Asian Journal of Water, Environment and Pollution, Vol. 17, No. 1 (2020), pp. 51–57.
DOI 10.3233/AJW200006

Study of Water Quality in Udaipur Region, India

Amarnath Mishra* and Bharat Nagda
Amity Institute of Forensic Sciences, Sector 125, Noida – 201313 (UP), India
✉ amishra5@amity.edu

Received February 21, 2019; revised and accepted October 16, 2019

Abstract: Aim of this study is to check the quality of water including water parameters that is pH, heavy metals in the sample. Udaipur, also known as city of lakes, has many lakes and they are the major source of drinking water of the city. To analyze the quality of water, samples were collected from five different lakes of Udaipur region. Due to industrial discharge of waste water of nearby area they are polluted which cause diseases. By using pH meter and atomic absorption spectroscopy in water, pH and presence of heavy metals present in sample was checked. Before using AAS samples were filtered through filter paper to minimize the contaminants of water like dust and other particles. This study's main aim is to check suitability of lake water.

Key words: Water quality, pH, TDS (total dissolved solid), AAS, heavy metals.

Introduction

Udaipur is the city located in southern region of Rajasthan where it has many lakes.There are few lakes which are the major source of water like Pichhola Lake, Jaisamand, Udai Lake, etc. The city of lake is situated between the 23°46′ and 25°05′ north latitude and 73°09′ and 74°35′ east longitude covering area of 13,419 sq. km. Udaipur has 11 sub-divisions viz. Girwa, Gogunda, Vallabhnagar, Jhadol, Sarada, Salumbar, Kherwara, Rishabdeo, Mavli, Lasadiar and Kotda (Saurabh et al., 2014). Since lakes are the major source of the city, checking quality of lake water is of significant value against the problems related with public health due to organic pollution (Abowei, 2010). Pollution word is derived from Latin word *pollutionem* which means an addition of any organic, inorganic or foreign material, physical and biological changes in environment which adversely throw an impact on living or non-living organism. Water is very important and natural resource as it is useful for developmental purpose. A basic need of human being is drinking water as it has great influence on all aspects of life.

Water is also used for five different purposes such as domestic purpose (cooking, drinking, bathing, washing), agriculture purposes (farming, gardening, fisheries), industrial purposes (manufacturing), recreational purposes and hydropower generation (Dara, 1997). Presence of contaminants in water cause harmful effect on health and a variety of diseases. Primary concern of human being living in developing countries all over world is obtaining clean and safe water (Johnson and Hallberg, 2005). Water has been checked regularly for the purpose of their purity level and confirms that it is useable or not because water is important for all physiological activities related to human, animal, and plant also. In water testing there are many parameters used like pH, TDS, BOD, COD, hardness of water. Safe and best quality of water are basics for human health but when polluted it may become source of undesirable and dangerous substances to human health which may cause diseases like cardiovascular, neurological and so on (Ahmed, 2005).

There are many problems faced by people due to presence of heavy metals in drinking water. Water can be directly consumed from the tap or through tube wells

*Corresponding Author

and indirectly in beverages or food prepared with water (APHA, 1989). Types of analysis vary from single field testing to laboratory based multi instrumental component analysis. Analytical process involves sampling and sample storage so that composition of sample does not change from sampling to the laboratory testing. A precaution has to be taken to ensure that water reaching the lab has same composition as it did when sampling was done (APHA, 1989). Serious ecological problem is presence of heavy metals in the water which affect both human health and animal health. Heavy metals like Pb, Cr, As, Cu, Zn, Fe, Mn and Cd are cause of many health issues. Aim of this study is to check the quality of water in Udaipur region by using such parameters as pH and TDS through AAS (atomic absorption spectroscopy).

There are many industries which are located far away from the lakes but their exposure of waste material is improper so that waste material along with water are mixed with ground water that can affect many of village area located near lakes and industries. Recently, many health problems were reported in the village named Gudli where many people were affected due to polluted water, because some factories operating in Gudli industrial area are negligent in treating water. Instead of properly disposing of industrial degradation, due to open flowing and grounded in ground water, situation is getting worse day by day. Due to this negligence many of the tube wells in the area have started to emit chemicals and polluted water coming from the wells. Gudli's nearby grounded water are getting polluted just because negligence in disposing the water and waste material of factories. This polluted water also affects the farms of the many villages sown by the farmers. This polluted water is then mixed with indirectly to the water of lake and affects the human health causing many health issues. Lakes of Udaipur are degrading due to direct or indirect discharge of industrial waste and anthropogenic activity. This type of waste contains health hazard chemicals like salts of chromium, cadmium, lead, arsenic and mercury. Heavy metals are hazardous because they are also liable to bioaccumulation. Bioaccumulation is the situation when chemical concentration in biological organism is increased with time. Water can also be polluted by natural causes like volcanic activity and forest fires. Aim of this study is primarily focused on the quality of water because human body contains 60% water; consumption of safe and clean water is the primary concern of the human body.

