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Physical-Chemical Analysis of Drinking Water of Government Hospitals of Gwalior City

Niranjan Dev Bharadwaj[1], Dr. Dinesh K. Uchharia [2], Rajesh Jain [3]

[1]*Environmental Chemist , Analitika Ecolab Pvt. Ltd.,Gwalior*
[2] *Head of Water Section and Deputy Technical Manager*
Analitika Ecolab Pvt. Ltd.,Gwalio
[3] *Technical Manager , Analitika Ecolab Pvt. Ltd.,Gwalior*

Abstract - *The drinking water quality was investigated in Government Hospitals of Gwalior district , Madhya Pradesh (India), to ensure the continuous supply of clean and safe drinking water for the public health protection. In this regard, a detailed physical and chemical analysis of drinking water samples was carried out in different hospitals of Gwalior city . A number of parameters such as pH, turbidity, conductivity, total suspended solids (TSS), total dissolved solids (TDS), along with Color , Taste and Odor /Smell were analyzed for each water sample collected . The obtained values of each parameter were compared with the standard values set by the World Health Organization (WHO). However, it is also important to investigate other potential water contaminations such as chemicals and microbial and heavy and radiological materials for a longer period of time in order to assess the overall water quality of government hospitals in Gwalior .*

Key Words: Water Quality Parameters , Government Hospitals Gwalior City , WHO Standards.

1.INTRODUCTION

Drinking water, also known as potable water, is water which is safe enough for drinking and food preparation. Water plays a very crucial role in maintaining the human health and welfare. Clean drinking water is now recognized as a fundamental right of human beings all around the world whether they are living in rich –developed countries or in poor-developing countries. Safe and readily available water is important for public health, whether it is used for drinking, domestic use, food production or recreational purposes. Improved water supply and sanitation, and better management of water resources, can boost countries' economic growth and can contribute greatly to poverty reduction[1].

Around 780 million people do not have access to clean and safe water and around 2.5 billion people do not have proper sanitation. As a result, around 6–8 million people die each year due to water related diseases and disasters[2] .Therefore, water quality control is a top-priority policy agenda in many parts of the world [3].In the today world, the water use in household supplies is commonly defined as domestic water. This water is processed to be safely consumed as drinking water and other purposes. Water quality and suitability for use are determined by its taste, odor, color, and concentration of organic and inorganic matters [4] .Contaminants in the water can affect the water quality and consequently the human health adversely .

A number of scientific procedures and tools have been developed to assess the water contaminants [4]. These procedures include the analysis of different parameters such as pH, turbidity, conductivity, total suspended solids (TSS), total dissolved solids (TDS),etc. These parameters can affect the drinking water quality, if their values are in higher concentrations than the safe limits set by the World Health Organization (WHO) and other regulatory bodies [3]

The present work is an attempt to measure the water quality of six government hospitals of Gwalior district , Madhya Pradesh, India.

2 EXPERIMENTAL SECTION

2.1 Study Areas

Study area compromises of Gwalior district of Madhya Pradesh. Gwalior is situated at 26.2215° N, 78.1780° E. Gwalior is a historic and major city in the Indian state of Madhya Pradesh and one of the Counter-magnet cities. Located 319 kilometres (198 mi) south of Delhi the capital city of India, Gwalior occupies a strategic location in the Gird region of India.

In this research paper , physic-chemical analysis of a few parameters was carried out in six government hospitals of Gwalior city : Government Civil Hospital Hajira , Government Hospital Birla Nagar ,Government Hospital Morar ,Civil Hospital Thatipur ,J.A. Hospital Lashkar ,K.R.H. Hospital , Lashkar.

Table 1 : Showing the Geographical Locations of the Study Areas

Serial Numb--er	Hospital	Sample Code	Latitude	Longitude
1.	Civil Hospital Gwalior Hazira	D.W.1	26.2414	78.1842
2.	Government Hospital Birla Nagar	D.W.2	26.2370	78.1946
3.	Government Hospital Morar	D.W.3	26.2238	78.2232
4.	Civil Hospital Thatipur	D.W.4	26.2258	78.2225
5.	J.A. Hospital Lashkar	D.W.5	26.1922	78.1607
6.	K.R.H. Hospital , Lashkar	D.W.6	26.1919	78.1611

2.2 Water Sampling

In present investigation six drinking water samples were collected in the month of March ,2016 in plastic bottles which were cleaned with acid water, followed by rinsing twice with distilled water. The water samples are chemically analyzed.

