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"Quality of Groundwater Around Rewa-Baisa Region and their Suitability For Drinking Purpose of Rewa District Madhya Pradesh"

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Abstract:

Present papers deals to quality of groundwater around Rewa-baisa region and their suitability for drinking purpose of Rewa District Madhya Pradesh". All the parameters of groundwater sampleswereanalyzed are within the prescribed limits as suggested by the World Health Organization (WHO), Indian Standard Institute (ISI) and BIS desirable limit. Yearly change in groundwater parameters like;Temperature,Turbidity, colour, odour, pH value, Total hardness, Calcium, Magnesium, Total alkalinity, Chloride, Nitrate,Total dissolved solid, Sulphate, Iron, Fluoride, Maganese,Arsenic etc.. Allthe parameters were present in desirable or undesirable limits.

Keywords: Groundwater quality, Groundwater Baisa, Rewa Madhya Pradesh.

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Introduction:

Water is an important role play in our life and also to the living environment, without it life is impossible[1]. Water plays an important rolein human life.Although statistics, the WHO reports that about 36% of urban and 65% of rural Indian were without access to safe drinking water.Fresh water is one of the most important resources crucial for the survival of all the living beings.All the types of water qualities are analyzed on the basis of soluble or insoluble impurities like; minerals, salts, acids, base, Dissolved gases and the physically dissolved content in water. In this research, analyzed present paper reports for parameter's data, i.e. Temperature, Turbidity, colour, Odour, pH value, Total hardness, Calcium, Magnesium, Total alkalinity Chloride, Nitrate,Totaldissolved solid, Sulphate, Iron, Fluoride, Maganese etc. in the year of march 2020 of baisa Rewa, Madhya Pradesh. All the analyzed parameters were found in desirable or undesirable limits according to the WHO, BIS and ISI.All the parameters presents in the samples of study area have been presented in Table-1[2].

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Material and Methods:

Groundwater sample were collected from village baisa Rewa, Madhya Pradesh, in the year of march 2020. Required materials for sampling and analysis of water sample of Itinerary for the trip, transport arrangement, location area map, sampling site location map, icebox, D.O.D. bottles, sample containers, special sample containers, chemicals and glasswares, thermometer, tissue papers, other field measurement are sample identification forms, labels for sampling containers, field note bottle, pen, pencil, markers, soap amd towel, matchbox, spirit lamp, torch etc. All the analysis data were carried out asper the WHO, ISI and BIS desirable limit for drinking water. Relevent methods are given below:

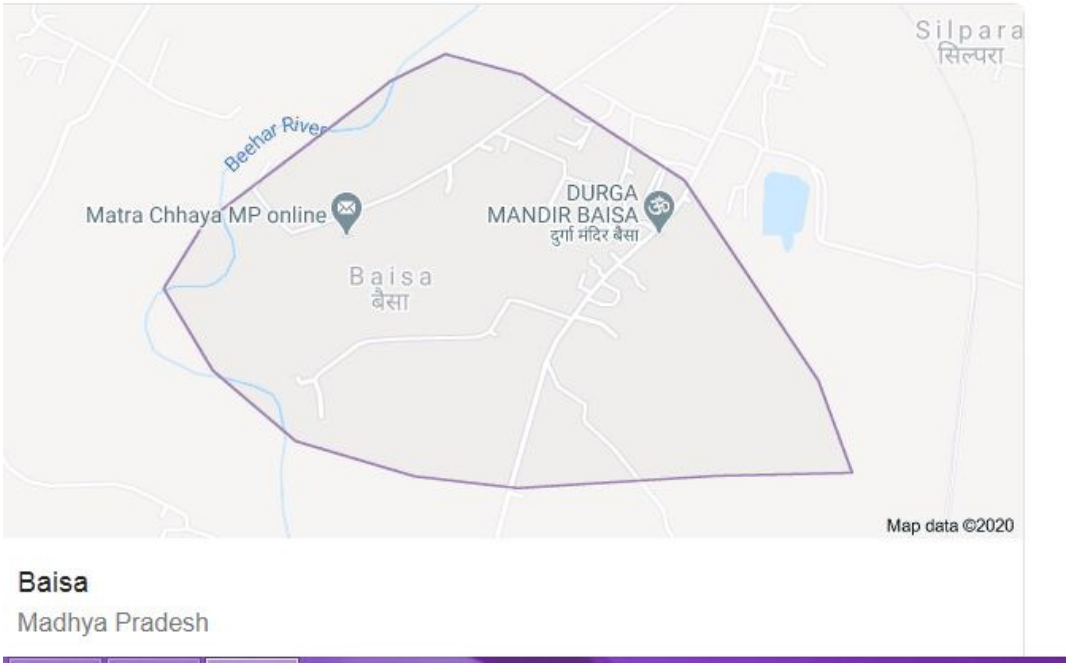

Fig.1. Location area map of sampling site

- ## Temperature:

Temperature is basically important for its effect on the chemical and biological reach in the organism present washer a rise in temperature leads to the speeding up of the chemical reaction of washer and reduces the solubility of gases it is measured with the help of a thermometer[3].