Figure 1: City of lakes or Udaipur city.

Figure 2: Gudli Talab site 1.

Figure 3: Udai-Sagar site 2.

Figure 4: Ayad River site 3.

Figure 5: Ground water site 4 and site 5.

Methodology

Study Area

Udaipur is the city located in southern region of Rajasthan where it has many lakes and there are few lakes which are the major source of water like Pichhola Lake, Jaisamand, Udai-Sagar Lake, etc. City of lake is situated between the 23°46′ and 25°05′ north latitude and 73°09′ and 74°35′ east longitude covering area of 13,419 sq. km. (Saurabh et al., 2014). The study area included for water quality analysis is Gudli Talab, Ayad-Rriver, Udai-Sagar and two groundwater samples collected from nearby Gudli village.

Sample Collection

Samples were collected from five different sites of Udaipur region in which three were from lakes that is Gudli Talab, Udai-Sagar, Ayad River, and two were from wells of nearby Gudli village area. Nowadays Gudli village area is suffering from many diseases caused by contaminated water because disposal of waste product from the factories are not suitable and they contaminate the other water sources. Waste and toxic water are mixed with the ground water and affect the water resources and endanger the human life. There are three parameters that is (i) heavy metal presence in water, (ii) TDS and (iii) pH used to detect the contaminated water in two variations—one is collected on day 1 at sites 1, 2, 3, 4 and 5 and other variables collected after 20 days at sites 1, 2, 3, 4 and 5.

Water pH

pH is the scale of character which expresses the acidity and alkalinity level of solution where below 7 pH shows that the solution is acidic whereas above 7 pH shows that the solution is alkaline. pH 7 is considered as neutral and we can easily detect the pH of any water by its nature and taste. Acidic pH of solution causes lack of cellular oxygenation and it causes cancer. The pH of a solution is the negative logarithm of the hydrogen ion activity.

In dilute solutions, the activity of hydrogen ion is approximately equal to the concentration of hydrogen ion.

The pH of water is a measure of the acid-base equilibrium and, in most natural waters is controlled by the carbon dioxide–bicarbonate–carbonate equilibrium system. An increased carbon dioxide concentration will therefore lower pH, whereas a decrease will cause it to rise. Temperature will also affect the equilibrium and the pH. In pure water, a decrease in pH of about 0.45 occurs as the temperature is raised by 25 °C.

In water with a buffering capacity imparted by bicarbonate, carbonate and hydroxyl ion, this temperature effect is modified. The pH of most drinking water lies within the range 6.5-8.5. Natural waters can be of lower pH, as a result of, for example, acid rain or higher pH in limestone areas (Bruvold and Ongerth, 1969). Sample is tested in two ways by using pH strip and using electronic meter. Both methods were performed to check the pH of water.

Table 1: pH range of day 1 and day 20

S.No.	*Site*	*pH range*		*BIS permissible limit*
		Day 1	*Day 20*	*6.5-8.5*
1.	SITE-1	7.2	7.2	
2.	SITE-2	6.0	6.0	
3.	SITE-3	6.5	6.0	
4.	SITE-4	6.5	6.0	
5.	SITE-5	7.0	6.8	

After collecting the samples, they were placed in five different beakers to check their pH respectively. Results listed in Table 1 will come after checking pH with pH meter as well as pH strips.

TDS (Total Dissolved Solids)

Describe the presence of inorganic salts and small amount of organic matter in the water or any solution in water termed as 'Total Dissolved Solid'. The key constituents are for the most part calcium, magnesium, sodium, and potassium cations and carbonate, hydrogen-carbonate, chloride, sulfate, and nitrate anions. If any matter or solid is dissolved in the water, it may affect its taste. The strategy for deciding TDS in water supplies most generally utilized is the estimation of explicit conductivity with a conductivity test that distinguishes the nearness of particles in water. Conductivity estimations are changed over into TDS values by methods for a factor that fluctuates with the type of water (Singh and Kalra, 1975). The constituents of TDS can likewise be estimated separately. By using TDS meter, we can directly check the dissolved solid or any inorganic matter in the water. Take water sample in beaker. Switch on the TDS meter and put into the beaker. Wait while the reading is stable and note down the reading.

According to BIS, water TDS permissible limit are as follows: less than 300 ppm (excellent), between 300-600 ppm (good), between 600-900 ppm (fair), between 900-1200 ppm (poor), and greater than 1200 ppm (unacceptable). After checking the water TDS level, note down all the readings. When water TDS level was again checked after 20 days there were some variation seen that are listed in Table 2.

