EVOLUTION OF GROUND WATER PHYSICAL-CHEMICAL PARAMETERS OF SOUTH-WEST ZONE OF THE ALWAR CITY (RAJASTHAN), INDIA

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Abstract – The assessment of ground water quality for suitability for potable and domestic purposes was carried out from Alwar city (Rajasthan). The objective of this study is to identify the quality of groundwater in Alwar city areas where groundwater is used for drinking and domestic purposes. Fourteen ground water samples were collected from different places of south-west zone in Alwar city. The present investigation is focused on the determination of physical-chemical parameters pH, Color, Odour, Turbidity, Taste, TDS, Total Hardness, Mg Hardness, Chloride, Nitrate, Fluoride, Arsenic, Ironand Zinc. The groundwater parameters were compared with WHO and BIS standards. The groundwater of few areas was not much useful for drinking.

INTRODUCTION

The fast pace of urbanization in India is creating a formidable problem of instantiation and pollution of aerial, terrestrial, aquatic and land lives of country. In India, there are 5 thousand big and middle size industries. In Bombay, Calcutta and Delhi, the Industries pollute only 13.11 and 10% of water, respectively the rest pollution is due to domestic waste. In Cities, the available water is being indiscriminately polluted by domestic and industrial effluents, so much so, that factory wastes in many industrial towns have contaminated the underground water resources due to sewage. Every day the effluent from large number of big and small industrial units are swept into various rivers of India without treatment. A large amount or various metals, plastics, pesticides, urea, nitrogen, ammonia, chlorine and other toxic materials are liberally let out in to big rivers of the country. Generally, water contains iron, calcium, magnesium, manganese, silica. fluoride, nitrate, phosphate, sulfates and chlorides. When the quantity of these elements increases, they affect the body systems and cause destruction of health, Arsenic salts can create cancer, cadmium affects kidney while barium carbonate has bed effects on vein, nerves and heart.

Excess of fluoride affects teeth and causes a disease called "Fluorosis". The presence of manganese in water causes loss of memory, impotence and eye diseases. Mercury poisoning system include loss of vision, hearing and of intellectual abilities.

Besides industrial waste, the use of pesticides like D.D.T. has posed a serious water pollution problem and a potential hazard not only to live stock and wild life but also to fish and other animals. Some of the common diseases transmitted through polluted water are hepatitis, dysentery, typhoid, malaria, yellow fever, dengue, trachoma, flue and tuberculosis, In India, about 164 million children in rural areas do not have access of safe drinking, water, diarrhea accounts for 8.8 percent of deaths in the 0-1 age group, 19.8 percent in the 1-4 age group and 15.4 percent in the 5-15 age group. More than 2000 chemical contaminants of different kinds have been identified in water. About 750 of these have been found in drinking water. In these more than 600 are organic substance. Many of them are pharmacologically active and are even carcinogenic. The acute health problems associated with chemical constituents arise primarily from their ability to cause adverse cumulative effects after prolonged consumption of the polluted water. Protection of water sources and supplies from


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contamination is the first line of defence. It is always better to protect water from contamination than to treat after it has been contaminated. Thus, source protection is invariably the best method of raw water protection. Many protection problems can be prevented by safeguarding the integrity of raw water sources and its watershed by proper maintenance and inspection of the distribution system. The watershed should be protected from human activities. This could include isolation/control of the watershed from polluting activities such as dumping of hazardous wastes, mining and quarrying, agricultural use of fertilizers and pesticides and the regulation of recreational activities in the area. Some potentially hazardous chemicals in drinking water are derived from treatment chemicals and construction materials used in water supply systems. Such chemicals can be controlled by specified procedures. It is important to ensure that quality of drinking water is satisfactory before a new source is selected. Regular and adequate monitoring is essential to ensure continuing compliance with drinking water quality standards. Once a potentially hazardous situation has been recognized it may be practical and cost effective to use alternative water sources. In areas where alternative sources are not available, it is necessary and preferred to treat a contaminated water supply to render it suitable for drinking. Urgent steps should be taken to check the increasing water pollution; otherwise, pure drinking water would be a big problem after some time. The physio-chemical properties were compared with WHO and ISI standards. The present study deals with study of physical-chemical parameters of ground water in South- West Zone of Alwar city.