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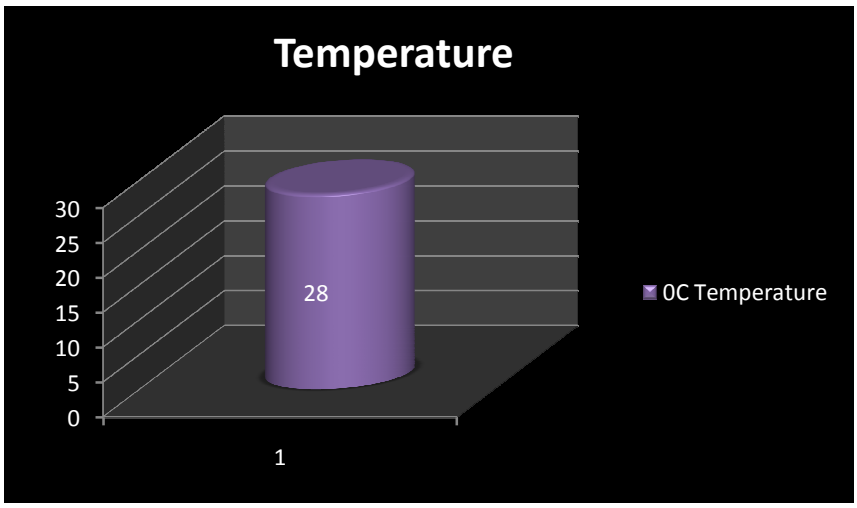

Fig.2. Temperature of groundwater sample

- ## Turbidity:

Turbidity in groundwater sample is analyzed by the nephelometric method by using Solution I. Dissolve 1.00 gm of hydrazine sulfate, (NH_3). Sulphuric acid in distilled water and dilute to 100 ml in volumetric flask, Solution II. Dissolve 10.00 gm hexamethylenetetramine, (CH_2)6 N4, in distilled water and dilute to 100 ml in volumetric flask, 4000 NTU suspension. In a flask mix 5.0 ml of solution 1 and 5.0 ml of solution II. Let stand for 24 h at 25 = 3°C. This results in a 4000 NTU suspension. Store in an amber glass bottle. The suspension is stable for up to 1 year, dilute, 4000 NTU stock solution with distilled to prepare dilute standards just before use and discard after use. Method for analysing the turbidity is given below;

a. Calibrate nephelometer according to manufacturer's operating instruction. Run at least one standard in each instrument range to be used.

b. Gently agitate sample. Wait until air bubbles disappear and pour the sample into the cell. Read turbidity directly from instrument display.

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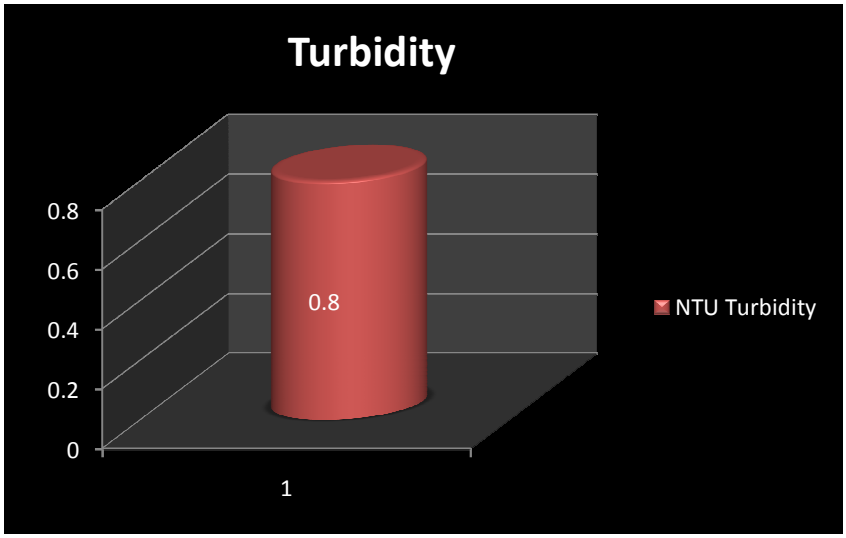

Fig.3. Turbidity of groundwater sample

- ## Colour:

Colour of groundwater sample is determined by visual so comparison of the sample with a known concentration of colored solution.