Table 2: TDS range variation in day 1 and day 20

S.No.	*Site*	*TDS Range (in ppm)*	
		Day 1	*Day 20*
1.	SITE-1	1120	1200
2.	SITE-2	1920	1900
3.	SITE-3	1290	1300
4.	SITE-4	1270	1250
5.	SITE-5	1700	1700

AAS (Atomic Absorption Spectroscopy)

Atomic absorption spectroscopy is used to determine the quantity of heavy metals in liquid. Analysis of metallic element was first pointed by Walsh and by Alkemade and Miltaz in 1955. About 60-70 elements have been determined by AAS in concentration as low as 1 ppm. It is a standard laboratory analytical tool for metal analysis and is based on the absorption of electromagnetic radiation by atoms. The absorption wavelengths and detections limits for the heavy metals were 217.0 nm and 0.001 ppm respectively.

Principle: AAS involves the study of radiant energy usually UV and visible by neutral atoms in gaseous state. The technique of absorption spectrometry is used to assess the concentration of an analyte in a sample. It requires standards with known analyte content to establish the relation between the measured absorbance and the analyte concentration based on the Beer-Lambert's Law. In short, the electrons of the atoms in the atomizer can be promoted to higher orbital (excited state) for a short period of time (nanoseconds) by absorbing a defined quantum of energy (radiation of a given wavelength). This amount of energy, i.e., wavelength, is specific to a particular electron transition in a particular element. In general, each wavelength corresponds to only one element, and the width of an absorption line is only of the order of a few picometres (pm), which gives the technique its elemental selectivity. The radiation flux without a sample and with a sample in the atomizer was measured using a detector and the ratio between the two values (the absorbance) were converted to analyte concentration or mass using the Beer-Lambert Law.

Sample Preparation

Water Sample Digestion: 30 ml water was taken in a conical flask and evaporated on a hot plate. When water is evaporated, remaining quantity is less than 5 ml. Added 5 ml conc. HNO_3. Again, evaporate it when the nitric acid is fumed out and remaining water sample looks like viscous solution. The concentrate was transferred to a 50 ml volumetric flask and diluted to mark with deionized water. Prior to analysis, the solutions were filtered through Whattman number 42 filter paper.

Reagents and Chemicals: All the chemicals and reagents used were of analytical or equivalent grade and obtained from Merck (Germany). The glassware used Borosil and Polylab manufactured company. Deionized water was used to prepare all aqueous solutions. All plastic and glassware used were rinsed and soaked in 10% (v/v) HNO_3 overnight. They were rinsed with deionized water and dried prior to using. All acids such as nitric (HNO_3), sulfuric (H_2SO_4), hydrochloric (HCl) and perchloric acid ($HClO_4$) and oxidants hydrogen peroxide (H_2O_2) were of standard pure quality.

Figure 6: Atomic absorption spectrometer.

After water treatment, samples were injected or tested in AAS instrument; after that a detector located the element present in the sample and sent to the read-out device which records all the data coming from the sample. So the two variants of samples are tested that is day 1 and another sample was tested after 20 days of interval.

Table 3: Result of AAS Site 1

S.No.	*Elements*	*Result (in ppm)*		*Permissible limit (in ppm)*
		Day 1	*Day 20*	
1.	Zinc	0.050	0.090	0.01-0.04
2.	Iron	1.548	1.600	0.50-10
3.	Copper	0.140	0.140	0.05-1.5
4.	Manganese	0.005	0.004	0.1-0.3
5.	Lead	2.020	2.000	0.5-1.0
6.	Nickel	0.190	0.200	0.1-2.5
7.	Cadmium	1.174	1.172	0.001-0.1
8.	Chromium	0.022	0.020	0.0004-0.05

Table 4: Result of AAS Site 2

S.No.	Elements	Result (in ppm)		Permissible limit (in ppm)
		Day 1	Day 20	
1.	Zinc	1.080	1.092	0.01-0.04
2.	Iron	1.892	1.910	0.50-10
3.	Copper	0.198	0.195	0.05-1.5
4.	Manganese	3.188	3.210	0.1-0.3
5.	Lead	2.268	2.275	0.5-1.0
6.	Nickel	0.230	0.310	0.1-2.5
7.	Cadmium	1.182	1.200	0.001-0.1
8.	Chromium	0.078	0.080	0.0004-0.05

