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# Quantitative Studies on Physico- chemical Properties of Ground Water of Agra (Uttar Pradesh) India

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**ABSTRACT**

***Ground water is the water present beneath earth's surface in soil pore spaces and in the fractures of rock formations. Water is the principal need of life on earth, and is an essential component for all form so flives, from micro-organism to man. At present, people on earth are under tremendous threat due to undesired changes in the physical, chemical and biological characteristics of water. Now a days water is highly polluted with many harmful contaminants due to increased human population, industrialization, use of fertilizers, herbicides, pesticides and various man-made activities. It is necessary that the quality of drinking water should be checked at regular time interval, because due to use of contaminated drinking water, human population suffers from various water borne diseases. The unplanned urbanization and industrialization has resulted in over use of environment in particular of water resource. It is a known fact that when pure water is polluted, its normal functioning and properties are affected. In the investigation an attempt is made by the author to study the physico-chemical properties of potable ground water of Agra District Utter Pradesh (India).***

***Key words: Ground water, Total Hardness, Potable and Physico-Chemical Properties.***

## INTRODUCTION

The health burden of poor water quality is enormous. It is estimated that around 37.7 million Indians are affected by waterborne diseases annually, 1.5 million children are estimated to die of diarrhea alone and 73 million working days are lost due to waterborne disease each year. The resulting economic burden is estimated at $600 million a year. The problems of chemical contamination are also prevalent in India with 1, 95, 813 habitations in the country are affected by poor water quality. The major chemical parameters of concern are fluoride and arsenic. Iron is also emerging as a major problem with many habitations showing excess iron in the water samples.

The pressures of development are changing the distribution of water in our country. The average availability of water is reducing steadily with the growing population and it is estimated that by 2020 India will become a water stressed nation. Groundwater is the major source of water in our country with 85% of the population dependent on it (Khurana and Sen 2010).

According to a report of “water aid” India has 16 per cent of the world’s population and four per cent of its fresh water resources. Estimates indicate that surface and ground water availability is around 1,869 billion cubic meter (BCM) out of this, 40 per cent is not available for use due to geological and topographical reasons. Around 4,000 BCM of fresh water is available due to precipitation in the form of rain and snow, most of which returns to the seas via rivers. Ninety two per cent groundwater extracted is used in the agricultural sector; five and three per cent respectively for industrial and domestic sector (Gupta *et al*. 2006).

Water is not only universal solvent but is one of the most indispensable resources and is the elixir of life. Water constitutes about 70% of the body weight of almost all living organism. Life is not possible on earth without water. It exists in three states namely solid, liquid and gas. Water has neutral pH and it acts as a media for both chemical and biochemical reactions and also as internal and external medium for several organisms. About 97.3% of water on earth is salty and only 2.7% is present as fresh water out of which about 20% constitutes ground water.

The negative effects on ground water quality are the results of man's activity at ground surface, unintentionally by agriculture, domestic and industrial effluents, unexpectedly by sub-surface or surface disposal of sewage and industrial wastes. The quality of ground water is of great importance in determining the suitability of particular ground water for a certain use (public water supply, irrigation, industrial applications, power generation etc.). The quality of ground water is the resultant of all the processes and reactions that have acted on the water from the moment it condensed in the atmosphere to the time it is discharged by a well. Therefore, the quality of ground water varies from place to place, with the depth of water table, and from season to season and is primarily governed by the extent and composition of dissolved solids present in it. A vast majority of ground water quality problems are caused by contamination, over-exploitation, or combination of the both. Most ground water quality problems are difficult to determine and hard to resolve. The solutions are usually very expensive, time taking and not always effective. Ground water quality is slowly but surely declining everywhere. Ground water pollution is intrinsically difficult to detect, since problem may well be concealed below the surface and monitoring is costly, time consuming and somewhat hit-or-miss by nature. The wide range of contamination sources is one of the many factors contributing to the complexity of groundwater assessment. It is important to know the geochemistry of the chemical-soil-groundwater interactions in order to assess the fate and impact of pollutant discharged on to the ground.

Pollutants move through several different hydrologic zones as they migrate through the soil to the water table. The serious implications of this problem need an integrated approach in explicit terms to undertake ground water pollution monitoring programs. The major problem in urbanized areas is the collection and disposal of domestic wastes and hospitals. As huge volume of sewage is generated in a small area, the waste cannot be adequately disposed of by conventional septic tanks. Therefore, special disposal sites are being used to collect and dispose such wastes in densely populated areas (Patil *et al*. 2012).

## MATERIAL AND METHODS

It is very essential and important to test the water before it is used for drinking, domestic, agricultural or industrial purpose. Water must be tested with different physico-chemical parameters. Selection of parameters for testing of water is solely depends upon for what purpose we going to use that water and what extent we need its quality and purity. Water does content different types of floating, dissolved, suspended and microbiological as well as bacteriological impurities. Some physical test should be performed for testing of its physical appearance such as temperature, color, odour, pH, turbidity, TDS etc., while chemical tests should be perform for its alkalinity, hardness and other characters (Patil *et al*. 2012). For obtaining more and more quality and purity the water should be tested for its trace metal, heavy metal contents and organic i.e. pesticide residue. It is obvious that drinking water should pass these entire tests and it should content required amount of mineral level. Only in the developed countries all these criteria's are strictly monitored. Due to very low concentration of heavy metal and organic pesticide impurities present in water it need highly sophisticated analytical instruments and well trained manpower.

Water samples were collected from submersible pump at Sikandra Agra, (Uttar Pradesh) in October -2014. Samples were packed in 1 liter PET bottles and capped. 6 liter samples were send to Intertek India Pvt. Limited (Food Services) Plot No-68, Udyog Vihar Phase-1, Gurgaon, Haryana, India for testing of all physico-chemical parameter as per IS:10500-2012.

