



G- Journal of Environmental Science and Technology

(An International Peer Reviewed Research Journal)

Available online at <http://www.gjestenv.com>

Assessment of Physico-chemical and Biological quality of Ground Water in the Residential Area of Bareilly City, UP, India

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ARTICLE INFO

Received: 22 June 2018

Revised: 22 July 2018

Accepted: 29 July 2018

Key words

ground water; physico-chemical parameters; microbial quality; pollution

ABSTRACT

Supply of good quality drinking water is very important for the development and improvement of community. Health of any community is related to the safe drinking water. Most of the drinking water supply comes from the underground water in the city. In this study, analysis of physico-chemical and microbial quality was done in the five residential area of Bareilly city by using standard method. The physico-chemical characters of all the five drinking water samples were within the recommended permissible level of WHO. In all the five water samples the total plate count was above the WHO guideline values (<10CFU's/ml). The result of microbial activity demonstrates that water is polluted with fecal coliform and need to disinfect before use and in physico-chemical investigation it was found that the maximum parameter was not at the level of pollution. So, ground water samples of all the area satisfied the requirement for the use in various purposes.

1) INTRODUCTION

Water is an indispensable element of nature for the sustenance of life on the planet earth. It is available in the form of surface water and sub-surface water or ground water. All over the world, ground water is one of the important resources. Surface water is mostly used for public water supply system. Ground water is generally less sensible to contamination and pollution when compared to surface water bodies [1]. Natural impurities are also in rainwater, which get removed while infiltrating through soil strata. In India ground water is used extensively for irrigation and industrial purposes [2]. A variety of land and water based human activities are causing pollution of this precious resource [3]. Safe and pure drinking water is the basic need of every human being. Fresh water has become a rare commodity due to over exploitation and pollution of water. In many areas ground water is only fresh source available and in this world one fifth of the water used is acquired from the ground water resources. In many cities and small towns especially in the developing countries ground water forms an important resource of water, mainly as being inexpensive to exploit [4].

The rapid growth of population and the resultant increased demand of water. Secondly, the growing urbanization and the consequent pollution of surface water sources, also increase the necessity of using ground water for various domestic and industrial purposes. Since, ground water occupying a major portion of water supply for both domestic and industrial purposes nowadays, it is highly essential that, its quality should match the domestic water standards. In most of the industrial cities, the indiscriminate disposal of industrial

wastes on to the land is resulting in the deterioration of ground water quality due to the leachates from wastes.

However, due to the scarcity of adequate surface waters, perpetually the people are to be suggested for various uses its quality should be evaluated. Harm free drinking water has a cogent impact in the obstruction of water-related diseases. Ground water environment is different from other aquatic environment in that microorganisms are the dominant inhabitants. Water is the principal thing for human consumption. Various physico-chemical parameters like pH, Dissolved Oxygen (DO), Free CO₂, alkalinity, hardness, calcium, total solids (TS), total dissolved solids (TDS), Electrical conductivity (EC), Chloride etc have a significant role in determining the quality of drinking water [5]. Water served to consumers should be free from disease carrying bacteria, colourless, tasteless, having DO, free from poisonous material and excessive amount of mineral and organic matter. Underground water (water from deep borings and wells) generally irreversible i.e. once it is contaminated, it is difficult to restore the original quality of the aquifer.

The biological analysis of water is mainly based on the notion of fecal bacteria because it would be infeasible to accurately enumerate all pathogenic organisms that are transmitted by water [6]. The principle of the detection of selected bacteria that are exhibit of either contamination or deterioration of water quality has been the foundation upon which protection

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of public health from water borne diseases has been developed [7]. The presence of any coliform organism in drinking water is used as an indicator of fecal contamination since they are the most sensitive indicator bacteria for exhibiting excremental contamination [8]. Faecal indicator is a group of organisms that indicates the presence of fecal contamination, such as the thermo tolerant coliforms or E. coli. Hence, they only speculate that pathogens may be present in water.

