

Physico-Chemical Characteristics of Open Well Water of Some Selected Villages of Manoharthana Block in Jhalawar District (Rajasthan)

¹, **Bharat Singh Meena*, ¹*Manju Meena*

¹Department of Chemistry, Government College, Kota- 324001, Rajasthan, India

*Corresponding author

E-mail: meenabharat81@gmail.com

Abstract: This study focused on the determination of physico-chemical characteristics of the open well water samples of Manoharthana Block of Jhalawar District. With the help of standard methods, we assessed the seasonal results of Manoharthana Block. Sampling was done during three seasons (summer, rainy and winter) throughout the one year from 30 villages of this block (November, 2010 to October, 2011). The physico-chemical parameters like pH, turbidity, total dissolved solids, total hardness and concentrations of ions like chloride, fluoride, nitrate and sulphate were analyzed to know the present status of the open well water quality. The results were compared with the drinking water standards of ISI (10500-91) and WHO (1973). It was found that the open well water was contaminated at few sampling sites. The remaining sampling sites shows physicochemical parameters within the water quality standards and the quality of water is good and it is fit for drinking purpose.

Keywords: Open well water, Drinking water, Physicochemical parameters, Water quality standards.

I. INTRODUCTION

The main resource of fresh water is the groundwater, which is commonly used for domestic, irrigation and industrial purposes. The domestic and agricultural activities in towns and villages entirely depend on the groundwater and hence, the importance of groundwater quality (Sinha and Saxena 2006; Wagh et al., 2009).

The groundwater or surface water quality is a function of natural influences and human activities either severally or collectively. Without human influences, water quality would be influenced only by the natural processes such as weathering of bedrock minerals; atmospheric processes involving evapotranspiration; deposition of dust and salt by wind; natural leaching of organic matter and nutrients from soil; hydrological factors leading to run-off; and biological processes in the aquatic environment that may bring about changes in the physical and chemical composition of water. Thus, water in the natural environment may contain dissolved substance as well as non-dissolved particulate matter. Minerals and dissolved salts are necessary components of good quality water as they help maintain the health and vitality of organisms that rely on this ecosystem service (Stark et al., 2000, Kalshetty et al., 2011).

Ground water in shallow aquifers is generally suitable for use for different purposes and is mainly of Calcium bicarbonate and mixed type. However, other types of water are also available including Sodium-Chloride water. The quality in deeper aquifers also varies from place to place is generally found suitable for common uses. Only in some cases, ground water has been found unsuitable for specific use due to various contaminations mainly because of geogenic reasons (Reza et al., 2009; Mahananda et al., 2010).

Hence a continuous monitoring on groundwater becomes mandatory in order to minimize the groundwater pollution and have control on the pollutants. This study involves the determination of physical and chemical parameters of open well water of Manoharthana Block at different villages. The objective of this study is to assess the present water quality, through analysis of some selected water quality parameters like pH, turbidity, total dissolved solids, total hardness & concentrations of ions like chloride, fluoride, nitrate, sulphate and compare the results with the standards values recommended by ISI and WHO.

II. EXPERIMENTAL

2.1 Study area

Jhalawar district located in the south-east of Rajasthan, between the longitudes of 75° 27' 35" to 76° 56' 48" East and latitudes of 23° 45' 20" to 24° 52' 17" North, adjoining the neighbouring state of Madhyapradesh. Manoharthana village is located in Manoharthana Tehsil of Jhalawar district in Rajasthan, India. Groundwater in weathered basalt occurs under water table condition. Thickness of weathering in basalt ranges maximum up to 20 meter. Ground water in compact basalt occurs under water table condition in the joints and fractures.

2.2 Methodology

Open well water samples were collected from 30 villages of Manoharthana Block in 2010-2011. Samples were collected in clean polythene bottles pre-washed with dilute hydrochloric acid and rinsed three to four times with the water samples before the samples were stored at a temperature below 40° C prior to analysis in the laboratory. The physico-chemical parameters such as pH, turbidity, total dissolved solids, total hardness & concentrations of ions like chloride, fluoride, nitrate, sulphate were determined by using standard methods (APHA, AWWA, 1998). Specific reagents were used for the analysis and double distilled water was used for preparation of solutions. Location of Sampling Stations of Manoharthana Block in Jhalawar District is shown in the Figure 2.2.1.

