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Assessment of The Physico-Chemical Parameters of Ground Water quality in Agra City

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Abstract

The minimum to maximum temperature value was observed 22ºC to 25.2ºC while pH value ranged between 7.2 (P-9) to 7.9 (P-1). The minimum to maximum Turbidity value was observed 5 (P-7) to 17.9 (P-11) NTU. The minimum to maximum TDS value was observed 1540 (P-10) to 4950 (mg/l (P-4). The minimum and maximum Total Hardness value was observed 240 (P-3) to 1250 mg/l (P-7). The minimum to maximum Calcium Hardness value was observed 75(P-3) to 436 mg/l (P-9). The minimum to maximum Magnesium Hardness value was observed 25.6 (P-6) to 139 mg/l (P-9). The highly positive correlated value was found between total hardness and Magnesium (0.944), TDS and Chloride (0.913). Highly negatively correlated value was, pH and (-0.640). The result comes out of study shows that the ground water in some areas is unfit for drinking purposes.

Keywords: Ground water, Agra City, Dissolved oxygen, Hardness, Total dissolved solids

INTRODUCTION

Water is an indispensable natural source on earth. Safe drinking wateris the primary need of every human being. Fresh water has become a scarce commodity, due to over exploitationand pollution of water. Groundwater is the major source of drinking water in both urban and rural areas [1]. Groundwater is the most important source of water supplyfor drinking and irrigation. Increasing population and itsnecessities lead to the deterioration of surface and sub surface water [2]. All metabolic and physiological activities and life processes of aquatic organisms aregenerally influenced by such polluted waste and hence, itis essential to study physio-chemical characteristics of water. For the human of whole world, the chemical and biological character of ground water is acceptable for most uses. The quality of ground water in some parts of India, is changing as a result of human activities. Due to freedom from bacterial pollution of ground water alone does not mean that water is fit to drink. Many unseen dissolved minerals and organic constituents are present in ground water in undesirable concentrations. Most are harmless or even beneficial; though occurring infrequently, other are harmful, and a few may be toxic. For examples too much Sodium in the water may be harmful to people who have heart problem. Water that contains a lot of Calcium and Magnesium is said to be hard. The hardness of water is of two types; Permanent and temporary hardness because the presence of Carbonate and Bicarbonate of calcium and magnesium. Drinking water considered soft if it contains 60 mg/l of hardness, moderately hard from 60 to 120 mg/L, and very hard more than 120 mg/L. Boron is a mineral that is good for plants in small amount 100 mg/L but toxic to some plants in only slightly larger (>100 mg/l) concentrations.

In the light of all these facts the work was demonstrate in the Agra City to access the

current ground water quality from twelve different sites to the city. The present study was investigated various Physico-chemical parameters like Temperature, pH, Electric conductivity, Turbidity, TDS, Alkalinity, Total Hardness, Ca^{++}, Mg^{++}, Na^{+}, K^{+} and Cl^{-}.

