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Water Quality Analysis of Sub-Surface Sources in A Village Area of Rajasthan

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ABSTRACT: *A systematic study has been carried out in village areas of Ajmer district in Rajasthan. 54 samples from 6 different sampling locations were collected and analysed for physico-chemical parameters (nitrate, chloride, fluoride, pH, total dissolved solids, alkalinity, calcium, magnesium and hardness). Water from sub-surface sources were taken for analysis as these waters are being used by local people for different household purposes. Analysis shows that in few areas, out of these 9 parameters taken for consideration, nitrate and fluoride were mostly dominating in waters from well. Ajmer district actually faces the problem of high fluoride in water due to its geographical structure. High nitrate concentration is mainly due to anthrapogenic activities.*

Keywords: *Water quality, physico-chemical analysis, fluoride, nitrate, water pollution.*

I. INTRODUCTION

Ajmer is a city situated in northern Indian state of Rajasthan and is surrounded by Aravali mountains. It has a hot and semi-arid climate and temeperature remains relatively high throughout the year. A study has been performed in some villages (Akodiya, Bhagwantpura, Dang and Dabrela) of this district to assess its water quality. Two locations were taken for monitoring in Aakodiya and Bhagwantpura and one station for remaining Daang and Dabrela village. Map of study area is shown in fig. 3.1. Total eight parameters were measured at all these locations for determination of water quality. These parameters are nitrate, chloride, fluoride, pH, total dissolved solids, alkalinity, magnesium and hardness. Reason behind selecting these parameters is that these parameters play a vital role in determining the quality of water for drinking purpose. Ajmer is the area which is hit by high concentration of fluoride in ground water as with many other districts of Rajasthan state. Samples were analyzed from six different monitoring stations and found high concentration of fluoride along with nitrate. Parameters were measured and evaluated as per the standards given by Government of India.

II. METHODOLOGY AND EQUATIONS

2.1 Determination Of Nitrate

Nitrate determination is somewhat difficult as it requires complex procedures. It was determined using UV Spectrophotometer method in laboratory by measuring the absorbance at 220nm in sample containing 1mL of hydrochloric acid (1N) in 100mL sample. The concentration is calculated from graph from standard nitrate solution in range 1-11mg/L as N.

2.2 Determination Of Fluoride

Fluoride is measured by Ion Selective Electrode Method. It requires ion meter, calomel electrode, fluoride-sensitive electrodes, magnetic stirrer etc. The concentration in mg/L is obtained directly from the specific ion meter.

2.3 Determination Of Chloride

The chloride present in water can be determined by treating the water sample with silver nitrate solution. Titrant is silver nitrate with a normality of 0.0171. End point of the reaction is brick red color.

$$\text{Chloride Ion Concentration (mg/L)} = \frac{A \times N \times 35.45}{V_{SAMPLE}} \times 1000$$

2.4 Determination Of Ph

The pH of a solution is measured as negative logarithm of hydrogen ion concentration in a sample. At a given temperature, the intensity of the acidic or basic character of a solution is indicated by pH or hydrogen ion concentration. pH is measured by pH meter and it can be measured at monitoring stations instantly. pH meter gives the value on a scale ranging from 0 to 14. pH values from 0 to 7 are diminishing acidic, 7 to 14 increasingly alkaline and 7 is neutral.

2.5 Determination Of Tds

TDS are the material which passes through a standard glass filter disk and remains after evaporating and drying at 180^0C. Well mixed water sample is first passed through membrane filter then evaporated in an oven for at least 1 hour at 180 ± 2^0C.

mg/L total filterable residue at 180°C = (A –B) x 1000 / C

Where:

A = weight of dried residue + dish

B = weight of dish

C = mL of filtrate used

2.6 Determination Of Alkalinity

Alkalinity of sample can be estimated by titrating with standard sulphuric acid (0.02N) at room temperature using phenolphthalein and methyl orange indicator. Titration to decolourisation of phenolphthalein indicator will indicate complete neutralization of OH^- and ½ of CO_3^{2-}, while sharp change from yellow to orange of methyl orange indicator will indicate total alkalinity (complete neutralization of OH^-, CO_3^{2-}, HCO_3^-).

P-alkalinity, as mg $CaCO_3$/L = A x 1000/mL sample

T-alkalinity, as mg $CaCO_3$/L = B x 1000/mL sample

In case H_2SO_4 is not 0.02 N apply the following formula:

Alkalinity, as mg $CaCO_3$/L = A/B x N x 50000 / mL of sample

Where,

A = mL of H_2SO_4 required to bring the pH to 8.3

B = mL of H_2SO_4 required to bring the pH to 4.5

N = normality of H_2SO_4

2.7 Determination Of Magnesium

Magnesium present in water can be determined using titration method. Reagents required are EDTA ($Na_2H_2Y.2H_2O$), pH 10 buffer, Eriochrome Black T (ground 1:10 with NaCl), pHydrion paper and Standard Zn solution. End of the reaction is clear blue colour. Result is reported as percent magnesium (% w/v) in "prepared" unknown sample.