- ## Odour:

Odour of groundwater sample is determined by qualitative human receptor.Method for analysing the odour is given below;

a. After collection of sample, fill a cleaned odorless bottle half of the sample Insert stopper shake vigorously for 2 to 3 seconds and then quickly observe the odor. The sample should be ambient temperature.

b. Report the odor as odor free rotten egg, brunt sugar, soap, fishy, septic aromatic clearness,

Alcoholic odor or any other specific odor, in case it is not possible to specify the exact nature of Odor, repeat as agreeable or disagreeable.

pH Value:

pH Value of groundwater sample is analyzed by using Potentiometric method. The pH in underground water is not pathologically significant, but is determination is of immense importance in the acid-base neutralization washer softening, perception, coagulation disinfection and corrosion control, it can be measured with a pH meter apparatus using a pH meter with a temperature compensating device, accurate and reproduce to 0.1 pH unit with a range of 0 to 14, reference electrode preferable with quartz liquid junction. Follow the manufacture instruction use and care of reference electrode, refill non-sealed electrode

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with correct electrolyte to proper level and make sure junction is properly wetted, Glass electrodes, Follow manufacture instruction on use and care of electrode and using Reagents Potassium hydrogen phthalate buffer, 0.005 M pH 4.00 dissolved 10.12 KHC8H4O4 (Potassium hydrogen phthalate in 1000 ml freshly boiled and cool with distilled water), 0.025 Potassium de-hydrogen phosphate +0.025 Disodium hydrogen phosphate butter. PH 6.86 dissolved 3.87gKH_2PO_4 in 1000 ml freshly boiled and cooled distilled water, 0.01 sodium borate (borax buffer), pH = 9.18 dissolve 3.80 g Na2 B4O7.10H2O in 1000 ml freshly boiled and cooled distilled water, Store buffer solutions in polyethylene bottles, replace buffer solutions every 4 weeks. Method for analysing the pH value is given below;

a. Remove the electrode from storage solution, rinse, blot dry with a soft tissue place in initial buffer solution
and standardize pH meter according to manufactures instructions.
b. Remove electrodes from the first buffer, rinse thoroughly with distilled water, blot dry and immense in the second buffer preferably of pH within 2 pH units.

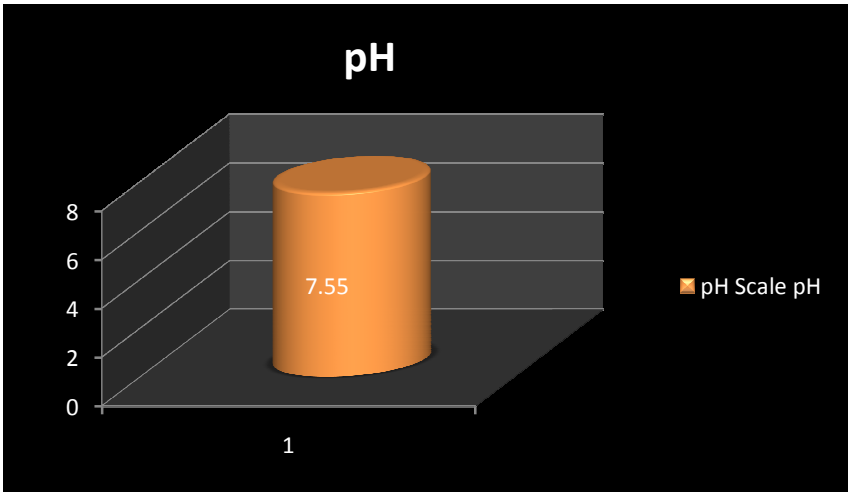

Fig.4. pH of groundwater sample

- **Total Hardness:**

Hardness of water is analyzed by EDTA complex metric titration method using EDTA solution, buffer solution, Standard calcium solution, Eriochrome black-T indicator, distilled water and required apparatus in titration etc. Method for analysing the Total hardness is given below;

a. Dilute 25 ml sample to 50 ml with distilled water. Add 1 to 2 ml buffer to give a pH of 10.0 to 10.1 Add 1 to 2 drops of indicator solution and titrate with EDTA titrant to change in color from a reddish tinge to blue.

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Select a sample volume that requires less than 15 ml EDTA titrant and complete titration within 5 min after buffer addition.

b. Standardize the EDTA titrant against standard calcium solution using the above procedure[4].

