



## Quality And Risk Assessment Of Drinking Water Of Gwalior City, India

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### Abstract

*The present study was designed to assess the quality of potable water supplied by municipal cooperation of Gwalior to the different human settlement areas like Hazira, Gole ka Mandir, Gorkhi, Darpan colony, Phoolbagh and Govindpuri of Gwalior city, Madhya Pradesh, India. All the samples were analyzed for various physico-chemical parameters like Hardness, Alkalinity, Total Dissolved Solids (TDS), chloride, Nitrate, Sulphite, Electrical conductivity, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) and heavy metal like Chromium, Iron, Lead Fluoride and Cadmium by following the standard methods of APHA. The results of present study revealed that all the parameters analysed are higher from the standard given by USEPA, WHO and BIS (Bureau of Indian Standards). The higher concentration of heavy metals in samples can cause different health issues to the population exposed.*

**Keywords:** Water quality, standards, APHA.

### 1- Introduction

The quality of water is of fundamental concern for civilization since it is directly linked with human welfare. Good drinking water is important for human development, health and well-being, and because of this it is an internationally accepted human right (WHO 1993; 1998). The quality of water offers information regarding the concentration of different solutes at a given place during that time. Water quality parameters provide the basis to evaluate the suitability of water for its designated uses and to improve existing conditions. The drinking water should be tasteless, colourless, odourless and free from toxic elements as well as biological contaminants which may be harmful to health [1-6]. Furthermore heavy metals contaminate the surface water and ground water, resulting in deterioration of drinking and irrigation water quality, affecting human health as well as the

health of the aquatic ecosystem. Eminent metals concentration in different water systems may pose a risk of adverse effects such as deformities, cancer, and health of aquatic animals together with their terrestrial predators. Some heavy metals like Chromium (Cr) and Lead (Pb) at the high concentrations are considered highly toxic for human and aquatic life, including liver and kidney problems and genotoxic carcinogens. Heavy metals enter the human body through several pathways such as food chain, direct ingestion, dermal contact, fume inhalation, and particles through mouth and nose [7-9]. The safety of drinking water is prime concern within the global village. Drinking water should have high quality so that it can be consumed without threat of immediate or long term adverse impacts to health. Such water is commonly called as "potable water". Water availability is equally important as water quality. Good and

adequate water supply services are essential for public health and well being. Many water resources in developing countries are unhealthy because they contain harmful physical, chemical and biological agents, maintain good health, however water should be safe to drink and meet the local standards. Considering the deteriorating quality of drinking water in Gwalior city, present study was carried out. In the present investigation, water quality of treatment plants and consumer ends was monitored to assess the drinking water quality status [10-11]. This study was an attempt to judge the water quality changes from the source to consumer, which may be useful in deciding appropriate remedial measures for preventing drinking water from contamination and help in safe drinking water supply to consumers.

## 2- Material & methodology

### Sampling:

In present study, the methods of sampling used were combination of random and purposive sampling. Water samples were

collected from the different municipal water tank. From different locality of Gwalior city like Gorkhi, Hazira Gole ka Mandir, Darpan colony, Phoolbag, Govindpuri. These samples were collected in sterilized glass bottles (500 ml), labeled properly with date and name of the location.

### Physico-chemical analysis

Temperature, Turbidity, pH, TDS etc. and chemical parameters comprised of Electrical conductivity, Total hardness, Total alkalinity, Chloride, Fluoride and Residual chlorine, Nitrite Nitrate, Sulphite, Dissolved oxygen and Biochemical oxygen demand. Methods employed for analysis of physico-chemical parameters were in accordance with APHA (1992).

### 3- Results and Discussion

The measured value of different physical and chemical water quality parameters of the collected water samples is summarized in Table 1. Findings of the study have been assessed according to WHO drinking water quality guidelines and BIS as well.