MATERIALS AND METHODS

Study Area: Rao Pratap Singh founded the study area Alwar in 1775. According to Cunningham the name of Alwar city has been taken from the salwar tribe which was originally Salwapur. Alwar lies in the north-east part of the state and it is one of the thirty-three (33) districts of the Rajasthan. It is situated in North-East of Rajasthan between $27^0 04'$ and $28^0 04'$ North latitude and $76^0 07'$ and $77^0 13'$ East longitudes covering a geographical area of about 8380 sq. km. It is situated among north-east by Gurugram district of Haryana and Bharatpur district of Rajasthan on the south-west by Jaipur and south by Dausa district. At present population of

Alwar city is about four lakes. So far water resources have not been utilized for drinking water. The drinking water means of the city are like tube wells, dug wells, Alwar city was divided into four zones viz. north-east, south-east, north-west, and south-west by assuming the Hope-circus as Centre point of the city during the study. Present study was carried out south-west zone only.
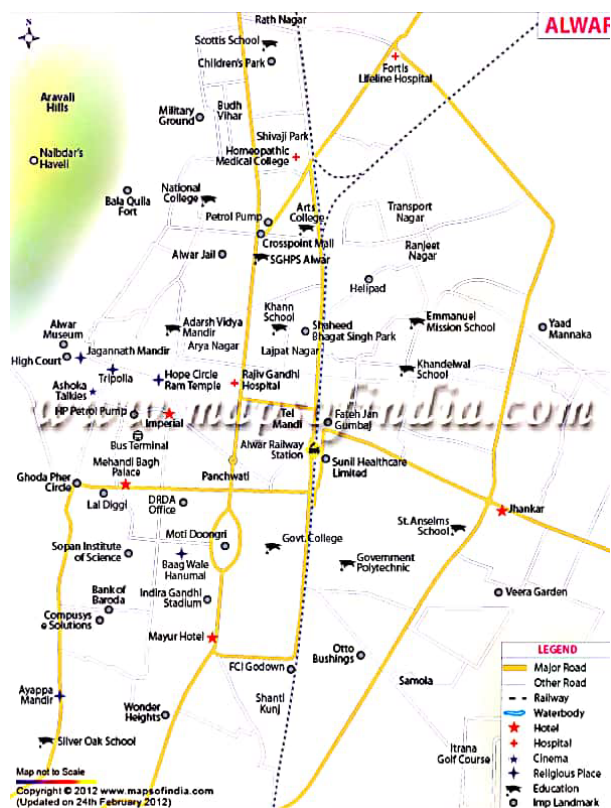
Alwar city (Rajasthan), India

Sampling of water samples: Samples were collected in plastic bottles of 1liter. Propylene bottles using standard procedure of grab or catch as per the methods of APHA. The samples were collected from PHED bore wells as well as from deep hand pumps at different seasons. It is proved by sample analysis in the laboratory. The bottles were absolutely scrub with Hydrochloric acid and then washed with mineral water rendered free of acid and then washed with distilled water twice and again rinsed. Samples of water collected in bottles with leaving a small air gap at the top. The bottle were sealed with paraffin wax. All the glassware, casserole and other pipettes were first cleaned with tap water thoroughly and finally with deionized distilled water. Burette was rinsed

with chemical before last used. For the analysis, the standard methods were followed. The chemical was used for analysis were annular grade. In this process parameters like pH meter, conductivity meter, and flame photometers instruments were used. These results were compared with BIS drinking water standards. Summary of results is given in the Table 4.

RESULTS AND DISCUSSION

Results of analysis has presented in Table 2 and 3. pH is considered an important ecological factor and piece of information in many types of geochemical equilibrium. The range of pH of ground water samples was found from 6.4 to 8.3 for pre-monsoonsamples and 6.4 to 8.5 for post monsoon samples, both samples are varying from 6.5 to 8.5 and these are within range according BIS standard. The colour of ground water samples of pre-monsoon and post monsoon are not same. Panchwati and Alwar railway station samples have slightly brown color and sample of Ayuppamandir has radishcolour due to iron content in post monsoon samples. Samples taken in pre-monsoon season only Laldigge sample seen also slightly brown color. Definitely order is symptomatic of organic and inorganic pollutant that arises from natural sources in the ground water samples. It can be evaluated by a taste test. Turbidity of the South – West zone was found within the range 1 to 5. The values for the pre-monsoon samples were found 1.79 to 4.85. In post

monsoon samples, the range of turbidity was found 1.58 to 4.30.