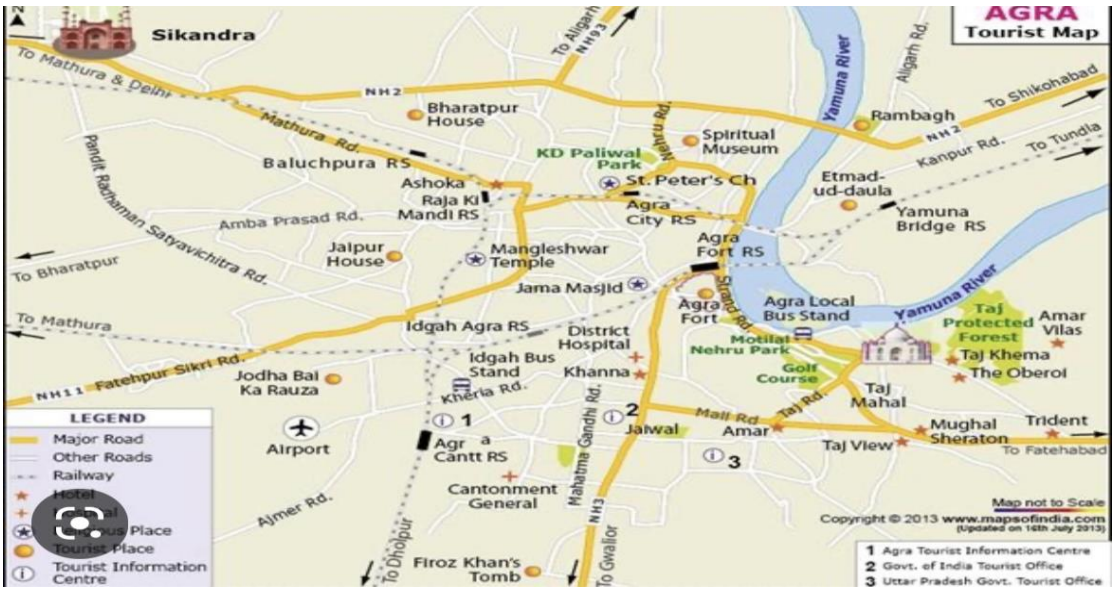
The availability of water determines the location and activities of humans in an area and our growing population is placing great demands upon natural fresh water resources [3]. The physicochemical contaminants that adversely affected the quality of groundwater is likely to arise from a variety of sources, including land application of agricultural chemicals and organic wastes, infiltration of irrigation water, septic tanks, and infiltration of effluent from sewage treatment plants.

MATERIAL AND METHODS

Study Area: Agra is situated on the bank of Yamuna River. Underground water samples were taken from twelve different selected area of Agra city namely (Pashchimpuri-P1), (Shastripuram-P2), (Dayalbagh-P3), (Khandari-P4), (Haripawat-P5), (Shahganj-P6), (Bodala-P7), (Lohamandi-P8) (Tajganj-P9), (Madhunagar-P10), (Belangunj-P11), and (Raja ki mandi-P12) were taken for the study.

Sample storage and preservation: To minimize the potential for volatilization or biodegradation between sampling and analysis, the samples are kept as cool as possible without freezing. Preferably pack samples in crushed or cubed ice or commercial ice substitutes before shipment. Dry ice was avoided because it will freeze samples and may cause glass containers to break. Dry ice also may effect a pH change in samples. Samples are analyzed as quickly as possible after arrival at the laboratory.

Fig: Location of water sample cllection



PARAMETERS:

- **pH:** pH is the measure of the intensity of acidity or alkalinity and measures the concentration of hydrogen ion concentration in water. It was measured by using the pH meter.
- **TDS:** Total dissolved solid or simply solids are mainly the inorganic mineral and some organic matter. There are large unity of state such as Cl^{-}, $CO^{=}_{3}$, HCO^{-}_{3}, NO^{-}_{3}, PO^{-3}_{4}, and $SO^{=}_{4}$ of Ca^{++}, Mg^{++}, Na^{+}, K^{+}, & F^{-} etc which import certain taste to water measurement.

- **Total Hardness:** The total hardness in water is defined as the summary concentration of calcium and magnesium cations expressed in milligram equivalent ions present in water and the standard formula id used for the Calcium hardness, magnesium hardness and total hardness.

$$Hardness\ in \frac{mg}{l}\ CaCO_3 = \frac{Volume\ of\ EDTA\ \times 1000}{Volume\ of\ water\ sample\ taken}$$

- **Calcium hardness:** Many indicators such as ammonium purpurate (MX), form a complex with only calcium but not with magnesium at higher pH

$$Calcium\ or\ CaCO_3(mg/l) = \frac{volume of EDTA \times 1000}{volume\ of\ water\ sample\ Taken}$$

Magnesium Hardness: Magnesium hardness can be calculated by applying following formula: Magnesium (mg/l) = Total hardness - calcium hardness

RESULTS AND DISCUSSION

The BIS Parameters for physico-chemical characteristics of Ground water of the study are presented in given table:

S. No.	Parameter	Requirement Desirable Limit
1.	Temperature	--
2.	pH	6.5-8.5
3.	Turbidity	1 NTU
4.	Dissolve Oxygen	5 mg/lit
5.	Total Dissolved Solid	500 mg/lit
6.	Total Hardness	300 mg/lit
7.	Ca^{++}	75 mg/lit
8.	Mg^{++}	30 mg/lit
9	Na^{+}	200
10	K^{+}	130
11	Cl^{-}	250

The value of different physico-chemical parameters observed in the whole study is given below:-

Temperature: Temperature variation occurs due to change in earth temperature. During the present investigation, there were no great variations obtained in the temperature of the underground water. This shows the average variation during the whole study.

pH: The pH of underground water ranged from a minimum of 7.2 to a maximum of 7.9 of P1 to P12 respectively (Table-2). During the present investigation a pattern of pH change was noticed. In underground water the maximum value of pH, which indicates the alkaline nature of water might be due to high temperature that reduces the solubility of CO_2.

The simple linear correlation analysis has been carried out to find out correlation between two tested parameters.

RESULT AND DISCUSSION

The average results of the physicochemical parameters for water samples are presented in Table 1 and

matrix of correlation among different parameters are shown in table 2.

The quality of water resources depends on the management of the water sources. This would include anthropogenic discharge as well as the natural physicochemical properties of the area.

pH

pH is considered as an important ecological factor and provides an important piece factor and piece of information in many type of geochemical equilibrium or solubility calculation (Shyamala et al., 2008). The maximum pH was recorded as 7.9 at sampling location P1 and minimum was 7.2 at P9. When composed with the standard values of WHO and IS 10500-91, the samples are found to be in the permissible limit as prescribed.

EC

Electrical Conductivity is a useful tool to evaluate the purity of water (Acharya et al., 2008). EC values were in the range of 2500 (P-5) to 4200 micromhos/cm (P-9). EC values for all the investigated samples were found to be greater than the limit prescribed by WHO. High EC values indicate the presence of high amount of dissolved inorganic substances in ionized form.

TDS

Total Dissolved Solids usually related to conductivity. Water containing more than 500 mg/l of TDS is not considered desirable for drinking water supplies, though more highly mineralized water may be used where better quality water is not available (Jain, 2002). The maximum value of TDS during the study period was found as 4950 mg/l at sampling location P-4 and minimum was 1020 mg/l at P-11. The TDS values of all the water samples of the selected places are greater than the limit prescribed by BIS-10500-91.

Turbidity

In most waters, turbidity is due to colloidal and extremely fine dispersions. The turbidity values varied between 7 NTU (P10),(P5) to 31.4 NTU (P-9). Of the total investigated samples, 50% water samples shows greater value than the limit prescribed by BIS.

Total Alkalinity

Alkalinity value in water provides an idea of natural salts present in water. The cause of alkalinity is the minerals which dissolve in water from soil. The various ionic species that contribute to alkalinity includes carbonate, bicarbonate, hydroxide, phosphate, borate and organic acids. These factors are characteristics of the source of water and natural processes taking place at any given time [4]. The maximum value of alkalinity was found as 525 mg/l at sampling location P-10 and minimum 330 mg/l at P-9 and found greater than the limit prescribed by WHO.

Total Hardness

Hardness is the property of water which prevents the lather formation with soap and increases the boiling points of water [5]. Total Hardness was found in the sample water ranges from 240 mg/l (P3) to 1425 mg/l (P-4), which shows the values higher than the permissible limit prescribed by WHO. According to some classifications, water having hardness upto 60 mg/l us classified as soft, 61-120 mg/l is moderately soft, 121-180 mg/l as hard and more than 300 mg/l as very hard [6]. On this basis, the results show that all the samples were very hard except Sample P-3.

Chloride

Chloride usually occurs as NaCl, $CaCl_2$ and MgCl in widely varying concentration, in all natural

waters. They enter water by solvent action of water on salts present in the soil, from polluting material like sewage and trade wastes [7]. The maximum value of chloride was recorded as 1140 mg/l at sampling location P-4 and minimum was 295 mg/l (P-5).