2.3 Physical -Chemical Analysis of Ground Water Samples

In this research paper ,we will be evaluating physical-chemical parameters of the collected groundwater samples .Color , Odor ,Taste , pH , Conductivity , Total Dissolved Solids (TDS) ,Total Suspended Solids (TSS) Total Solids (TS)and Turbidity is measured and conclusions are drawn accordingly . The analysis of water was done using procedure of standard methods.[5]

- **Color**

Water is usually thought as a colorless liquid however it possesses some level of color. Colors in drinking waters can originate from any impurity present in it .

The samples D.W. 1 , D.W. 2 and D.W. 3 ,D.W.4 ,D.W.5 have clear water , whereas D.W. 6 is little faint or diluted as per its appearance .

- **Odor /Smell**

Smell in water in the present study was classified into three categories of slight smell, no smell, and fast smell. The D.W.1, D.W. 3 and D.W. 4 have No smell , and D.W. 2,D.W.5,D.W.6 have a Slight smell .

- **Taste**

Various odors and tastes may be present in water. Taste is generally classified in three groups of sweet, medium and brackish. Taste in water can be traced to a number of factors including decaying organic matter, presence of living organisms, iron or any other impurities .In the present study D.W. 3 and D.W. 4 have medium taste , whereas D.W. 1,D.W.2,D.W.5,and D.W.6 possess Brackish taste .

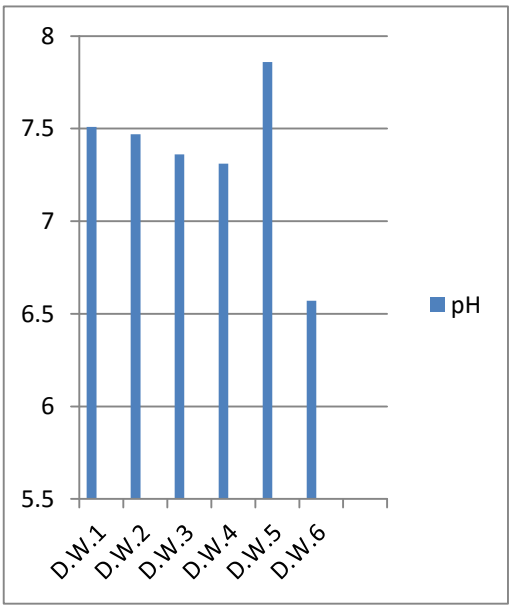
- **pH**

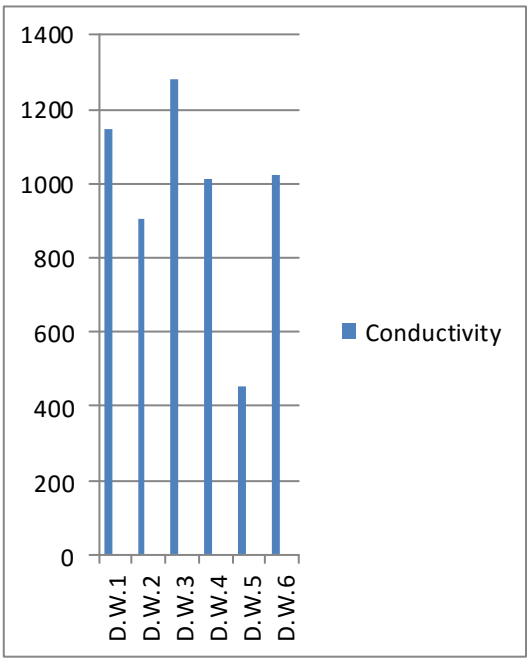
pH is a measure of a solution's acidity. In water, small numbers of water molecules (H2O) will break apart or disassociate into hydrogen ions (H+) and hydroxide ions (OH-). Other compounds entering the water may react with these, leaving an imbalance in the numbers of hydrogen and hydroxide ions. When more hydrogen ions react, more hydroxide ions are left in solution and the water is basic; when more hydroxide ions react, more hydrogen ions are left and the water is acidic. pH is a measure of the number of hydrogen ions and thus a measure of acidity

pH is measured on a logarithmic scale between 1 and 14 with 1 being extremely acid, 7 neutral, and 14 extremely basic. Because it is a logarithmic scale there is a ten fold increase in acidity for a change of one unit of pH, e.g. 5 is 100 times more acid than 7 on the pH scale. In the following table , we have measured pH values of the samples under analysis .

The results for pH of D.W. 1, D.W.2 D.W.3 , D.W. 4,D.W. 5 and D.W.6 are 7.51,7.48,7.36,7.31,7.85 and 6.58 respectively.

Graph 1: pH Values of Samples





- **Electrical Conductivity**

This is a measure of the capability of a solution such as water in a stream to pass an electric current. This is an indicator of the concentration of dissolved electrolyte ions in the water. It doesn't identify the specific ions in the water. However, significant increases in conductivity may be an indicator that impurities have entered the water.