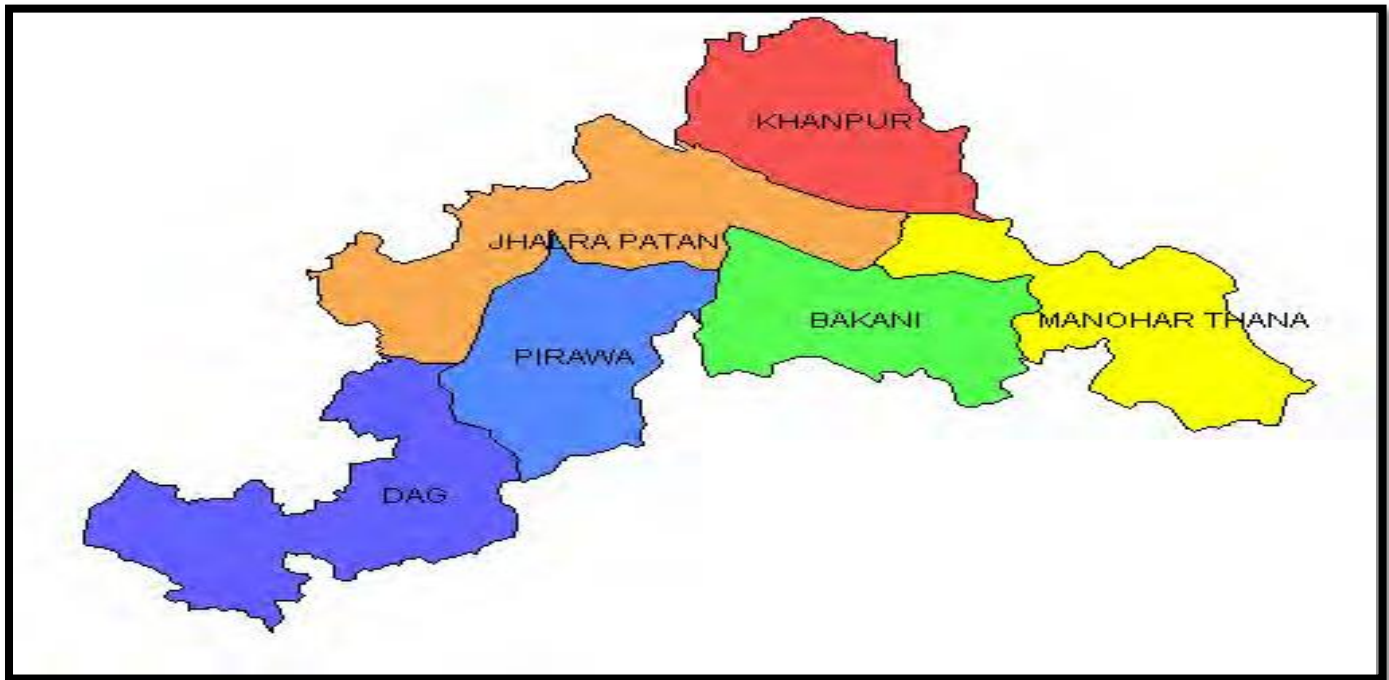


Figure 2.2.1: Location of Sampling Stations of Manoharthana Block in Jhalawar District

III. RESULT AND DISCUSSIONS

Open well water samples of Manoharthana Block were collected and analysed as per standard methods. With the help of these, we assessed the seasonal results of Manoharthana Block. Sampling was done during three seasons (summer, rainy and winter) throughout the one year from various villages of this block (Nov., 2010 to Oct., 2011). Results of three seasons physico-chemical parameters are shown in Table 3.1 and minimum, maximum and average concentration of various physico-chemical parameters are represented by Figure 3.1.