2) MATERIALS AND METHODS

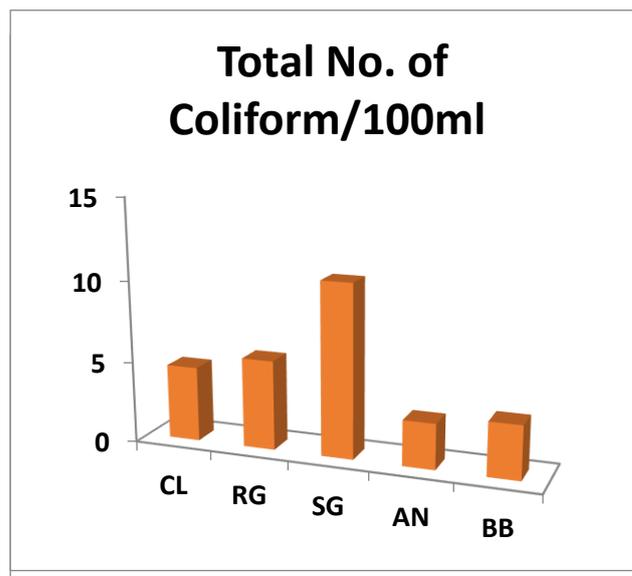
Water samples were collected for physico-chemical and microbiological analysis from five different sites Civil Lines (CL) Rampur Garden (RG), Shayam Ganj (SG) Azam Nagar (AN) and Bara Bazar (BB) of Bareilly city. Sample collection is a very vital part of study because conclusions drawn are based only on the testing of collected samples. Samples were collected in plastic bottles. Microbiological analysis of water sample was done within an hour of collections to avoid unpredictable change in the microbial populations. Samples were analyzed using standard methods for physico-chemical examination of water and waste water [9, 10].

Temperature, pH and dissolved oxygen (DO) were measured on the sampling spot. Colour was identifying by visual comparison method, Odor was observed by threshold odor test. Temperature and pH were measured by water analysis kit, dissolved oxygen by Winkler's method, total alkalinity by simple titration method and total hardness by EDTA titration method. Microbial analysis like isolation and calculation of bacterial colonies in CFU's/ml were performed.

3) RESULTS AND DISCUSSION

The averages of physico-chemical parameter of water samples collected from five sites of Bareilly city are given in table. In Microbial analysis on an average in water samples of Civil Lines (CL) 95.5 CFU's/ml, Rampur Garden (RG) 89.6 CFU's/ml, Shayam Ganj (SG)60CFU's/ml, Azam Nagar (AN) 95 CFU's/ml, Bara Bazar (BB) contains 93.5 CFU's/ml. The most probable number of coliform in the sample CL is 4.6/100 ml, RG is 5.5/100 ml, SG is 10.6/100 ml, AN is 2.8/100ml, BB is 3.3/100 ml

Parameters	Civil lines	Rampur Garden	Shyam Ganj	Azam Nagar	Bara Bazaar
	CL	RG	SG	AN	BB
pH	7.29	7.15	7.15	7.20	7.40
DO(mg/l)	21.36	22.4	25.6	21.43	20.32
Free CO ₂ (mg/l)	60	260	80	65	84
Alkalinity (mg/l)	260	390	330	270	400
Hardness (mg/l)	390	430	480	400	355
Calcium (mg/l)	64.07	84.2	75.10	70.5	160
TS(mg/l)	75	80	30	80	70
TDS(mg/l)	155.6	163.6	160.3	140.4	148.6
EC	73.0	73.5	107.3	76.2	85.0
Chloride (mg/l)	92.18	78.0	148.9	95.10	99.27
Iron	.09	.09	.20	.08	.07
Ferrous	.17	.14	.26	.15	.12



pH: pH is affected not only by the reaction of carbon dioxide but also by organic and inorganic solutes present in water [11]. Any alteration in water pH is accompanied by the change in other physico-chemical parameters. pH maintenance (buffering capacity) is one of the most important quality of any aquatic systems in all the biochemical activities depend on pH of the surrounding water. It was concluded that the pH range of all water samples within the acceptable limit of WHO i.e. 6.5-8.5. There is no anomalous change in the ground water samples. Long term expose to pH beyond the permissible limit affects mucous membrane of cells.