2.8 Determination Of Hardness

Hardness of water is due to presence of multivalent cations present in water sample like calcium ion, magnesium ion, aluminum ion etc. It is determined using titration method. EDTA is used as titrant, EBT as an indicator and ammonia buffer solution.

Total Hardness as $CaCO_3$ (mg/L) = (Volume of EDTA titrant x N x 1000 x 50)/ Volume of unboiled sample taken for analysis

Permanent hardness as $CaCO_3$ (mg/l) = (Volume of EDTA titrant x N x 1000 x 50)/ Volume of boiled sample taken for analysis

Figures And Tables

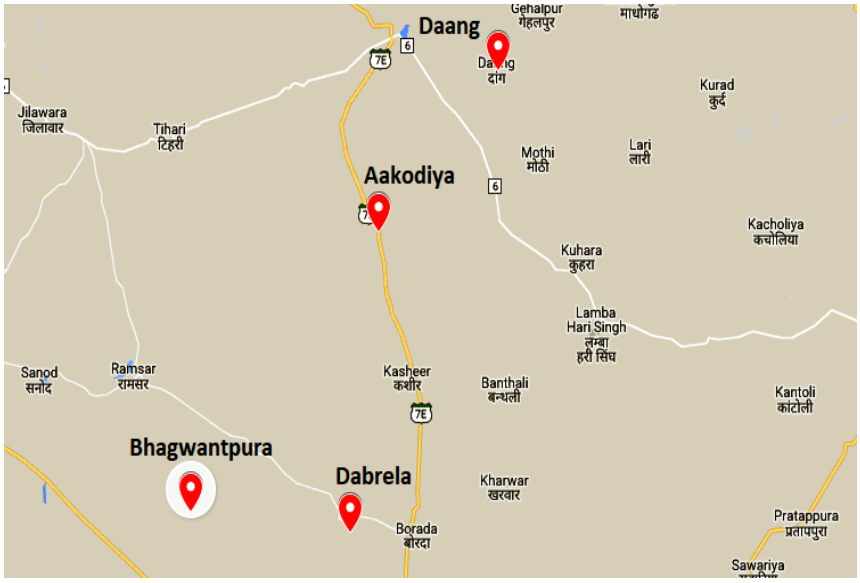

Fig. 3.1: Map Of Study Area

Table 3.1: Indian standard for parameters

S.N.	Parameters	Unit	BIS (IS 10500:2012)	
			Desirable limits	Permissible limits
1	Nitrate	mg/L	45	45
2	Fluoride	mg/L	1	1.5
3	Chloride	mg/L	250	1000
4	pH		6.5-8.5	6.5-8.5
5	TDS	mg/L	500	2000
6	Alkalinity	mg/L	200	600
7	Magnesium	mg/L	30	100
8	Hardness	mg/L	300	600

Table 3.2: Value of parameters for different locations

Date	21-04-2017	24-04-2017	27-04-2017	30-04-2017	03-05-2017	06-05-2017
District	Ajmer	Ajmer	Ajmer	Ajmer	Ajmer	Ajmer
Village	Aakodiya	Aakodiya	Bhagwantpura	Bhagwantpura	Daang	Dabrela
Location	Jorawarpura Road	Near Pathwari Sironj Road	Near school	Near bus stand	Near school	Near Kapasiya Bhavan
Source/ Parameter	Deep tubewell	Shallow tubewell	Shallow tube well	Deep tube well	Shallow tube well	Shallow tube well
Nitrate	2 mg/L	40	6	230	100	65
Fluoride	0.30 mg/L	0.8	2.5	0.6	1.7	2.2
Chloride	40 mg/L	200	50	1510	270	120
pH	8	7.9	8.1	7.6	8	7.9
TDS	259 mg/L	1300	560	3822	1200	840
Alkalinity	110 mg/L	400	370	110	380	290
Magnesium	14 mg/L	14	14	12	53	17
Hardness	120 mg/L	120	190	110	400	90

III. CONCLUSION

Study of sub-surface source of these areas shows that there is problem of high fluoride contamination in water of the villages Bhagwantpura, Daang and Dabrela. Fluoride concentration at these locations ranges from 1.7 to 2.5 mg/L which is higher than the permissible limit of 1.5 mg/L. This concentration is enough to cause dental fluorosis in villagers if they are using it for drinking purposes. Nitrate concentration was reported high in the villages of Bhagwantpura, Daang and Dabrela. Reason behind such a high nitrate concentration may be due to excess use of fertilizer and maure, animal feedlots or due to disposal of municipal wastewater on land. Chloride content total dissolved solids were reported high near bus stand of Bhagwantpura. Out of all these monitoring stations, Aakodiya village was found to be most clean in terms of water quality. People must be aware regarding polluted water and they should be educated to conserve and maintain water quality.

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