Table 3.1: Physico-Chemical Parameters of Open Well Water of Manoharthana Block

S.No.	Sample No.	Villages	Season	pH	Turbidity (NTU)	TDS (mg/l)	TH (mg/l)	Cl ⁻ (mg/l)	F ⁻ (mg/l)	NO ₃ ⁻ (mg/l)	SO ₄ ⁻² (mg/l)
1	S ₁	Ametha	Summer	7.18	6.9	1070	482.1	302.8	1.22	65.8	8.7
			Rainy	7.42	7.4	1140	505.8	337.5	1.39	83.9	21.4
			Winter	7.39	7.1	1110	512.3	342.9	1.34	80.6	12.9
2	S ₂	Anwarhera	Summer	8.16	5.8	620	222.4	140.2	0.93	12.7	28.4
			Rainy	8.09	6.4	690	200.1	149.5	1.04	25.9	13.7
			Winter	7.92	6.1	710	215.3	153.8	0.97	17.5	18.5
3	S ₃	Baneth	Summer	8.62	6.1	930	351.6	267.4	1.08	73.7	23.8
			Rainy	8.43	5.8	1040	305.8	302.9	0.99	70.8	16.4
			Winter	8.51	6.4	980	335.4	298.8	0.92	59.6	26.9
4	S ₄	Banskhera	Summer	8.68	1.5	800	376.6	51.7	1.01	19.7	14.7
			Rainy	8.49	2.3	890	392.5	89.6	1.17	28.5	19.2
			Winter	8.62	2.7	920	388.5	50.9	1.11	23.9	26.8
5	S ₅	Barrawada	Summer	8.65	6.4	1200	399.7	69.8	1.16	20.1	17.6
			Rainy	8.51	7.8	1270	405.4	52.7	1.09	32.7	31.5
			Winter	8.72	5.9	1250	387.2	64.1	0.98	25.8	24.7
6	S ₆	Chandipur	Summer	8.53	10.4	1080	468.2	205.8	0.86	72.7	15.6
			Rainy	8.46	11.2	1110	442.3	212.4	0.97	85.8	29.5
			Winter	8.32	11.7	1040	455.8	181.8	0.91	81.2	21.9
7	S ₇	Chureliya	Summer	8.09	9.1	620	405.7	393.7	0.95	74.3	37.7
			Rainy	8.27	8.9	690	432.3	410.8	1.09	61.7	26.8
			Winter	8.21	8.3	740	420.8	392.5	1.12	72.8	28.9
8	S ₈	Dangipura	Summer	8.94	10.3	970	295.1	100.9	1.42	19.5	22.3
			Rainy	9.13	9.7	1110	264.3	153.8	1.69	26.7	33.7
			Winter	9.06	9.5	1050	288.6	148.9	1.71	23.5	21.8
9	S ₉	Deorikalan	Summer	7.77	11.5	970	482.2	234.7	1.19	56.5	27.9
			Rainy	7.89	12.3	1020	505.4	202.6	1.22	65.4	15.4
			Winter	7.85	13.1	1100	498.3	222.5	1.26	72.9	20.2
10	S ₁₀	Garboliya	Summer	7.42	16.2	1110	489.3	196.5	1.17	71.7	8.4
			Rainy	7.59	18.7	1180	509.2	172.3	1.12	84.9	16.7
			Winter	7.55	17.9	1210	522.4	205.9	1.06	80.9	12.9
11	S ₁₁	Jawar	Summer	8.46	15.3	1220	567.8	244.7	1.16	65.7	20.3