**Table 1: Mean concentration of various Physico-chemical parameters (mg/L) in samples from different sites.**

S.No.	Parameters	BIS permissible limit (mg/L)	WHO Acceptable limit (mg/L)	Gorkhi (mg/L)	Hazira (mg/L)	Gole ka Mandir (mg/L)	Darpan colony (mg/L)	Phoolbag (mg/L)	Govindpuri (mg/L)
1	Hardness	600	200	300	400	300	350	300	350
2	Alkalinity	600	200	150	300	150	210	150	210
3	TDS	200	500	0.12	1.37	1.06	0.2	0.12	0.58
4	Chloride	100	250	56.8	216.55	56.8	67.45	67.45	67.45
5	Nitrate	100	45.0	7.5	4.0	10.0	0.0	4.0	4.0
6	Nitrite	1.0	-	6.0	0.8	6.5	8.0	4.0	2.0
7	Sulphite	-	-	0.192	1.92	1.6	1.6	1.12	1.12
8	Electrical conductivity	2000	-	177.7	242.16	183.15	161.0	191.0	53.6
9	Dissolved oxygen	6.0	-	6.4	6.4	6.4	5.8	6.4	4.8
10	BOD	6.0	-	0.8	1.6	0.8	1.6	0.4	0.8
11	Fluoride	1.5	1.0	2.6	4.4	2.8	2.6	2.8	6.7

### 3.1 Water characteristics

Evaluation of TDS of water samples collected from different locations ranged

from 0.1 to 1.5 mg/L. Maximum value of 1.37 mg/L was found at Hazira and minimum value of 0.12 mg/l at Phoolbag and

Gorkhi. Water which has TDS level less than 500 mg/L is regarded as good, while water having TDS more than 500 mg/L is unacceptable for human consumption (BIS). High TDS may result in offensive odors, tastes, colors, and health problems depending on the specific contaminant (s) present. Electrical conductivity of samples was found to be in range of 53.6 to 242.6. Maximum conductivity was seen at Hazira.

Total hardness of water samples collected from different sampling locations were found to be from 200 to 300 mg/L. Maximum value of total hardness level was found at Hazira which was 400 mg/L. Total hardness of drinking water at all sampling locations was within BIS guideline value of 600 mg/L but not acceptable according to WHO Standards. Alkalinity of collected sample were in the range of 150 to 300 mg/L in terms of CaCO<sub>3</sub> which in within permissible limit of BIS standard but little higher than the WHO acceptable limit.

BOD values examined in water samples collected from different were ranged from 0.4 to 1.6 mg/L. Maximum concentration of BOD was recorded from Hazira and Darpan colony. BOD at all sampling locations was well within permissible limit of 6 mg/L of BIS and the dissolved oxygen was also found satisfactory in the range of 4 to 6 mg/L. Maximum dissolved oxygen was found at Phoolbag, Gole ka Mandir, Hazira, Gorkhi.

Chloride was observed in samples in significant range between 50 to 220 mg/L which is within permissible range of BIS and Maximum amount was found at Hazira (216.55 mg/L). Nitrate values observed in water samples were ranged from 0 to 7.5 mg/l. Maximum level of nitrate was found at Gorkhi but all values were well with BIS permissible limit of 45 mg/L. Evaluation of fluoride of water samples from different sampling locations ranged 2.6 to 6.70mg/L. Maximum value of 6.7 mg/L was found at Govindpuri while minimum value of 2.6 mg/L was recorded at Darpan colony. Concentrations at all sampling location were well above BIS standard (1.5 mg/L). F<sup>-</sup> Has a

significant mitigating effect against dental cares if the concentration is approximately 1 mg/L, However, continuing consumption of higher concentrations of 4mg/L or more can cause dental fluorosis and in extreme cases even skeletal fluorosis.