Calcium and Magnesium

The source of calcium and magnesium in natural water are various types of rocks, industrial waste and sewage [8]. The values of calcium varied from 75 mg/l (P-3) to 436 mg/l (P9) and the values of magnesium ranged from 25.6 mg/l (P-6) to 130.5 mg/l (P-8).

Sodium

Sodium concentration was found in between 126.5 mg/l(P-11)to 1254.9 (P-6) . All the samples were found greater than the permissible limit of WHO except the sampling point P-1,P-2, P-3, P-11 and P-12.

Potassium

The major source of potassium in natural fresh water is weathering of rocks but the quantities increase in the polluted water due to disposal of waste water [9]. It was varied between 2.1 mg/l (P-3) to 60.6 mg/l (P-6).

Interrelationship studies between different variables are very helpful tools in promoting research and opening new frontiers of knowledge. The study of correlation reduces the range of uncertainty associated with decision making. The correlation co-efficient 'r' was calculated using the equation.

$$r = \frac{N\sum(XY) - (\sum X)(\sum Y)}{\sqrt{[N\sum\sum X2 - (X)2][N\sum\sum Y2 - (Y)2]}}$$

Where, x and y represents two different parameters,

N =Number of total observation

The high positively correlated values were found between Total hardness and Calcium (0.944), Chloride and TDS (0.913), Magnesium and E.C. (0.666), Calcium and Total Hardness (0.844), Magnesium and Total Hardness (0.944), and total hardness and TDS (0.708) While the negatively correlated values were found between Total Alkaline and Chloride (-0.079), Magnesium and pH (-0.419), and pH is negatively correlated with most of the parameters. However, Total Alkalinity is negatively correlated with all parameters.

Table 1: Average results of the physiochemical parameters

Parameters	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
pH	7.9	7.6	7.7	7.4	7.3	7.6	7.5	7.5	7.2	7.4	7.7	7.6
EC	3100	2700	3200	3400	2500	2650	3450	4350	4200	2600	3200	3600
TDS	1235	1315	2770	4950	1065	1435	2780	3270	3635	1540	1020	1600
Turbidity	10.8	8	9	6	7	9	5	9	31.4	7	17.9	6.9
T.A.	512	450	455	395	340	385	395	390	330	525	345	350
T. Hard	674	700	240	1425	460	535	1250	955	1160	840	675	580
Chloride	305	425	1050	1140	295	429	1070	1060	980	535	320	405
Calcium	148	174	75	333	134	172	294	168	436	186	137	180
Magnesium	74.1	64.6	14.6	151.2	30.5	25.6	125.6	130.5	139	95.1	81.1	75
Sodium	162	140	153.5	715	1030	1254.9	520	650	484.9	439.9	126.5	124.6
Potassium	8.4	5.1	2.1	8.5	47.5	60.6	10.2	11.2	21.5	11.2	3.9	12.6

Table; 2 Pearson metric between different Parameters

Parameters	pH	EC	TDS	Turbidity	T. Alkali	T. Hard.	Chloride	Calcium	Mag.	Sod.	Pot.
pH	1	-0.191	-0.436	-0.275	0.445	-0.473	-0.355	-0.640	-0.419	-0.486	-0.318
EC	-0.191	1	0.636	0.454	-0.386	0.484	0.634	0.492	0.666	-0.189	-0.351
TDS	-0.436	0.636	1	0.146	-0.175	0.708	0.913*	0.662	0.683	0.139	-0.250
Turbidity	-0.275	0.454	0.146	1	-0.378	0.155	0.070	0.495	0.255	-0.147	-0.003
T Alka.	0.445	-0.386	-0.175	-0.378	1	-0.135	-0.079	-0.335	-0.140	-0.317	-0.365
T. Hard.	-0.473	-0.473	0.708	0.156	0.156	1	0.583	0.844*	0.944*	0.124	-0.237

CONCLUSION

Analysis of water samples collected from various locations of Agra City revealed that all water samples do not completely with BIS, WHO standards and Indian Standards-10500-91. Groundwater in Agra region requires precautionary measures before drinking so as to prevent adverse health effects on human beings.

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