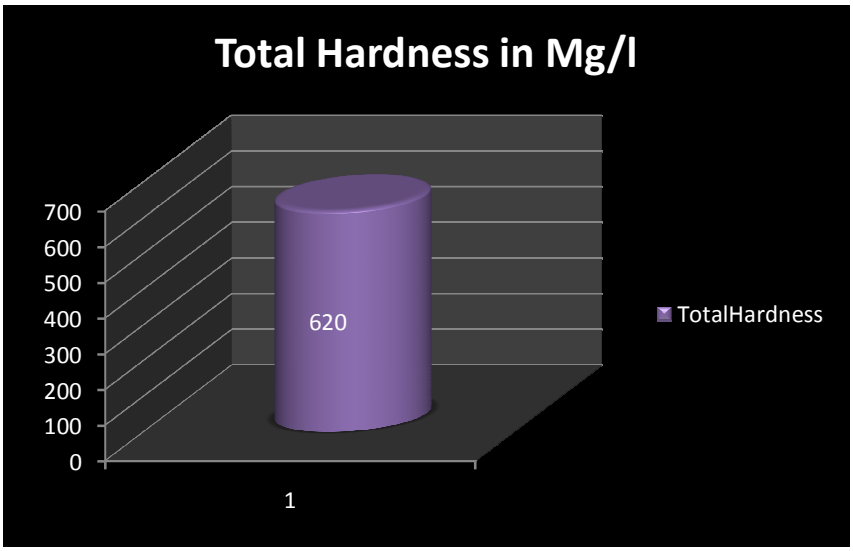

Fig.5. Total hardness of groundwater sample

- **Calcium:**

Calcium in water is analyzed by EDTA titration method using reagents; NaOH, ammonium purpurate, standard EDTA solution, standard calcium solution and ammonium hydroxide etc. Method for analysing the calcium is given below;

a. Take 50 ml sample or and aliquot dilute to 50 ml such that the calcium content is not more than 10 mg. The sample which contains alkalinity greater than mg/L should be neutralized with acid, boiled for minute and cooled before titration.

b. Add 2 ml NaOH solution or a volume sufficient to produce a pH of 12 to 13. Start titration immediately after addition of alkali. Add 0.1 to 0.2 indicator mixture. Titrate with EDTA solution, with continuous mixing, till the color changes from pink to purple. Check end point by adding 1 to 2 drop excess titrate to make certain that no further color charge occurs.

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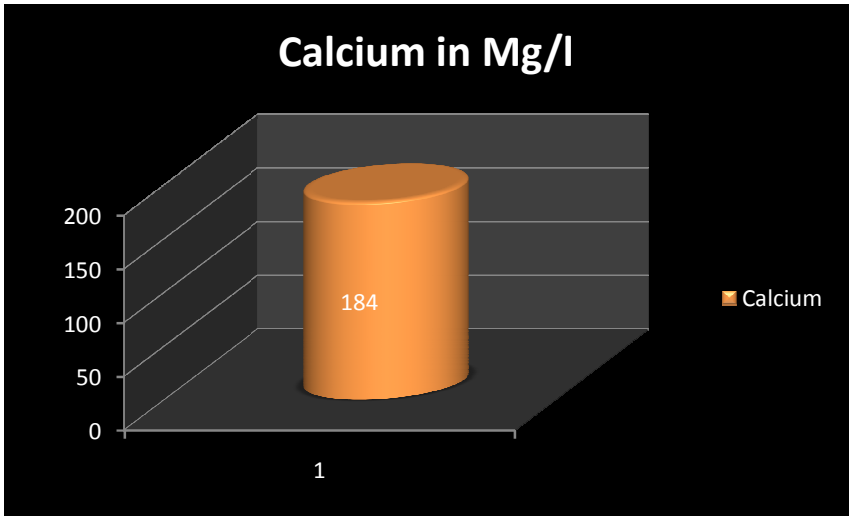

Fig.6. Calcium of groundwater sample

Magnesium: Method for analysing the magnesium is given below;

Magnesium in water is determined by calculation from total hardness and calcium hardness and get the values for total hardness, and calcium hardness determined by EDTA and calculate Mg.

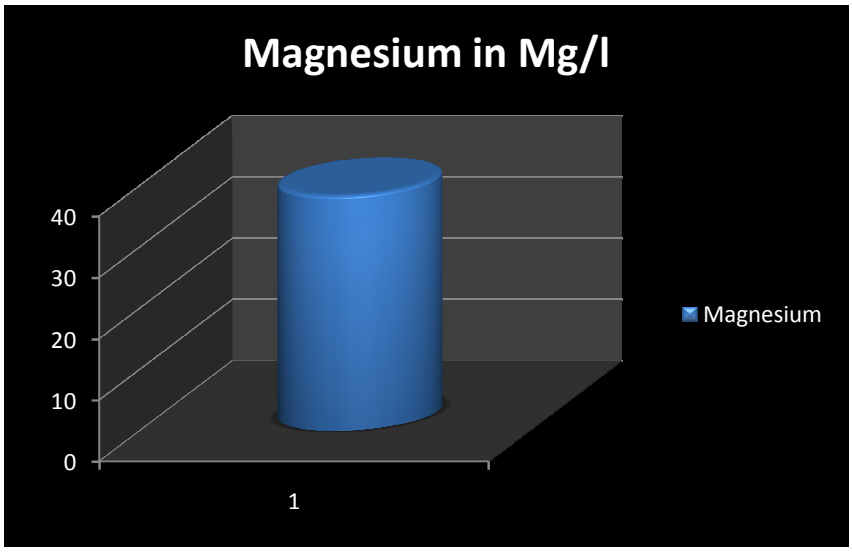

Fig.7. Magnesium of groundwater sample

- **Total Alkalinity:**

Total alkalinity of water is analyzed by titration method using Standard Na_2CO_3, Standard sulphuric acid solution, methyl orange, phenolphthalein etc. using titrimetric to pH = 8.3 (Phenolphthalein) method. Method for analysing the total alkalinity is given below;

