



## Seasonal Variation of Physico – Chemical Parameters in Ground Water of Gwalior City, MP, India

Navita Maurya\* and Anish C Pandey

Department of P.G. Studies and Research in Chemistry, SLP Govt. PG College (Jiwaji University), Gwalior, India  
navitamaurya@gmail.com

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### Abstract

Water pollution is a global problem of urban cities. Its use is universal – by man, plants and animals because it is essential for life, health and sanitation. Water required for domestic consumption should be free from suspended and dissolved impurities, bacteria etc. As improper sanitation and lack of suitable drainage system causes ground water pollution in the municipal cities. The present study aims to deal with the ground water quality of Gwalior city which is assessed by examining various physico - chemical parameters. Ground water and municipal supplied water samples were collected from fifteen (15) area in Gwalior city during Pre-monsoon (April, May, June) and Post-monsoon (Oct, Nov, Dec) 2010. The physico – chemical parameters such as Temperature, pH, Turbidity, Electrical Conductivity, Total Dissolved Solids, Calcium, Magnesium, Chloride, Dissolved Oxygen, Chemical Oxygen Demand, Total Hardness, Total Alkalinity were analyzed (APHA, 2005) to know the present status of the ground water quality. The results were compared with standards prescribed by ISI 10500-91 and WHO (2008).

**Keywords:** Gwalior ground water, Physico-chemical Parameter, Gwalior, Quality of water.

### Introduction

Water is the physical and chemical basis of life and is essentially required by all life forms. It is due to wrong notion that the ground water has been considered safe for drinking purpose owing to natural geological filtration process<sup>1-2</sup>. Ground water pollution is generally traced at four major sources industrial, agricultural, domestic and over exploitation<sup>3</sup>. The research in India reveal that major reason of ground water pollution is unplanned urban development without adequate attention to sewage and wastage<sup>4</sup>. The water sources like rivers, lakes and ponds have been used as dumping grounds for human sewage and industrial wastes of every conceivable kind many of them have been toxic. Water pollution i.e. changed pH, DO, nitrate, Ca<sup>++</sup>, Mg<sup>++</sup>, alkalinity, microbes level, BOD, COD, etc. from domestic and human wastewater is the main problem for some severe water borne diseases. For example high concentration of fluoride in water (>1.5 ppm WHO limit) causes fluorosis<sup>5</sup>. Fresh water resource is becoming polluted day-by-day at the faster rate of deterioration of the water quality is today's world problem, there are too many private wells (approx 2 million) in addition to the government tube wells (Datta, 2005)<sup>6</sup>. Industrialization without planning of proper treatment and disposal of waste and effluent is other source of ground water pollution excessive application of fertilizers for agricultural development coupled with over irrigation intrusion due to extreme pumping of fresh water. Over burden of the population pressure, unplanned urbanization, unrestricted exploration and dumping of the polluted water at improper place increase the infiltration of harmful matter to the ground

water<sup>7,8</sup>. There are various ways as ground water is contaminated such as use of fertilizer in farming, seepage from effluent bearing water sources<sup>9</sup>. Most of the industries discharge their effluent without proper treatment into nearby open pits or pass them through unlined channels, resulting in the contamination of ground water<sup>10-11</sup>. The incidence of ground water pollution is highest in municipal areas where huge amount of waste are concentrated and discharge into relatively small areas. This study is aims to investigate qualitative analysis of some physico – chemical characteristics of ground water and municipal water in study area, Gwalior city, (M.P.), India.

**Study Area:** Study range Gwalior is located at (Latitude: 26° 13' 25 N, Longitude: 78° 10' 45 E). It has an average elevation of 197 meters (646 feet). It is an historic Indian city located in M.P. It occupies a strategic location in the Gird region of India. Gwalior had a population of 8, 26,919 and population density of 2409/km<sup>2</sup>. Its greater urban area is the 46<sup>th</sup> most populous area in India.

Gwalior has a sub-tropical environment with summers from end of March to early July, the humid season from late June to early October and a cool dry winter from early November to late February. Under *Koppen's climate classification* the gwalior has a humid sub-tropical climate. The highest temperature was 52°C and the lowest was -1°C recorded by IMD.

Gwalior receives 980 mm (39 in) of rain every year (approximate), most of which is concentrated in the monsoon months from July to early October.

**Sample Sites:** The ground water samples were collected from ground water of different location of Gwalior during Pre-monsoon (April, May, June) and Post-monsoon (Oct, Nov, Dec) 2010. The sampling sites of Gwalior are given in Table-1 below.