			Rainy	8.62	16.4	1290	592.7	272.4	1.23	84.5	34.5
			Winter	8.59	16.7	1350	588.3	265.8	1.27	81.8	28.9
12	S ₁₂	Kamkhera	Summer	6.85	13.0	880	302.8	57.4	0.82	21.4	16.7
			Rainy	7.09	13.4	950	337.4	75.8	0.93	32.5	29.8
			Winter	6.95	14.1	880	321.3	65.3	0.88	28.9	18.9
13	S ₁₃	Kharpa	Summer	7.02	16.8	930	520.4	241.3	0.97	66.4	11.3
			Rainy	7.29	17.8	1100	537.8	258.7	1.09	82.2	31.4
			Winter	7.23	17.9	1190	512.6	262.8	1.03	76.7	24.3
14	S ₁₄	Khatakheri	Summer	8.86	5.3	1150	288.2	85.7	1.56	29.5	8.5
			Rainy	8.99	6.4	680	319.5	102.3	1.73	41.8	14.6
			Winter	9.02	6.1	630	301.5	95.6	1.69	33.4	10.5
15	S ₁₅	Kherkhera	Summer	8.88	3.8	590	338.4	99.1	0.96	18.5	20.3
			Rainy	8.93	4.9	740	302.4	88.3	1.08	32.7	32.2
			Winter	8.74	2.9	810	322.8	111.5	1.17	24.5	27.8
16	S ₁₆	Lahas	Summer	9.19	1.6	890	277.4	41.4	1.54	11.4	48.9
			Rainy	9.12	3.2	650	318.3	54.9	1.67	25.4	37.5
			Winter	9.01	2.1	730	307.3	48.3	1.78	17.5	31.8
17	S ₁₇	Manapsar	Summer	8.91	10.4	580	396.2	135.4	1.74	29.5	10.1
			Rainy	9.13	12.4	800	381.1	149.8	1.89	42.4	21.2
			Winter	9.22	9.3	890	372.5	157.3	1.84	38.6	15.6
18	S ₁₈	Manoharthana	Summer	7.25	0.7	850	376.2	112.7	0.76	42.3	17.5
			Rainy	7.18	1.3	780	410.3	136.8	0.85	47.8	22.8
			Winter	7.32	0.5	870	399.3	127.6	0.89	55.9	20.4
19	S ₁₉	Methoon	Summer	8.25	1.2	910	555.8	325.7	0.72	56.7	32.7
			Rainy	8.43	2.7	1250	584.5	342.5	0.65	62.3	44.8
			Winter	8.34	2.9	1330	576.3	318.9	0.52	71.4	39.5
20	S ₂₀	Mishroli	Summer	7.79	5.4	690	279.8	91.4	0.74	19.4	21.3
			Rainy	7.94	4.9	580	307.4	113.7	0.95	35.7	35.5
			Winter	7.89	4.1	540	297.1	102.8	0.91	28.8	28.7
21	S ₂₁	Nayapura	Summer	8.32	11.4	450	192.5	79.3	0.92	19.5	29.4
			Rainy	8.54	12.8	610	234.8	100.8	1.02	32.8	42.5
			Winter	8.49	12.1	650	218.7	92.5	0.99	27.9	31.3
22	S ₂₂	Pindola	Summer	9.06	0.9	890	439.3	115.7	1.27	41.3	18.5
			Rainy	9.13	0.8	850	415.8	93.3	1.38	46.5	32.4
			Winter	9.21	1.1	810	399.4	102.7	1.31	51.4	16.8
23	S ₂₃	Ranwasya	Summer	8.99	7.2	740	388.3	108.7	0.96	50.7	49.7
			Rainy	9.17	7.8	780	402.7	88.6	1.07	42.4	38.4
			Winter	9.09	7.9	810	419.7	99.8	0.99	47.8	36.8
24	S ₂₄	Samrol	Summer	8.62	0.6	680	335.3	97.9	1.46	45.9	9.5
			Rainy	8.89	1.2	600	282.4	88.4	1.57	29.4	17.7
			Winter	9.15	1.1	650	318.7	111.3	1.62	38.3	11.5
25	S ₂₅	Sareri	Summer	7.81	5.4	550	308.1	96.5	1.28	40.6	15.8
			Rainy	7.89	6.3	620	276.3	64.2	1.19	31.2	36.7
			Winter	7.84	6.8	590	299.5	85.8	1.24	44.1	29.5
26	S ₂₆	Shorti	Summer	8.47	3.7	700	418.7	88.7	1.51	43.4	25.6
			Rainy	8.36	5.4	740	386.7	112.3	1.47	38.5	43.2
			Winter	8.41	4.8	770	402.3	101.6	1.54	29.2	38.3
27	S ₂₇	Tharaul	Summer	7.88	1.9	830	489.7	76.9	1.28	53.4	14.3
			Rainy	7.69	2.4	790	482.5	109.3	1.39	50.8	22.2
			Winter	7.96	2.1	880	470.4	98.7	1.33	45.5	27.3
28	S ₂₈	Theekriya	Summer	7.82	5.7	750	378.2	128.2	0.94	43.9	28.5
			Rainy	8.05	6.9	820	412.2	100.4	1.08	38.6	24.3
			Winter	7.99	7.2	700	399.2	115.8	0.99	23.5	18.4
29	S ₂₉	Thhanawad	Summer	8.86	8.2	1010	456.8	131.4	0.91	41.2	39.4
			Rainy	9.09	7.8	1080	488.0	102.5	1.09	52.4	45.8
			Winter	9.01	7.4	980	477.3	115.6	0.94	49.9	20.5
30	S ₃₀	Turkariya	Summer	9.24	11.5	1100	492.9	99.8	1.11	51.4	17.1
			Rainy	8.86	10.2	1170	509.3	127.7	1.29	62.5	40.8
			Winter	8.57	11.3	1140	521.3	118.8	1.34	58.6	30.6

