil permeability to check suitability of water for irrigation purposes.

$$PI = \frac{Na + \sqrt{HCO_3}}{Ca + Mg + Na} \times 100$$

[Schoeller 1967] gives a formula, chloroalkaline indices (CAI) to calculate exchange between ground water and surroundings.

$CAI = [Cl^- - (Na^+ + K^+)]/Cl^-$

The negative value of CAI indicates that there is exchange between sodium and potassium ($Na^+ + K^+$) in water with calcium and magnesium ($Ca^{+2} + Mg^{+2}$), in the rocks by a base exchange reactions. The positive value of CAI represents the absence of base exchange reactions and existence of cation-anion exchange type of reactions [Raju 2007].

Sodium content is expressed by percentage of Sodium or soluble sodium percentage. [Wilcox 1955] gives a method for rating the irrigation water based on percentage of sodium and electrical

$$\%Na = \frac{(Na+K)}{(Na+K+Ca+Mg)} \times 100$$

CALCULATION OF INDICES

Langelier Saturation Index (LSI) : It indicate driving force for scale formation and growth in terms of pH. It is an equilibrium index explain thermodynamic driving force for calcium carbonate scale formation and growth. But it do not explain how much scale or calcium carbonate actually precipitate to bring water to equilibrium [Langelier 1936].

If LSI is negative, no potential scale water will dissolve CaCO3. If LSI is positive scale can form and CaCO3 precipitation may occur. It LSI is close to zero : Border line scale potential.

To calculate LSI, value of total alkalinity (mg/lit as CaCO3), Calcium hardness (mg/lit) as CaCO3), total dissolved solids (mg/lit TDS) and value of pH and temperature of water (°C) required.

LSI = pH – pHs

pHs is the pH at saturation in calcite or calcium carbonate and is defined as

pHs = (9.3 + A + B) – (C + D)

where-

A = (log10 [TDS] –1)/10

B = –13.12 × log10 (°C + 273) + 34.55

C = log10 [CaH as CaCO3] –0.4

D = log10 [Total alkalinity as CaCO3]

We can calculate LSI by help of these equations.

This is useful in predicting the scaling or corrosive tendencies of the water[20]. It water dissolves calcium carbonate, water is corrosive and has a negative value. If the water deposits calcium carbonate; it has a scaling tendency and a positive value. Temperature of water is taken 25°C.

Table-2 STATISTICAL ANALYSIS OF VARIOUS WATER SAMPLES

	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
SAR	4.59	3.8 0	3.48	3.31	5.09	4.56	4.64	3.94	3.62	3.57
PI	38.49	35.43	33.31	36.41	40.46	37.95	35.13	32.54	35.82	40.53
CAI	–0.18	–0.06	0.003	0.25	–0.25	–0.22	–0.48	–0.17	0.08	0.25
%Na	0.29	0.26	0.24	0.25	0.30	0.29	0.27	0.24	0.25	0.27
LSI	0.76	0.51	0.68	0.75	0.80	0.36	0.33	0.60	1.03	0.47

Volume : 4 | Issue : 4 | April 2015 • ISSN No 2277 - 8179

Table-3 CLASSIFICATION OF GROUND WATER SAMPLES OF RAMGANJMANDI TEHSIL OF DISTRICT, KOTA

S.No.	Classification Pattern	Categories	Range	No. of samples	% of samples
1	Sodium Absorption Ratio (SAR)	Excellent	0-10	All (10)	100%
		Good	10-18		
		Fair	18-26		
		Poor	>26		
2.	Permeability Index (PI)	Class I	>75		
		Class II	25-75	All (10)	100%
3	Chloroalkaline Indices (CAI)	Base exchange reactions	Negative value	06	60%
		Cation-Anion exchange reactions	Positive Value	04	40%
4	Percentage Sodium (%Na)	Excellent	0-20	All (10)	100%
		Good	20-40		
		Permissible	40-60		
		Doubtful	60-80		
		Unsuitable	>80		

Table 4 : INTERPRETATION OF LANGELIER SATURATION INDEX (LSI) TEST RESULTS

S.No.	Index	Appearance	Water condition quality Issues
1.	−4.00	Very severe corrosion	Conditioning required
2.	−3.00	Severe corrosion	Conditioning usually recommended
3.	−2.00	Moderate corrosion	Some conditioning is recommended
4.	−1.00	Mild corrosion	Need some conditioning
5.	−0.50	Slight corrosion	Should not/may need some conditioning
6.	0.00	Blanced	Conditioning not recommended
7.	0.50	Faint scale coating	Conditioning not recommended
8.	1.00	Slight scale/ Encrustation	Some visual appearance concern
9.	2.00	Mild scale/ Encrustation	Should consider some conditioning
10.	3.00	Moderate scale/ Encrustation	Should use some conditioning
11.	4.00	Severe scale/ Encrustation	Conditioning usually required

CONCLUSION

In the present research, we analysed ten samples for various factors. All the samples comes below higher permissible range although TDS (total dissolved solid) alkalinity and total hardness is at the alarming level which show pollution of ground water due to mining industry so treatment of water is required before its use for drinking and other purpose. Different statistical parameters is also calculated which show mild conditioning agents required before use of water.

FUTURE SCOPE

In the present research selected area is important for stone industies from minning to cutting and polishing a hundreds of industries running and using ground water and name of Kota is associated with kota stone industry also this place Ramganjmandi is famous for cultivation of corriender wordvide. And both these industries is depends upon gound water and this is the first attempt of analysis of ground water with all important parameters. We are also working on techniquies so that water can be recycle and waste water can be reused so that water demand can be decress this is our next step of working.

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