**Table-1**  
**Sources of different water samples collected from in and around Gwalior**

Locations	Sources	Sampling No.
SLP College	Bore well	S1
C.P.Colony	Bore well	S2
Pinto Park	Bore well	S3
Birla Nagar	Bore well	S4
Maharajpura	Bore well	S5
Gola Ka Mandir	Bore well	S6
Thatipur	Bore well	S7
Mela Ground	Bore well	S8
Baradari Chauraha	Hand Pump	S9
Govindpuri	Bore well	S10
Railway Stations	Bore well	S11
Sindhe Ki Chawani	Municipal Supply	S12
Chetakpuri	Bore well	S13
Phool Bagh	Bore well	S14
Hazira	Hand Pump	S15

## Materials and Methods

The water samples were collected in sterilized bottles and were stored at 4°C till further research. Chemicals used were of analytical reagent grade. Analysis was carried out for various physico – chemical parameters which were measured by standard, APHA methods. The water samples were analyzed for different physico – chemical parameters such as Temperature, pH, Turbidity, Electrical conductivity (EC), Chloride (Cl<sup>-</sup>), Calcium (Ca<sup>2+</sup>), Magnesium (Mg<sup>2+</sup>), Dissolved Oxygen (DO), Total Dissolved Solids (TDS), Chemical Oxygen Demand (COD), Total Alkalinity (ALK), Total hardness (TH), as per standard procedures (APHA, 2005). The ground water quality has been assessed by comparing each parameter with the standard desirable limit of that parameter in drinking water as prescribed by ISI 10500-91.

The concentration of Calcium is estimated by flame photometer (ELICO CL 220). Magnesium ion is estimated by calculate method. Do and BOD will be analysed by winkle’s methods. Total hardness is analysed by EDTA titration using Erio chrome Black T indicator and conductivity measured by conductivity meter. All the other parameters were estimated by using the standard methods<sup>12</sup>.

**Table-2**  
**Physico – chemical parameters of water (standards)**

Parameter used	Unit	WHO (MPL)	ISI (1050091)
Temp	°C	-	-
Turbidity	(NTU)	5.0	10
pH	-	6.5-9.2	6.5-8.5
EC	µmho/cm	300**	400-1000
TDS	mg/l	500	500
DO	mg/l	40-60**	5.0
Total ALK	mg/l	250	200-600
TH	mg/l	100	-
Ca <sup>2+</sup>	mg/l	100	75-200
Mg <sup>2+</sup>	mg/l	50	30-100
Cl <sup>-</sup>	mg/l	200	200-1000
COD	mg/l	10	-
Fluoride	mg/l	1.5	1.5

## Results and Discussion

The physico - chemical properties of Gwalior water sample is as per the above are given in Tables 3 and 4.

**Temperature:** The Temperature was in the range of 30-46°C during Pre-monsoon and 10-32°C during Post-monsoon. The variation sample in water temperature may be due to much timing of collection and impact of season and also due to solar reaction of the city.

**Hydrogen Ion Concentration (pH):** pH of Gwalior water was found to be alkaline in nature in most of the samples and range between 7.3-8.5 in Pre-Monsoon and 7.5-8.5 in Post- Monsoon. As per WHO recommended maximum permissible limit of pH from 6.5 to 9.2. pH value of different water samples are within desirable and suitable range.

**Turbidity:** Turbidity is measure of extend to which light is either scattered or absorbed by the suspended material in water. Turbidity content of the ground water samples ranges from 6 to 9.4 in Pre-monsoon and 6.2 to 9.4 mg/L in Post-monsoon.

**Electrical Conductivity:** EC is for the measure of mineral concentration, was found changing from 0.42 to 0.90 mmho/cm in Pre-monsoon and 0.32 to 0.81 mmho/cm in Post-monsoon.

**Total Hardness:** Hardness is a very important parameter for decreasing the toxic effect of contaminants. The observed hardness range was 150 - 390 mg/L in Pre-monsoon and 152 to 605 mg/L in Post-monsoon. In some areas of Gwalior, the hardness is very high, also above permissible limit. It may be due to rocks bearing salts of Calcium and Magnesium Gwalior region. As per Bureau of Indian Standard the prescribed limit of total hardness is 300 mg/lit and permissible limit in the absence of another source is 600 mg/lit.

**Total Dissolved Solids:** Total Dissolved Solid in study areas ground water samples ranges from 590 to 1032 mg/L in Pre-

monsoon and 600 to 1020 mg/L in Post-monsoon.

**Dissolved Oxygen:** Dissolved oxygen is a very important pollution parameter. The values of DO indicate the degree of pollution in the water bodies. In the present study, The observed DO values were from 5.6 to 7.8 mg/L in Pre-monsoon and 6.0 to 7.8 mg/L in Post-monsoon

**Chemical Oxygen Demand:** COD observed in the ground water samples were ranges from 17.8 to 40.5 mg/L in Pre-monsoon and 17.9 to 41 mg/L in Post-monsoon.

**Calcium and magnesium:** Calcium and Magnesium and their salts are directly related to hardness. Calcium concentration ranges from 53 to 86 mg/L in Pre-monsoon and 53.9 to 81 mg/L in Post-monsoon. Magnesium content in investigated in the water samples ranged from 15.09 to 45.01 mg/L and 10.02 to 25.04 mg/L in Post-monsoon and Pre-monsoon respectively.