The Table 2 and 3 also revealed that the values of total hardness vary from 336 to 710 mg/l for the pre-monsoon samples and Mg hardness varies from 29.6 to 48.2 mg/l respectively. For the post monsoon samples range of TH was found 348 to 860 mg/l and Mg Hardness range, 28.3 to 44.7 mg/l respectively. TH is in limit in both sessions according to BIS parameters. The chloride contents in the all-ground water samples were found in the range from 96.5 to 294.4 mg/l and 105 to 398 mg/l for the pre and post monsoon samples respectively. Almost samples have chloride values under limits for the pre-monsoon samples as compare to BIS-10500-2012 desirable limits. TDS in groundwater originate from natural sources, sewage, urban run-off and industrial wastes**. The total dissolved solids for pre-monsoon samples which was found between 324 to 1590 mg/l. The Table indicate that Alwar railway station, Laldiggi and Indra Gandhi Stadium area samples have higher value than the permissible limits. The values for the post monsoon sample range 540 to 1645 mg/l and Laldiggi, Alwar railway station area samples have higher TDS value than the permissible limits. It may be finishing that all water sources have more TDS value than the advisable limits. The values of nitrate for the pre-monsoon samples 12.4 mg/l to 41.3 mg/l and for post monsoon samples, 12.8 mg/l to 43.8 mg/l. All ground water samples have under limit value of nitrate than the desirable limits according to BIS-10500-2012. Fluoride range in this

Table 1. Drinking water standards (IS: 10500-2012)

S. No.	Parameters	Desirable limit mg/l (ppm)	Permissible limit in the absence of alternate source (ppm)
1	Colour (Hazen Units)	5	15
2	Odour	Agreeable	Agreeable
3	Taste	Agreeable	Agreeable
4	Turbidity, (NTU)	1	5
5	pH value	6.5-8.5	No Relaxation
6	Total Hardness (as $CaCO_3$), mg/l	200	600
7	Iron (Fe), mg/l	0.3	No Relaxation
8	Chloride (as Cl), mg/l	250	1000
9	Total Dissolved Solids, mg/l	500	2000
10	Magnesium Hardness (as Mg), mg/l	30	100
11	Arsenic as As (mg./l)	0.01	0.05
12	Zink as Zn, (mg/l)	5	15
13	Fluoride (as F), mg/l	1.0	1.5
14	Nitrate (as No_3), mg/l	45	No Relaxation

Table 2. Physical and chemical parameters of South- West zone (Alwar city): Pre- monsoon samples

Location /Source	PH	Color	Odour	Turbidity	Taste	Cl-	NO3-	TDS	F-	As	Fe	Zn	Total Hardness	Mg-Hard Ness
Kala kuan	7.12	Clear	UOA	4.85	Agreeable	96.5	15.4	324	0.56	ND	0.20	ND	336	27.0
Housing Board	6.40	Clear	UOA	1.79	Agreeable	126.8	12.4	440	0.64	ND	0.30	ND	389	25.6
Aravalivihar	7.14	Clear	UOA	2.98	Agreeable	112.2	13.8	1056	1.62	ND	0.32	ND	389	16.5
Mahandi Bagh place	6.85	Clear	UOA	2.82	Agreeable	108.4	18.0	598	0.58	ND	1.10	ND	468	26.3
Panchwati	6.91	Clear	UOA	2.88	Agreeable	110.0	16.8	482	0.38	ND	0.36	ND	478	20.2
DRD office	6.96	Clear	UOA	2.56	Agreeable	116.4	18.7	632	0.96	ND	0.45	ND	346	30.9
Laldiggi	6.81	Slightly Brown	UOA	3.66	Agreeable	126.0	41.3	1203	0.69	ND	1.82	ND	523	28.5
Ghoda Pher circle	7.04	Clear	UOA	2.92	Agreeable	131.1	29.5	643	0.73	ND	0.4	ND	385	18.0
Sopan institute of science	7.0	Clear	UOA	1.82	Agreeable	129.3	18.9	352	0.63	ND	1.2	ND	406	25.0
Indira Gandhi stadium	8.3	Clear	UOA	1.91	Agreeable	121.0	17.4	980	0.94	ND	0.31	ND	355	48.2
Ayuppa mandir	7.10	Clear	UOA	1.74	Agreeable	124.1	18.4	414	0.38	ND	0.25	ND	412	36.9
Shanti kunj Motidungri	7.22	Clear	UOA	1.65	Agreeable	102.0	25.6	660	0.30	ND	0.36	ND	478	31.2
Alwar railway station	6.50	Reddish	OA	3.69	Agreeable	262.0	40.3	1590	1.90	ND	1.3	ND	710	12.6
Silver oak school	6.59	Clear	UOA	2.82	Agreeable	294.4	32.9	609	0.66	ND	0.36	ND	482	28.5

UOA = Unobjectionable   (OA=Objectionable)   (ND = Not Detectable)