## RESULTS AND DISCUSSION

The detail of physico chemical properties of ground water of Sikandra, Agra along with maximum desirable limit and maximum permissible limit in the absence of alternative sources as per Bureau of Indian Standard IS: 10500 -2012 is given in Table-1.

By the above data it is clear that ground water quality of Agra is potable on the experimental site that is Sikandra. Physico-chemical properties of Ganga River have already been assessed by the author (Jaiswal, H. *et al*. 2013 & 2015).

A lot of works have been carried out by different investigators to study the physico-chemical properties of potable water as well as polluted water in different parts of India. Pawar Anusha *et al*. (2006) have studied the bore well and dug well water samples from a highly polluted industrial area, Nacharam.

Sample were collected and analysed for physico-chemical parameters by adopting the standard methods for examination of water and waste water. The analyzed samples obtained a high values, compared with drinking water standards.

Poonkothai and Parvatham (2005), analyzed physico-chemical and microbiological studies of automobile wastewater in Nammakkal, Tamil Nadu, India, indicated that the values for physico-chemical parameters were on the higher side of permissible limits of BIS.

**Table 1. Physico-chemical properties of ground water of Agra.**

| Serial No. | Tested Parameter with unit | Maximum Desirable limit | Maximum Permissible limit in the absence of alternate source | Result | Test method used |
|---|---|---|---|---|---|
| 01 | Color, Hazen unit | 5 | 15 | 1.0 | IS:3025 (P-4) |
| 02 | Odour | Agreeable | Agreeable | Agreeable | IS:3025 (P-5) |
| 03 | Taste | Agreeable | Agreeable | Agreeable | IS:3025(P-7,8) |
| 04 | Turbidity, NTU | 5 | <5 | 0.11 | IS:3025 (P-10) |
| 05 | pH | 6.5 to 8.5 | No relaxation | 6.89 | IS:3025 (P-11) |
| 06 | Chloride as Cl, mg/l | 250 | 1000 | 82.56 | IS:3025 (P-32) |
| 07 | Calcium, mg/l | 75 | 200 | 41.64 | IS:3025 (P-40) |
| 08 | Magnesium, mg/l | 30 | 100 | 19.57 | IS:3025 (P-46) |
| 09 | Total Hardness mg/l | 200 | 600 | 184.24 | IS:3025 (P-21) |
| 10 | Total Dissolved Solid, mg/l | 500 | 2000 | 443.7 | IS:3025 (P-16) |
| 11 | Residual free Chlorine, mg/l | 0.20 | 0.20 | Absent | IS:3025 (P-26) |
| 12 | Alkalinity, mg/l | 200 | 600 | 175.33 | IS:3025 (P-23) |
| 13 | Sulphate as $SO_4$, mg/l | 200 | 400 | 16.41 | IS:3025 (P-24) |
| 14 | Fluoride as F, mg/l | 1.0 | 1.5 | 0.14 | 23 of IS:3025 |
| 15 | Aluminum as Al, mg/l | 0.03 | 0.2 | Not detected | IS:3025 (P-55) |
| 16 | Nitrate as $NO_3$, mg/l | 45 | No relaxation | 5.22 | IS:3025 (P-34) |
| 17 | Boron as B, mg/l | 0.5 | 1.00 | Not detected | Annex H of IS:13428 |
| 18 | Copper as Cu, mg/l | 0.05 | 1.5 | Not detected | IS:3025 (P-42) |
| 19 | Iron as Fe, mg/l | 0.30 | No relaxation | Not detected | IS:3025 (P-53) |
| 20 | Manganese as Mn, mg/l | 0.1 | 0.3 | 0.01 | IS:3025 (P-35) |
| 21 | Mercury as Hg, mg/l | 0.001 | No relaxation | 0.0004 | IS:3025 (P-48) |
| 22 | Cadmium as Cd, mg/l | 0.01 | No relaxation | Not detected | IS:3025 (P-41) |
| 23 | Arsenic as As, mg/l | 0.01 | No relaxation | Not detected | IS:3025 (P-37) |
| 24 | Cyanide as CN, mg/l | 0.05 | No relaxation | Absent | IS:3025 (P-27) |
| 25 | Lead as Pb, mg/l | 0.05 | No relaxation | Not detected | IS:3025 (P-47) |
| 26 | Chromium as Cr, mg/l | 0.05 | No relaxation | Not detected | IS:3025 (P-52) |
| 27 | Zinc as Zn, mg/l | 5.00 | 15 | 0.1 | IS:3025 (P-49) |
| 28 | Selenium as Se, mg/l | 0.01 | No relaxation | Not detected | IS:3025 (P-56) |
| 29 | Phenolic Compounds | 0.001 | 0.002 | Absent | IS:3025 (P-43) |
| 30 | Mineral oils | Absent | Absent | Absent | IS:3025 (P-39) |

Microbiological studies revealed the presence of bacteria at high concentration and these organisms serves as indicators for pollutants. Rokade and Ganeshwade (2005) showed high

fluctuations in the physico-chemical parameters indicating the intensity of pollution. Kumar and Kumar (2012) analyzed the groundwater of Bijjoli area of Jhansi district for various physico-chemical parameters. They find that most of the physico-chemical parameters like alkalinity, turbidity, D.O, total hardness, nitrate, fluoride, iron and chloride are well within the acceptable limit.

## CONCLUSION

Although all the parameters are within maximum acceptable limit but the water is slightly acidic. From the result of above experiments author conclude that the ground potable water of Agra is though fit for drinking purpose yet it need few treatment to minimize some contaminations especially total hardness and fluoride which are reported to be on higher level.

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