The basic unit of measurement for conductivity is micromhos per centimeter (µmhos/cm) or microsiemens per centimeter (µS/cm). It is a measure of the inverse of the amount of resistance an electric charge meets in traveling through the water.

The results for Conductivity of D.W. 1, D.W.2 ,D.W.3 , D.W. 4,D.W. 5 and D.W.6 are 1146 ,905 ,1281 ,1014 ,455 and 1023 respectively .

Graph 2 : Electrical Conductivity of Samples

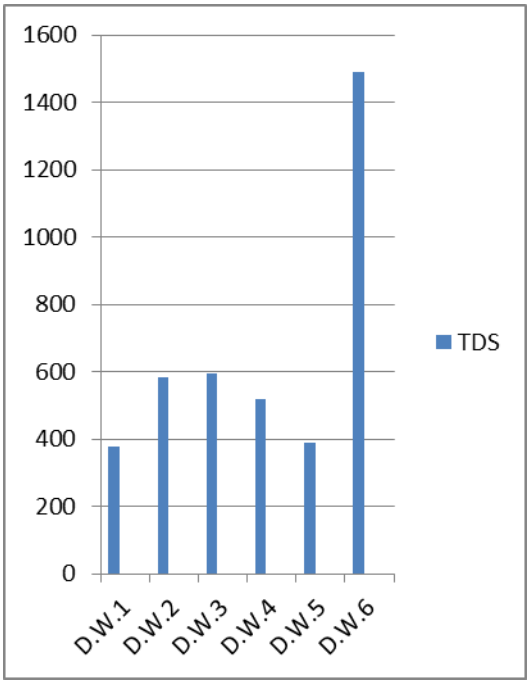
- **Total Dissolved Solids**

Total Dissolved Solids (TDS) are the total amount of mobile charged ions, including minerals, salts or metals dissolved in a given volume of water, expressed in units of mg per unit volume of water (mg/L) .

TDS in drinking-water originate from natural sources, sewage, urban run-off, industrial wastewater, and chemicals used in the water treatment process, and the nature of the piping or hardware used to convey the water, i.e., the plumbing.

The results for D.W. 1, D.W.2 ,D.W.3 , D.W. 4,D.W. 5 and D.W.6 are 376,582,596,518,388 and 1490mg/L respectively .

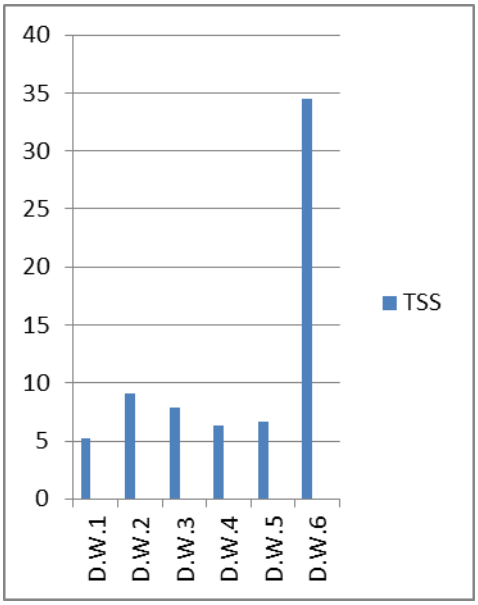
Graph 3 :TDS values of the sample



- **Total Suspended Solids (TSS)**

Total Suspended Solids (TSS) are solids in water that can be trapped by a filter. TSS can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. High concentrations of suspended solids in drinking water can cause many health problems . The results for D.W. 1, D.W.2 ,D.W.3 , D.W. 4,D.W. 5 and D.W.6 are 5.22,9.13,7.88,6.28,6.65 and 34.44 mg/L respectively .

