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PHYSICO-CHEMICAL ANALYSIS OF BORE WELL WATER IN FOUR CITIES OF MADHYA PRADESH, INDIA

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ABSTRACT

The quality of water is of utmost importance compared to quantity in any water supply, especially for potable purpose purity is of the prime requirement. With this viewpoint groundwater monitoring of four cities in Madhya Pradesh has been carried out. The analytical results reveal that few parameters like fluoride and alkalinity needs treatment before use for drinking purpose whereas all the remaining water samples have been found to be safe from potability consideration of course after disinfection.

Keywords: Ground Water, Water Quality, Fluoride, Alkalinity, etc.

I. INTRODUCTION

Water is very crucial for survival of all living beings (Humans, Animals or Plants). Almost all human activities (Domestic, Agricultural and Industrial) require plenty of water. The water quality appears to be of utmost importance for domestic especially from potability viewpoint. The physico-chemical, metallic and bacteriological analysis of water determines its usefulness [1 - 5].

The present communication deals with the water quality monitoring for the four cities with five sampling sites each of Madhya Pradesh.

II. MATERIALS AND METHOD

Twelve physio-chemical parameters namely pH, conductivity, turbidity, alkalinity, TDS, TSS, hardness, calcium, magnesium, chloride, sulphate and fluoride of sampled water were determined for all the water samples. Sampling, analysis and preservation of water have been carried out as per Standard Methods for the Examination for Water and Wastewater [6]. The analysis results for all the Twelve physico-chemical parameters of four cities with five sampling sites water samples are given in Table 1 to 4. The analysis results were verified for correctness by use of automated workbook meant for checking of correctness of water analysis [7]. The respective values for all the Twelve parameters were compared with the standard limits recommended by Indian Standards for drinking water [8].

III. RESULTS AND DISCUSSION

Physico-chemical analysis data for four cities with five sampling sites each have been recorded in Table 1 to 4.

Table 1: Analysis results for Indore city.

Sr. No.	Parameters	Unit	Indore-1	Indore-2	Indore-3	Indore-4	Indore-5
			Kalindi Township	Baikund-dham Colony	Sudama Nagar	Nehru Nagar	Vijay Nagar
1	pH		7.07	6.75	7.36	7.41	7.13
2	Conductivity	µs/cm	980	1004	520	1152	1065
3	Turbidity	NTU	1.2	0.7	ND	0.4	0.8
4	Alkalinity	mg/L	141	118	94	470	301

5	TDS	mg/L	689	705	365	814	765
6	TSS	mg/L	8	7	3	10	6
7	Total Hardness	mg/L	255	265	112	336	325
8	Calcium	mg/L	60	60	32	88	61
9	Magnesium	mg/L	25	28	8	28	39
10	Chloride	mg/L	191	178	157	248	261
11	Sulphate	mg/L	40	84	18	97	28
12	Fluoride	mg/L	0.62	0.54	0.27	0.64	0.82

Table 2: Analysis results for Bhopal city.

Sr. No.	Parameters	Unit	Bhopal-1	Bhopal-2	Bhopal-3	Bhopal-4	Bhopal-5
			Shahpura	Crompton and Greaves	DB CITY Mall	Railway Station	Courtyard by Mariott
1	pH		7.13	7.13	7.35	7.18	7.23
2	Conductivity	µs/cm	1050	1035	1000	1020	1070
3	Turbidity	NTU	0.8	ND	1.6	0.4	0.5
4	Alkalinity	mg/L	282	376	282	282	305
5	TDS	mg/L	765	732	707	715	750
6	TSS	mg/L	8	9	6	4	8
7	Total Hardness	mg/L	320	312	256	320	320
8	Calcium	mg/L	80	60	60	80	60
9	Magnesium	mg/L	29	39	26	29	41
10	Chloride	mg/L	263	299	197	263	277
11	Sulphate	mg/L	32	33	19	26	35
12	Fluoride	mg/L	0.84	0.86	0.71	0.7	0.84

Table 3: Analysis results for Gwalior city.

Sr. No.	Parameters	Unit	Gwalior-1	Gwalior-2	Gwalior-3	Gwalior-4	Gwalior-5
			Thatipur	Abhinandan Nagar	Railway Station	Substation Centre	Kotilya Nagar
1	pH		7.2	7.2	7.76	7.93	7.18
2	Conductivity	µs/cm	740	770	590	600	750
3	Turbidity	NTU	0.2	0.4	0.1	0.2	0.4
4	Alkalinity	mg/L	223	353	259	259	282
5	TDS	mg/L	510	537	408	401	507
6	TSS	mg/L	4	4	2	2	5
7	Total Hardness	mg/L	223	223	191	191	223
8	Calcium	mg/L	44	48	48	48	48
9	Magnesium	mg/L	27	25	17	17	25
10	Chloride	mg/L	139	161	94	87	131
11	Sulphate	mg/L	14	17	60	59	14
12	Fluoride	mg/L	0.53	0.63	0.7	0.71	0.5

Table 4: Analysis results for Ujjain city.