**Fluoride:** Fluoride content in the water samples of Gwalior ranges from 0.25 to 0.89 mg/L in Pre-monsoon and 0.40 to 0.90 mg/L in Post-monsoon.

**Table-3**  
**Physico- Chemical Parameters of sampled Groundwater of Gwalior city (in Pre- monsoon)**

Sample No.	Temp (°C)	Odour	pH	Colour	Turbidity (NTU)	EC	TH	TDS	DO	COD	Ca <sup>2+</sup>	Mg <sup>2+</sup>	F <sup>-</sup>
S1	30	OL	8.0	CL	6	0.62	300	925	6.4	30	53	22.23	0.57
S2	35	OL	7.6	CL	7	0.82	330	1000	6.6	35	63	30.02	0.59
S3	40	OL	8.2	CL	9.4	0.60	332	800	7.5	25	55	32	0.71
S4	40	OL	7.7	CL	6.5	0.42	220	1032	7.2	40	60.2	20.89	0.56
S5	38	OL	7.5	CL	7.01	0.48	330	850	7.0	36	81.0	15.09	0.58
S6	35	OL	8.5	CL	6	0.90	185	749	7.2	37.4	70.2	20.15	0.48
S7	39	OL	7.8	CL	6.9	0.80	160	800	6.9	29	69	30	0.48
S8	35	OL	7.5	CL	7.0	0.90	150	600	6.8	26.1	78	42.01	0.72
S9	35	OL	8.1	CL	9.2	0.85	302	625	7.0	39	75.6	34.01	0.57
S10	38	OL	8.4	CL	7.0	0.62	160	910	7.1	30	67	25.02	0.40
S11	45	OL	8.2	CL	8	0.49	280	590	5.6	40.2	80	22.47	0.90
S12	46	OL	7.5	CL	9.0	0.50	160	700	6.5	30	75	36.02	0.45
S13	40	OL	7.9	CL	6.8	0.56	189	600	7.0	17.8	71.2	15.42	0.55
S14	36	OL	7.3	CL	7.5	0.63	320	720	7.5	40.5	79	45.01	0.42
S15	38	OL	7.6	CL	7.9	0.42	390	800	7.8	38	86	28.22	0.85

**Table-4**  
**Physico Chemical Parameters of sampled Groundwater of Gwalior (in Post- monsoon)**

Sample No.	Temp. (°C)	Odour	pH	Colour	Turbidity (NTU)	EC	TH	TDS	DO	COD	Ca <sup>2+</sup>	Mg <sup>2+</sup>	F <sup>-</sup>
S1	15	OL	8.0	CL	6.5	0.60	285	925	6.7	35	53.9	10.38	0.48
S2	20	OL	7.7	CL	7.4	0.72	325	1002	6.9	37	62.4	25.04	0.51
S3	30	OL	8.2	CL	8.6	0.65	350	750	7.8	25.9	56	18.22	0.70
S4	29	OL	7.5	CL	6.3	0.48	210	1020	7.4	38	61	35.01	0.59
S5	29	OL	8.0	CL	7.2	0.42	342	847	7.3	36.5	78.5	10.21	0.57
S6	25	OL	8.2	CL	6.2	0.80	605	695	7.8	38	67.2	19.00	0.42
S7	29	OL	7.9	CL	7.0	0.72	180	780	7.2	28	68	22.03	0.49
S8	28	OL	7.5	CL	9.4	0.81	152	652	7.0	27	78.9	20.32	0.70
S9	32	OL	7.9	CL	7.4	0.62	225	628	7.4	40	74	15.09	0.55
S10	30	OL	8.5	CL	8	0.42	200	922	7.5	32	64	10.62	0.41
S11	30	OL	7.5	CL	9.1	0.47	300	600	6.0	41	81	10.22	0.89
S12	31	OL	8.1	CL	6.9	0.60	170	710	6.9	30.9	77	17.54	0.48
S13	29	OL	8.2	CL	7	0.61	160	601	7.2	19.2	74	10.02	0.25
S14	10	OL	7.5	CL	6.6	0.45	329	680	7.2	32	80	23.04	0.35
S15	30	OL	7.8	CL	7.6	0.32	225	700	7.5	17.9	75	10.72	0.25

## Conclusion

The present study concludes that water quality is in the process of deterioration in Gwalior and is may be caused by various reasons. The ground water is an important potable water source in some areas of the Gwalior during summer. Better water quality found in the Post-monsoon than that of Pre-monsoon season in Gwalior, it may be due to water recharging by rains. Pollution occurred due to urbanization; anthropogenic activities and increased human in the quality of water sources have been observed. The drinking water quality results also compared with primary drinking water quality criteria for best use after treatment and disinfection. To improve physico - chemical water quality on the basis results it will be easy to find remedial measures for safe life.

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