Table 3. Physical and chemical parameters of South -West zone: post-monsoon samples

Location /Source	pH	Colour	Odour	Turbidity	Taste	Cl-	NO3-	TDS	F-	As	Fe	Zn	Hardness	Mg-Hardness
Kala Kuan	7.1	Colorless	UOA	2.63	Agreeable	230	13.2	864	0.4	ND	0.3	ND	452	20.0
Housing Board	6.9	Clear	UOA	1.68	Agreeable	356	12.8	698	0.3	ND	0.5	ND	348	28.0
Aravalivihar	7.3	Clear	UOA	1.89	Agreeable	105	35.1	540	0.9	ND	0.4	ND	680	24.0
Mahandi Bagh place	8.0	Clear	UOA	2.02	Agreeable	216	35.8	980	0.3	ND	0.2	ND	518	28.5
Panchwati	7.9	Slightly brown	OA	2.62	Agreeable	291	43.8	1256	1.5	ND	1.0	ND	458	30.0
DRD office	7.1	Clear	UOA	1.89	Agreeable	198	41.3	926	0.6	ND	0.5	ND	468	38.5
Laldiggi	6.5	Clear	OA	3.01	Agreeable	245	40.0	1022	2.1	ND	0.2	ND	657	44.7
GhodaPher circle	8.0	Clear	UOA	0.98	Agreeable	256	38.5	688	1.9	ND	0.3	ND	458	25.6
Sopan institute of Science	7.5	Clear	UOA	2.63	Agreeable	198	34.0	782	1.1	ND	0.5	ND	365	18.0
Indira Gandhi stadium	8.1	Clear	UOA	2.52	Agreeable	301	17.9	980	1.6	ND	1.1	ND	483	36.5
Ayuppa mandir	7.2	radish	UOA	1.58	Agreeable	315	19.5	874	0.9	ND	0.8	ND	518	19.6
Shanti Kunj Motidungri	6.8	Clear	UOA	1.87	Agreeable	158	25.9	650	1.0	ND	0.7	ND	498	22.0
Alwar Railway Station	8.5	Slightly Brown	OA	4.30	Agreeable	398	40.6	1645	2.4	ND	1.35	ND	860	25.0
Silver Oak School	6.9	Clear	UOA	2.36	Agreeable	297	39.4	1450	0.9	ND	0.8	ND	547	38.0

(ND = Not Detectable)   (OA = Objectionable)

Table 4. Drinking water quality status in South – West Zone

Location / Source	Samples Collected			
	Pre –Monsoon	Remarks	Post-Monsoon	Remarks
Kala kuan	Good	In limit	Good	In limit
Housing Board	Good	In limit	Good	In limit
Aravalivihar	Doubtful	TDS Higher	Permissible	TDS Higher
Mahandi Bagh place	Good	In limit	Good	TDS Higher
Panchwati	Doubtful	TH Higher	Permissible	TDS Higher
DRD office	Permissible	TDS Higher	Permissible	TDS Higher
Lal diggi	Unsuitable	NO_3^- TDS,TH Higher	UNSUITABLE	F^-, NO_3^-, TDS, TH Higher
Ghoda Pher circle	Good	In limit	Good	In limit
Sopan institute of science	Good	In limit	Good	In limit
Indira Gandhi stadium	Permissible	TDS Higher	Doubtful	TDS Higher
Ayuppa mandir	Good	In limit	TDS slightly high	TH Higher
Shanti kunj Motidungri	Permissible	TH Higher	Good	In limit
Alwar railway station	Unsuitable	NO_3^-, TDS, TH, Turbidity Higher, color radish	Unsuitable	TDS, THand Turbidity higher, color brown
Silver oak school	Good	In limit	Good	TDS Higher

zone for the pre-monsoon samples varies from 0.3 to 1.9 mg/l and Alwar railway station and Aravalivihar area sample have higher fluoride values then the permissible limits. The fluoride range for the post monsoon samples was found 0.3 to 2.4 mg/l and Alwar railway station, Laldiggi, Aravalivihar have higher fluoride values than the permissible limits. The range of iron for the pre-monsoon samples varies from 0.2 to 1.3 mg/l. Alwar railway station, Sopan Institute of Science and Laldiggi area sources have higher values than the permissible limits. Iron values for the post monsoon samples varies from 0.25 to 1.35 mg/l. Alwar railway station, Laldiggi, Aravalivihar have higher values than the permissible limits in post-monsoon season. The heavy metal arsenic is not detectable in ground water samples for pre and post monsoon samples. The heavy metal zinc is not detectable in ground water samples for pre and post monsoon samples.

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