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a. Take 25 to 50 ml sample in a conical flask. Add 2 to 3 drops of phenolphthalein indicator. If it turns pink (pH>8.3), titrate with 0.02 N sulphuric acid to the disappearance of the color record ml tyrant used. If sample does not turn pink (pH<8.3) directly go to below.

b. Add 2 to 3 drops of Bromocresol green indicator. Continue the titration until change is the color is observed. Record total ml titrate used in A and B.

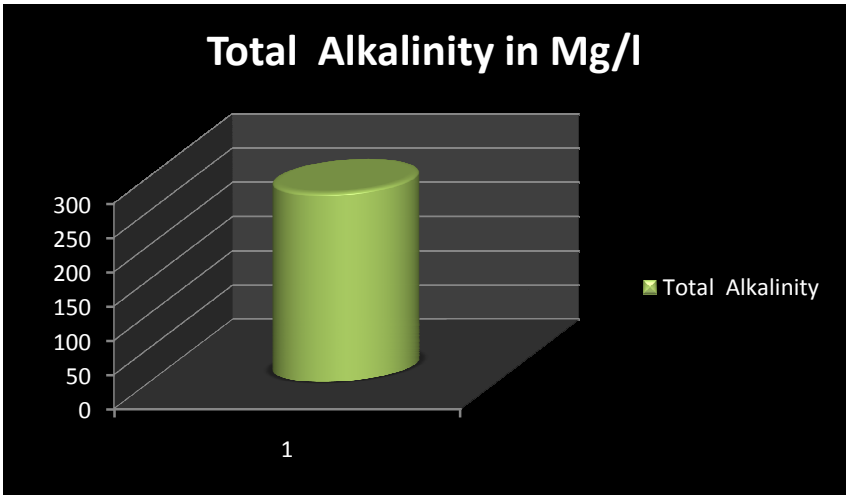

Fig.8. Total alkalinity of groundwater sample

- **Chloride:**

Chloride of water is analyzed by an argentometric titration method using potassium chromate indicator solution, standard $AgNO_3$titrating solution, standard sodium chloride, distilled water, etc. Method

1. Use a 100 ml sample or suitable portion diluted to 100 ml. If the sample is colored of turbid, add 3 ml (OH) 3 suspension, mix, let settle and filter. Method for analysing the chloride is given below;

a. Add 1 ml K_2CrO_4 indicator solution, titrate with $AgNO_3$ titrate to pinkish yellow end point.

b. Repeat the titration with distilled water blank. A blank of 0.2 to 0.3 ml is usual.

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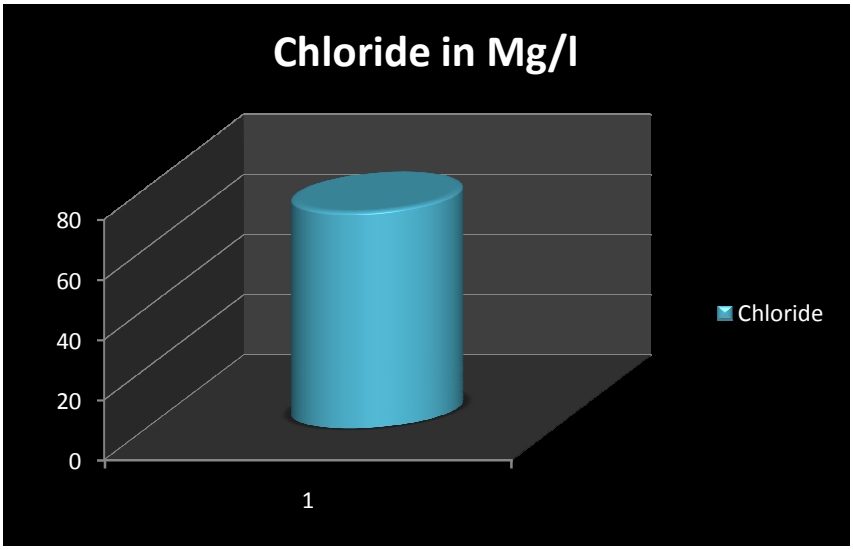