Table 5: Result of AAS site 3

S.No.	Elements	Result (in ppm)		Permissible limit (in ppm)
		Day 1	Day 20	
1.	Zinc	0.536	0.620	0.01-0.04
2.	Iron	1.548	1.650	0.50-10
3.	Copper	0.056	0.070	0.05-1.5
4.	Manganese	0.010	0.030	0.1-0.3
5.	Lead	2.350	2.400	0.5-1.0
6.	Nickel	0.270	0.310	0.1-2.5
7.	Cadmium	1.160	1.180	0.001-0.1
8.	Chromium	0.066	0.065	0.0004-0.05

Table 6: Result of AAS site 4

S.No.	Elements	Result (in ppm)		Permissible limit (in ppm)
		Day 1	Day 20	
1.	Zinc	0.018	0.025	0.01-0.04
2.	Iron	1.474	1.510	0.50-10
3.	Copper	0.084	0.090	0.05-1.5
4.	Manganese	0.006	0.005	0.1-0.3
5.	Lead	2.598	2.650	0.5-1.0
6.	Nickel	0.150	0.180	0.1-2.5
7.	Cadmium	1.210	1.320	0.001-0.1
8.	Chromium	0.050	0.080	0.0004-0.05

Table 7: Result of AAS site 5

S.No.	Elements	Result (in ppm)		Permissible limit (in ppm)
		Day 1	Day 20	
1.	Zinc	0.004	0.004	0.01-0.04
2.	Iron	1.622	2.110	0.50-10
3.	Copper	0.112	0.152	0.05-1.5
4.	Manganese	0.018	0.050	0.1-0.3
5.	Lead	3.008	4.010	0.5-1.0
6.	Nickel	0.194	0.210	0.1-2.5
7.	Cadmium	1.218	1.200	0.001-0.1
8.	Chromium	0.219	0.250	0.0004-0.05

Result and Discussion

As a result, as shown in Tables 3 to 7, the range of pH, TDS, and heavy metals present in the samples are higher than permissible limit set by the WHO (World Health Organization) and BIS (Bureau of Indian Standard). These results show that water collected from the different sites are polluted and hazardous for human health as well as animal health. Heavy metals lead, zinc, chromium, cadmium, copper, manganese, nickel and iron are higher in the samples so that it should not be used as drinking water as well as domestic works. But in Gudli village, people regularly use waters for their daily purposes and it is not good for their health because presence of heavy metals in the drinking water are not good sign. It causes varieties of diseases and throws bad impact on human health as well as it causes many health issues. Also, this study shows exceeded TDS and heavy metals limit which shows that drinking water is not suitable for consumption.

Conclusion

In this study, the outcomes obviously demonstrate that the water nature of the waterway is debased. The water quality declined for the most part because of mass washing, release of untreated sewage water and local waste water of urban zone. In water samples which were tested, were not fit for consumption on daily basis for human. The water samples are not suitable as well as its quality was not good; so it is not good for consumption as drinking water. Heavy metals present in the water cause many biochemical problems in human health. There is an urgent requirement to stop the inappropriate measurement of water of Udaipur region and treated in a systemic way to improve the quality of water as well as use advance technique to improve water quality and decrease the amount of pollutants in the water. Also, awareness is needed among the people of polluted area to decrease the pollution of water, and collective approach by the government and people are essential.

Acknowledgement

Authors thank Dr. Nidhi Rai, Professor & Head, Department of Environmental Science, M.L.S. University, Udaipur, Rajasthan, who helped during this research work and provided the facility.

References

Abowei, J.F.N. (2010). Salinity dissolved oxygen, pH and surface water temperature conditions in Nkoro River, Niger Delta, Nigeria. *Adv. J. Food Sci. Technol.*, **2(1):** 36-40.

Ahmed, R. (2005). Studies on the chemistry control of some selected drinking and industrial waters. Pak. *J. Sci. Ind. Res.*, **48(3):** 174-179.

APHA (1989). Standard methods for the examination of water and wastewater, 17th ed. Washington, DC, American Public Health Association.

Bruvold, W.H. and H.J. Ongerth (1969). Taste quality of mineralized water. *Journal of the American Water Works Association*, **61:** 170.

Dara, S.S. (1997). A textbook of environmental chemistry and pollution control. Chand Publishing Company, New Delhi, India.

International Organization for Standardization (1985). Water quality—determination of electrical conductivity. Geneva.

Johnson, D.B. and K.B. Hallberg (2005). Acid mine drainage remediation options: A review. *Sci. Total Environ.*, **338:** 3-14.

Shashank, S., Singh, D. and S. Tiwari (2014). Drinking Water Quality of Rajasthan districts. *Journal of Basic and Applied Engineering Research*, **1(10):** 105-109.

Singh, T. and Y.P. Kalra (1975). Specific conductance method for in situ estimation of total dissolved solids. *Journal of the American Water Works Association*, **67(2):** 99.