Graph4: TSS values of the samples

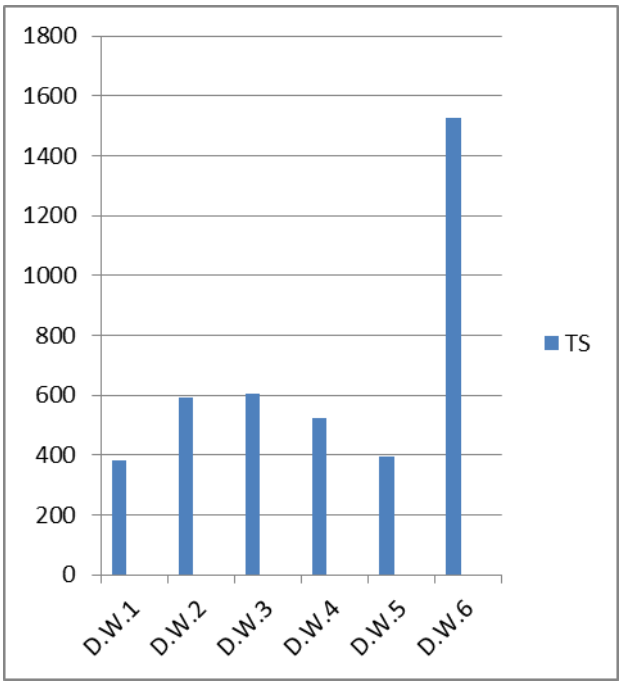


- **Total Solids (TS)**

The term "total solids" refers to matter suspended or dissolved in water or wastewater, and is related to both specific conductance and turbidity. Total solids (also referred to as total residue) is the term used for material left in a container after evaporation and drying of a water sample. Total Solids includes both total suspended solids, the portion of total solids retained by a filter and total dissolved solids, the portion that passes through a filter.

The results for D.W. 1, D.W.2 , D.W.3 , D.W. 4,D.W. 5 and D.W.6 are 381.22,591.13,603.88,524.28,394.65 and 1524.44 mg/L respectively .

Graph 5 :TS values of the sample

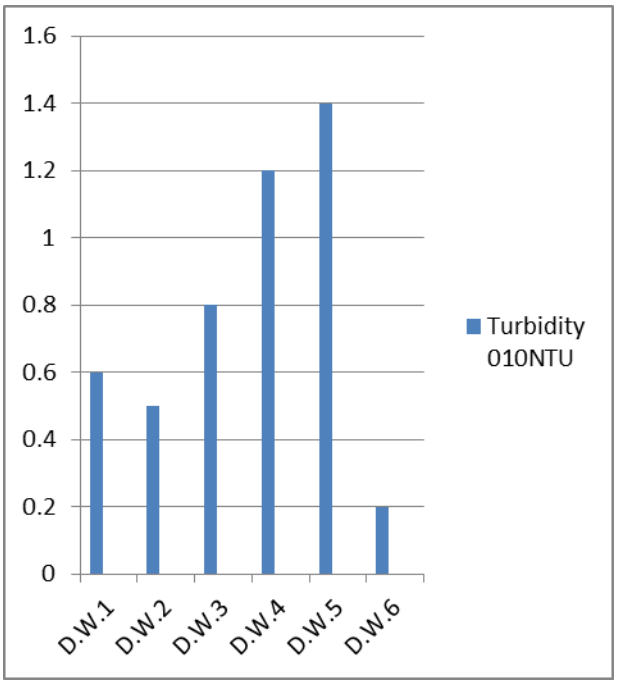


- **Turbidity**

Turbidity is the measure of relative clarity of a liquid. It is an optical characteristic of water and is an expression of the amount of light that is scattered by material in the water when a light is shined through the water sample.

The results for D.W. 1, D.W.2 ,D.W.3 , D.W. 4,D.W. 5 and D.W.6 at 21.5^{0}Care 0.6 ,0.5,0.8,1.2,1.4 and 3.2 NTU 010 .

Graph 6 :Turbidity values of the samples



3. CONCLUSIONS

The pH values of all the samples are within the WHO limits of 6.5-8.5 range ,but the pH value of drinking water sample at K.R.H hospital is nearing to exceed the permissible limit and should be lowered .The present study suggests that TDS values of D.W. 6 is above the permissible values as per WHO Standards(WHO Standard 1000 mg/L TDS) .The TDS Values of these samples taken at K.R.H Hospital is very high and should be lowered down before usage .
As per WHO Standards Electrical Conductivity of all samples is very high. Although, the present investigation is essentially a primary work and needs to be further investigated to arrive at specified conclusion with respect to clinical implications.

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BIOGRAPHIES

Niranjan Dev Bharadwaj is a student , who has done Bachelors of Engineering(B.E.) in Chemical Engineering in Honors from Rajiv Gandhi Proudyogiki Vishwavidyalaya, India . He is currently working as an Environmental Chemist at Analitika Ecolab Pvt. Ltd.,Gwalior. He is also an online volunteer for the United Nations.

Dr.Dinesh K.Uchcharia is working as the Head of Water Section and Deputy Technical Manager Analitika Ecolab Pvt. Ltd.He has done his phD from Jiwaji University in 2012 .

Mr.Rajesh Jain is working as the Technical Manager , Analitika Ecolab Pvt. Ltd. He has done his MSc in Environmental Chemistry from Jiwaji University in 1999 .