Dissolve Oxygen (DO): Dissolve oxygen is a very important parameter of water quality and an index of physical and biological process going on in water. In the present study, the maximum concentration of dissolved oxygen is 25.6 mg/l. Which favours solubility of oxygen among the study sites? DO is of great importance to all living organisms. It may be present in water due to direct diffusion from air and photosynthetic activity of autotrophs. Concentration of DO is one of the most important parameters to indicate water purity and to determine the distribution and abundance of various algal groups.

Free CO₂: Respiratory activity of aquatic organisms and the process of decomposition are important source of CO₂ in bodies of surface waters. The range of free CO₂ in all samples between 60-260 mg/l. highest range observed from RG Rampur garden and lowest from CL civil lines.

Alkalinity: Alkalinity of water is its capacity to neutralize a strong acid. In nature waters most of the alkalinity is caused due to CO₂. In samples value of alkalinity is obtained between the range of 330-400 mg/l. highest value observed from BB and lowest from SG.

Hardness: Hardness is an important parameter in decreasing the toxic effect of poisonous element and it is also the indicator of capacity of water to precipitate soap. The hardness was found to be in the range of 355-480 mg/l It is within desirable limit. The hardness of water increases in the polluted waters by the deposition of calcium and magnesium salts. In this study, the calcium values recorded between 64.7-160 mg/l. the highest value of 160 mg/l is observed in sample BB bara bazar and the lowest value of 64.07 mg/l is observed in sample

CL civil lines. For all the samples the value of calcium were found within the maximum permissible limit (200 mg/l).

Total Solids (TS): In present study the range of Total solid found between 30-80 mg/l. Highest range of Total solids obtained from two sites RG and AN and the lowest range was obtained from site SG. In the present study range of total solid found between 30-80 mg/l. According to [12] the portability of water with a TDS level less than 600mg/l is generally considered to be good.

Electrical conductivity (EC): It is a measure of capability of water to transmit electric current and also it is a tool to assess the purity of water [13]. Electrical conductivity found in the range 73.0-107.3 mmho/cm which were within the WHO maximum allowable limit of 50-1500 mmho/cm. High levels of conductivity and cations are the products of decomposition and mineralization of organic materials [14].

Chloride: The chloride value of samples was found within the range between 78.0-148.9 mg/l. The highest value of 148.9 mg/l is observed in sample SG shyam ganj and the lowest value of 64.07 mg/l is observed in sample RG Rampur garden. For all the samples the value of chloride were found within the maximum permissible limit.

Iron (Fe): Iron value found between the range of 0.07mg/l-.20mg/l. Highest range obtained from SG sites and lowest from the site BB. In present study range of ferrous found between 0.12-0.26. Highest range is observed in sample SG and lowest range is observed in sample BB. All the water samples analyzed had iron concentration below 0.3mg/l, which is the WHO standard for iron in drinking water.

4) CONCLUSION

This study reveals that samples collected from different sites of Bareilly city have physico-chemical parameters within the permissible limits of standards given by WHO and Indian standard. A comparative study of ground water was carried out by taking certain important parameter like pH, TDS, Alkalinity, Hardness, Chloride, Calcium, Iron etc. No sample crossed the permissible limit for physico-chemical parameters. The results of microbial activity indicate that water is contaminated with faecal coliform and need to disinfect before use. In the present investigation it was found that the maximum parameters were not at the level of pollution. Therefore, the ground water from these areas satisfied the requirement for the use in domestic purposes and unlikely to pose a major health risk to consumers.

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