3.1 pH: pH values ranged between 6.85 mg/l to 9.24 mg/l during one year samplings. The average value of pH was 8.32. The sampling points S₃, S₄, S₅, S₆, S₈, S₁₁, S₁₄, S₁₅, S₁₆, S₁₇, S₂₁, S₂₂, S₂₃, S₂₄, S₂₉ and S₃₀ showed higher pH values then prescribed

limit given by ISI. The minimum value of pH was monitored in sample S₁₂ and the maximum value of pH was viewed in sample S₃₀ respectively.

- 3.2 Turbidity:** The data table reveals that the turbidity values in one year varied from 0.5 NTU to 18.7 NTU for all open well water samples and they all were below permissible limits recommended by WHO standards except samples S₆, S₈, S₉, S₁₀, S₁₁, S₁₂, S₁₃, S₁₇, S₂₁ and S₃₀. The minimum value of turbidity was observed in sample S₁₈ and the maximum value of turbidity was found in sample S₁₀. The average value of turbidity was 7.52 NTU for one year.
- 3.3 Total Dissolved Solids (TDS):** TDS values varied between 450 mg/l to 1350 mg/l. The sampling points S₁, S₃, S₅, S₆, S₈, S₉, S₁₀, S₁₁, S₁₃, S₁₉, S₂₉ and S₃₀ showed higher TDS values than prescribed limit given by WHO. The minimum value of TDS was found in sample S₂₁ and the maximum value of TDS was detected in sample S₁₁. The average value of TDS was 914.21 mg/l.
- 3.4 Total Hardness (TH):** TH values ranged between 192.5 mg/l to 592.7 mg/l during one year samplings. The sampling points S₁, S₉, S₁₀, S₁₁, S₁₃, S₁₉ and S₃₀ showed higher TH values than prescribed limit given by WHO. The average value of TH was 398.52 mg/l. TH was monitored in sample S₂₁ as minimum value and TH was monitored in sample S₁₁ as maximum value.
- 3.5 Chloride (Cl⁻):** Chloride values ranged from 41.4 mg/l to 410.8 mg/l and the average value of chloride was 152.76 mg/l all of the studied samples of one year. It was notice that S₁, S₃, S₇, S₁₁, S₁₃ and S₁₉ open well water samples have more chloride as compare to WHO permissible limit. The minimum value of chloride was examined in sample S₁₆ and the maximum value of chloride was scrutinized in sample S₇.
- 3.6 Fluoride (F⁻):** Fluoride values were varied from 0.52 mg/l to 1.89 mg/l and the average value of fluoride was 1.17 mg/l all of the studied samples of one year. All samples were lesser values than the prescribed WHO standards except sample S₈, S₁₄, S₁₆, S₁₇, S₂₄ and S₂₆. In sample S₁₉ minimum value of fluoride was observed and in sample S₁₇ maximum value of fluoride was surveyed.
- 3.7 Nitrate (NO₃⁻):** The data table reveals that the nitrate values in one year varied from 11.4 mg/l to 85.8 mg/l and the average value of nitrate was 46.33 mg/l. The sampling points S₁, S₃, S₆, S₇, S₉, S₁₀, S₁₁, S₁₃, S₁₈, S₁₉, S₂₂, S₂₇, S₂₉ and S₃₀ showed higher nitrate values than prescribed limit given by WHO. The minimum value of nitrate was found in sample S₁₆ and the maximum value of nitrate was detected in S₆.
- 3.8 Sulphate (SO₄²⁻):** All values of sulphate were under recommended standards in one year sulphate values varied between 8.4 mg/l to 49.7 mg/l. The minimum value of sulphate was found in sample S₁₀ and the maximum value of sulphate was detected in sample S₂₃. The average value of sulphate was 25.06 mg/l.