Fig.9. Chlorideof groundwater sample

- **Nitrate:**

Nitrate of water is analyzed by UV Spectrophotometric method using apparatus Spectrometer, for use at 220 NM and 275 nm with matching silica cells of 1 cm or longer light path using reagents nitrate free water. Use re-distilled or de-ionized water to prepare all solutions, stock Nitrate solution: Dissolve 0.7218 g KNO_3, earlier dried in hot air oven at 105° overnight and cooled in desiccators, in distilled water and dilute to IL. Preserve with 2 ml of $CHCl_3$; 1 mL = 100□g NO_3—N, stable for 6 months, standard Nitrate Solution: Dilute 100 ml of stock solution to 1000 ml with water. Preserve with water. Preserve with 2 ml $CHCl_3$/1 1 mL -= 10□g NO_3-N, stable for 6 months, hydrochloric acid solution, HCl, 1 N Cautiously add 83 ml concentration. HCl to about 850 ml of distilled water while mixing, cool and dilute to 1 L. Method for analysing the Nitrate is given below;

a. Treatment of sample: Add 1 mL HCl to 50 ml clear/filtrate sample, mix.

b. Preparation of standard curve: Prepare calibration star cards in the range of 0–7 mg NO_3-N/L by diluting to 50 ml the following volumes of standard solutions, add 1 mL of HCl and mix.

c. Spectrophotometric measurement: Read absorbance or transmittance against re-distilled water set at Zero absorbance or 100% Transmittance. Use a wavelength of 220 to obtain NO_3- reading and a wavelength of 275 nm to determine interference due to dissolved organic matter.

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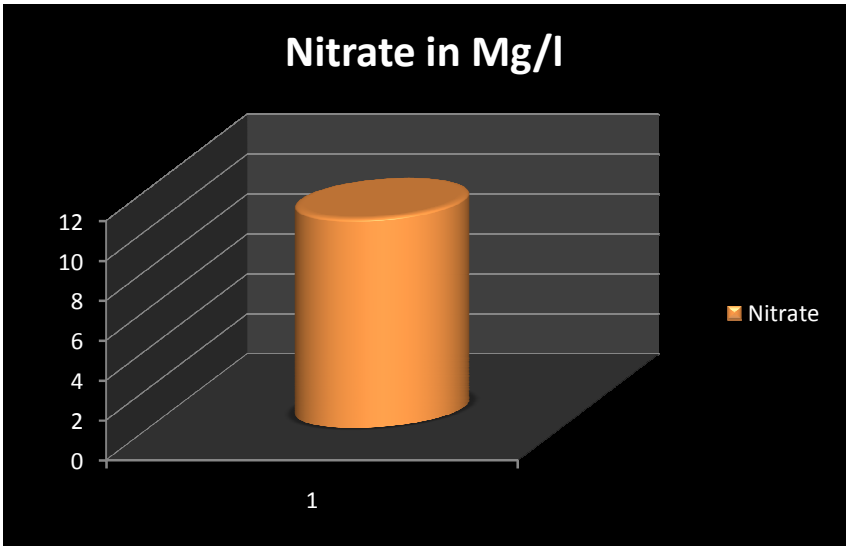

Fig.10. Nitrate of groundwater sample

- ## Total Dissolved Solid:

Total dissolved solids in water are determined by gravimetric after filtration methods using 100 ml capacity of porcelain, platinum or high-silica glass made, glass-fiber disk, Filtration apparatus. Filter funnels Gooch crucible with the adapter and suction flask of sufficient capacity for sample size selected.

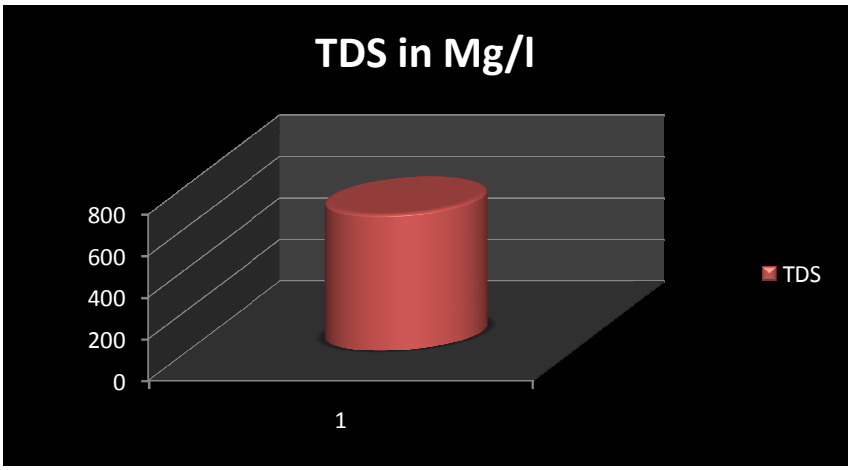

Fig.11. Total dissolved solid of groundwater sample

- ## Sulfate:

Sulfate inwater is analyzed by nephelometry methods using buffer solution, standard sulfate solution standard sodium carbonate solution, standard sulphuric acid solution etc.