### 3.2 Heavy metals analysis

The quantity of heavy metals found in this research have stated with their maximum admissible

Limit. The resulting trace elements resulting with their concentration in drinking water were compared with international and national Organizations such as WHO and BIS. The mean concentrations of all investigated metals in the waters tested were well not, prominent in their desirable limits (WHO-2008). The Heavy metals in drinking water samples like Pb, Cd, Cr and Fe with their respective concentrations are related with chronic diseases. Heavy metals drinking water have been set up by different authors and also listed their adverse effects on the human health. The samples showed the presence of lead, cd and Cr, Fe and their concentrations resulted were also compared with (WHO-2008) specified contaminant levels for drinking water. Lead and cadmium concentrations were found to be above the WHO maximum acceptable concentration (MAC). Thus, result showed an indication of pollution hazards encompassing high emission of lead (Pb) in drinking waters from the different Industry. The concentration of Pb found in drinking water samples were in the range of 0.020 mg/L to 0.215 mg/L. The maximum acceptable concentration results are of concern as lead is a poisonous metal that can damage nervous connections (especially in young children's) and cause blood and brain disorders. One of the most important and serious biochemical effects of lead is its interference with haemoglobin synthesis, which leads to haematological damage. The presence of elevated levels of Pb & Cd in almost regions is serious. According to BIS the permissible limit of Iron is about 0.3 mg/L and the amount found were in range 0.4 to 0.8 mg/L

which is greater than the permissible limit. Maximum amount was found at Hazira. Cr concentration was found to be in the range of

0.5 to 2.0 mg/L Maximum at Hazira and is much greater than BIS permissible limit which is 0.05 mg/L.

**Table 2: Concentration of Heavy Metals (mg/L) in water samples collected from sampling sites.**

S.No.	Parameters	BIS permissible limit (mg/L)	WHO Acceptable limit (mg/L)	Gorkhi (mg/L)	Hazira (mg/L)	Gole ka Mandir (mg/L)	Darpan Colony (mg/L)	Phoolbag (mg/L)	Govindpuri (mg/L)
1	Lead	<b>NO relaxation</b>	0.01	1.3	0.6	0.1	1.1	0.8	0.7
2	Chromium	0.05	0.05	0.0	2.0	1.5	0.0	0.5	0.0
3	Cadmium	<b>NO relaxation</b>	0.003	0.01	0.08	0.09	0.03	0.04	0.07
4	Iron	0.3	0.3	0.4	0.8	0.4	0.4	0.4	0.4

#### 4- Conclusions

Results of water samples collected from the different area revealed that the water entering the distribution system was not of desired some physico-chemical quality like fluoride, Chloride, conductivity and also a trace level of heavy metals ( lead ,chromium and cadmium) were also detected in samples which were greater than the WHO limits and found in range of 0.4 mg/L to 0.8 mg/L respectively, chromium was found in high concentration which was about 2.0 mg/L in some sampling stations after finding the

result we conclude that local authority should concerned about the quality of which they were supplying to the local people as presence of these metals can cause a serious health effects like dysentery, diahorrea, typhoid and stomach disease in exposed population specially on the children of area Hence, this study clearly showed that the local authority need to improve the water quality of storing tank before supply in houses to produce high quality drinking water to local population.

Table 4: Correlation matrix for different various physico-chemical and microbiological parameters analyzed during present study.

	Hardness	Alkalinity	TDS	Chloride	Nitrate	Nitrite	Sulphite	Electrical conductivity	Dissolved oxygen	BOD	Fluoride
Hardness	1										
Alkalinity	-0.33991	1									
TDS	0.718577	-0.57257	1								
Chloride	0.989478	-0.30902	0.705677	1							
Nitrate	-0.16708	-0.47824	0.307065	-0.20197	1						
Nitrite	-0.75619	-0.03459	-0.50588	-0.68143	0.06217	1					
Sulphite	0.497918	-0.04799	0.685645	0.556983	-0.29175	-0.2075	1				
Electrical conductivity	-0.20371	0.054512	-0.24916	-0.06738	-0.16045	0.696613	0.14856	1			
Dissolved oxygen	0.134675	-0.17135	0.12518	0.229453	0.394838	0.222329	0.008639	0.683776	1		
BOD	0.567149	-0.45479	0.396549	0.609	-0.51014	-0.00294	0.576111	0.290376	-0.02512	1	
Fluoride	0.376168	-0.01435	0.340096	0.259077	-0.15596	-0.74446	0.138953	-0.92561	-0.79047	0.021176	1

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