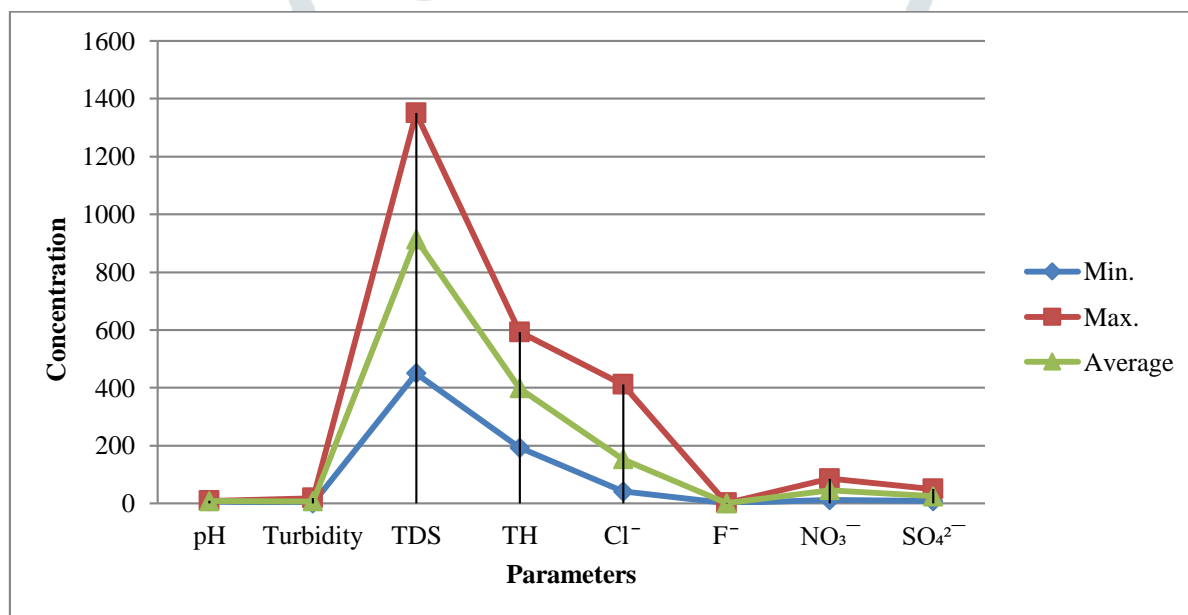


Figure 3.1: Minimum, Maximum & Average Concentration of Various Parameters in Manoharthana Block

IV. CONCLUSION

From the observations, it may be concluded that the values of SO₄²⁻ are within permissible standard limits but more than 46 % of the studied samples were high in pH, TDS, Turbidity, TH, Cl⁻, F⁻ and NO₃⁻ which suggest that these samples have poor water quality on critical limit.

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