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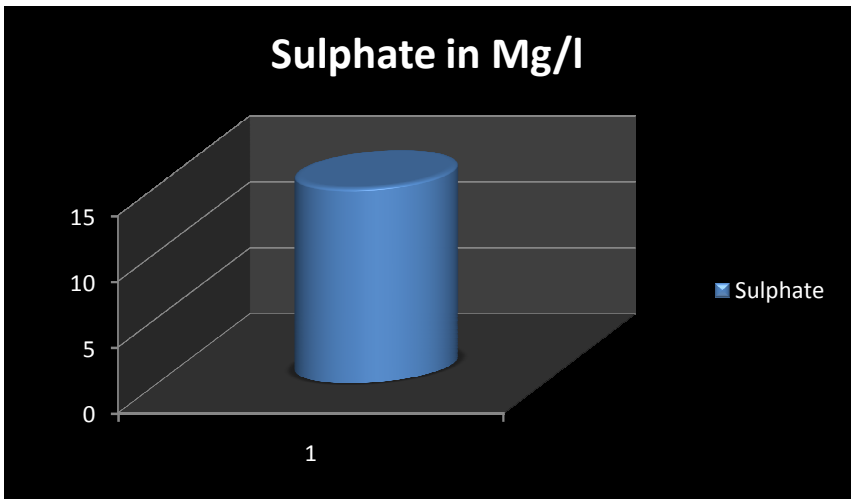

Fig.12. Sulphate of groundwater sample

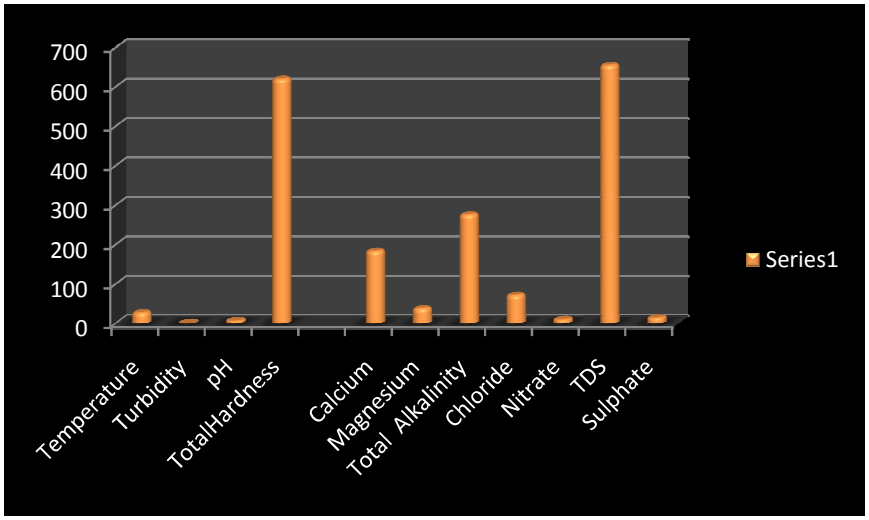

Fig.13. All the analyzing parameters of groundwater sample

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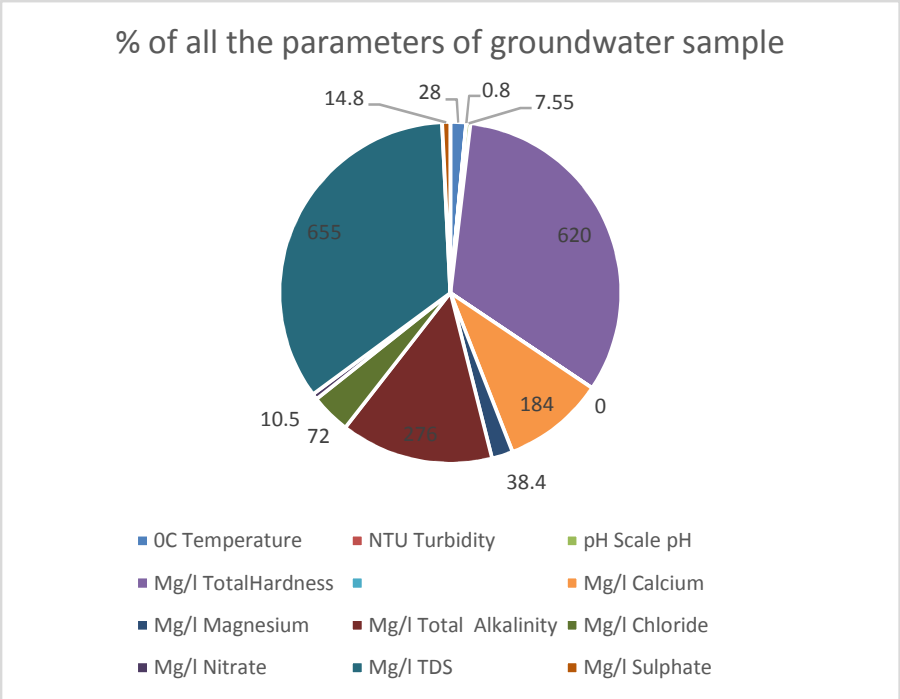