Sr. No.	Parameters	Unit	Ujjain-1	Ujjain-2	Ujjain-3	Ujjain-4	Ujjain-5
			Shir Sagar Colony	Arpita Nagar	Abhishekh Nagar	Nanakheda	RD Gardi
1	pH		7.21	8.18	8.42	8.06	7.93
2	Conductivity	µs/cm	780	770	720	700	1155
3	Turbidity	NTU	0.2	0.4	0.3	0.2	0.8

4	Alkalinity	mg/L	353	306	329	259	342
5	TDS	mg/L	520	545	535	493	879
6	TSS	mg/L	6	8	8	6	12
7	Total Hardness	mg/L	152	160	142	187	351
8	Calcium	mg/L	40	48	28	44	57
9	Magnesium	mg/L	13	10	16	18	50
10	Chloride	mg/L	246	246	232	160	212
11	Sulphate	mg/L	45	40	46	42	44
12	Fluoride	mg/L	0.76	0.75	0.54	0.72	0.5

pH

From Tables 1 to 4 it is seen that the pH value of all the samples ranges between 6.7 and 8.4. The lowest value is observed for water sample Indore-2 whereas higher pH values were observed in sample Ujjain-3 while other water samples showed good pH values. It is also observed that all the water samples lie in the range of 6.5 – 8.5 prescribed by Indian Standards for Drinking Water.

Conductivity

This parameter indicates the presence and concentration of electrolytes in water. Electrical conductivity (EC) is a useful tool to evaluate the purity of water. Maximum EC is recorded for sample Ujjain-5 (1155 μ mhos/cm) and the minimum for sample Indore-3 (520 μ mhos/cm). In general the EC for nearly all the samples is well within the prescribed limits.

Turbidity

The turbidity analysed in all the 20 sampling stations shows the turbidity value <1 NTU, which is well in the prescribed limits for water.

Alkalinity

The values of alkalinity in the water samples varied from 94 - 470 mg/L. Alkalinity of nearly 60% of the samples have crossed the desirable limit of 200 mg/ L and are very close to the permissible limit of 600 mg/L prescribed by Indian Standards for drinking water. The value of 470 mg/L is observed for water sample Indore-4.

Total Dissolved Solids

The Total Dissolved Solids (TDS) of the water samples ranged from 365 mg/L to 879 mg/L. TDS value of 365 mg/L is shown by sample Indore-3, whereas water sample Ujjain-3 showed a value of 879 mg/L. All the samples lie within the permissibility of 2000 mg/L for drinking water as per Indian Standards.

Hardness

Total Hardness of the analyzed water samples have been found to vary from 112 to 336 mg/L. All the samples are within the permissible value of 600 mg/ L. The hardness is mainly due to calcium and magnesium salts soluble in water.

Calcium

Calcium ions contribute the greatest portion of the hardness occurring in natural waters. The concentration of Ca⁺⁺ varies from 32 to 88 mg/L. The minimum and maximum concentrations of Ca⁺⁺ have been observed for sample Indore-3 and Indore-4 respectively. For all water samples the values for calcium are well below the permissible limit prescribed by Indian Standards for Drinking Water (Ca⁺⁺ = 200 mg/L).

Magnesium

Magnesium ion (Mg⁺²) concentration is seen to vary from 8 to 50 mg/L, being minimum again for sample Indore-3 and the maximum value for sample Ujjain-5. All the samples show values well below the permissible limit prescribed by Indian Standards for Drinking Water (Mg⁺⁺ = 100 mg/L).

Chloride

Chloride salts in excess of 100 mg/L give salty taste to water particularly when sodium and potassium ions are also present in water. Calcium and magnesium chlorides are reported to increase the corrosive activity of water. It is therefore recommended that chloride content should not exceed 250 mg/L. Its highest concentration has been recorded for water samples Indore-5, Bhopal-1, Bhopal-2, Bhopal-4 and Bhopal-5 which is seen to be at the upper limit.

Sulphate

Sulphate ion concentration is varying from 14 to 97 mg/L and these values are within the desirable limits prescribed by Indian Standards for Drinking Water (200 mg/L).

Fluoride

Fluoride concentration for water samples varies from 0.27 to 0.86 mg/L. The values for fluoride ion concentration are seen to be less than the permissible limit prescribed by Indian Standards for Drinking Water (1.5 mg/L).

IV. CONCLUSION

The physico-chemical analysis data for all the 20 sampling sites of the 4 cities of Madhya Pradesh show that only alkalinity is above the permissible limits prescribed by Indian Standard. Hence the water from these sampling stations is fit for domestic purpose and are potable after disinfection.

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