Fig.14. Percentage of all the parameters of groundwater sample

Table –1
Groundwater Sample Parameters 2020

Units	Parameters	Sample
^{0}C	Temperature	28
NTU	Turbidity	0.8
Hazen Units	Colour	Colourless
-	Odour	Unobjectionable
pH Scale	pH	7.55
Mg/l	TotalHardness	620
Mg/l	Ca^{2+}	184
Mg/l	Mg^{2+}	38.4
Mg/l	Total Alkalinity	276
Mg/l	Cl^-	72
Mg/l	NO_3^-	10.5
Mg/l	TDS	655
Mg/l	SO_4^{2-}	14.8

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Table - 2

Range of hardness according to the water quality Association

Degree of Hardness	Grains Per Gallon (GPG)	(ppm or mg/L)
Soft	<1.0	<17.0
Slightly Hard	1.0-3.5	17.1-60
Moderately Hard	3.5-7.0	60-120
Hard	7.0-10.5	120-180
Very Hard	>10.5	>180

Table - 3

Water Quality Parameters and Drinking Water Standards of BIS (2020)

Units	Parameters	As per BIS – 10500:2012 For Drinking Water	
		Requirement (Desirable Limit)	Permissible Limit in the absence of Alternate Source
^0C	Temperature	-	-
NTU	Turbidity	1.0	5.0
Hazen Units	Colour	5	15
-	Odour	Unobjectionable	Objectionable
-	Test	-	-
pH Scale	pH	6.5 to 8.5	No Relaxation
Mg/l	Total Hardness	200	600
Mg/l	Ca^{2+}	75	200
Mg/l	Mg^{+2}	30	100
Mg/l	Total Alkalinity	200	600
Mg/l	Cl^-	250	1000
Mg/l	NO_3^-	45	45
Mg/l	TDS	500	2000
Mg/l	Iron	0.3	0.3
Mg/l	SO_4^{2-}	200	400
Mg/l	Fluoride	1.0	1.5
Mg/l	Mn^{2+}	0.1	0.3

Table - 4

Water Quality Parameters and Drinking Water Standards of WHO , ISI and BIS

PARAMETERS	UNITS	DRINKING WATER WHO (1984) and ISI (1991)		DRINKING WATER BIS
		Desirable	**Maximum**	**Desirable Limit**

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PH value	-	6.5 to 8.5	No relaxation	6.5–8.5
Dissolved Solids	mg/L	500	2000	500
Color	Hazen units	5	25	-
Odor	-	Unobjectionable	-	-
Turbidity	NTU	5	10	-
Taste	-	Agreeable	-	-
Total hardness (as$CaCO_3$)	mg/L	300	600	300
Alkalinity	mg/L	200	600	200
Calcium	mg/L	75	200	75
Manganese	mg/L	0.1	0.3	100
No_3^-	mg/L	50	No relaxation	45
Chloride (Cl^-)	mg/L	250	1000	250
Sulfate	mg/L	200	400	200
Na^{2+}	mg/L	-	-	<60
HCo_3^{2-}	mg/L	-	-	250

Results:

Colour; Colourless, Odor; UNOB, Temperature; 28(°C), Turbidity; 0.8 (NTU), pH 7.55,Total Hardness; 620 (mg/L), Ca^{2+}; 184, Mg^{2+} ; 38.4 (mg/L), Total Alkalinity; 276 (mg/L), Cl^-; 72, TDS; 655 (mg/L), NO_3^-; 10.05 (mg/L), SO_4^{2-}; 14.8(mg/L).

Conclusion:

The results of analyzing data of groundwater; Alkalinity is in desirable limits. The undergroundwater samples; pH between desirable limits.Total dissolved solid is not in desirable limits, hence not suitable for drinking purpose. Calcium and magnesium is not in desirable limits, but permissible limit in the absence of alternate source other parameters like; normal chloride, normal sulphate, normal nitrate and normal fluoride. The hardness of water sampleis very hard so, it is not in desirable limits, but permissible limit in the absence of alternate source. All the data were analyzed and compared with WHO, ISI and BIS(10500:2012) desirable limits. According to WHO, ISI and BIS, underground water, indicate the water is not suitable for drinking purpose due to the hardness of water but permissible limit in the absence of alternate source.

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