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STUDY AND ANALYSIS OF WATER QUALITY OF KOTA CITY BY VARIOUS EXPERIMENTAL METHODS

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Abstract

The present study the quality of drinking water supplied to the various areas of the city, through tap, which includes tests for temperature, pH value, total solids, hardness and chlorine. Kota is one of the most important industrial complexes city in the state of Rajasthan which has Integrated Thermal Power Plant, a number of coaching institutes, cement manufacturing unit, chemicals, explosives, ceramics and distillery units and large number of small and medium industries. A water quality standard is a rule or law comprised of the uses to be made of a water body or segment and the water quality criteria necessary to protect that uses.

The average temperature, concentration of pH, turbidity, TDS (Total Dissolved Solids), total hardness, alkalinity and chloride are found to be 27.38 ^{0}C, 7.37, 2.438 NTU, 156.8 mg/l, respectively. The results obtained from the water quality criteria parameter are within the drinking water standard. (IS: 10500).

Keywords: *Water quality, IS: 10500, pH, Hardness, TDS, Residual chlorine, Turbidity.*

I. INTRODUCTION

All biological reactions occur in water and it is the integrated system of biological metabolic reactions in an aqueous solution that is essential for the maintenance of life. Most human activities involve the use of water in one way or other. It may be noted that man ‘s early habitation and civilization sprang up along the banks of rivers. Although the surface of our planet is nearly 71% water, only 3% of it is fresh. Of these 3% about 75% is tied up in glaciers and polar icebergs, 24% in groundwater and 1% is available in the form of fresh water in rivers, lakes and ponds suitable for human consumption (Dugan, 1972). Due to increasing industrialization on one hand and exploding population on the other, the demands of water supply have been increasing tremendously. Moreover, considerable part of this limited quality of water is polluted by sewage, industrial waste and a wide range of synthetic chemicals. Fresh water which is a precious and limited vital resource needs to be protected, conserved and used wisely by man. But unfortunately, such has not been the case, as the polluted lakes, rivers and streams throughout the world testify. According to the scientists of National Environmental Engineering Research Institute, Nagpur, India, about 70 % of the available water in India is polluted (Pani, 1986).

Water quality parameters taken in account are:

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pH: A figure expressing the acidity or alkalinity of a solution on a logarithmic scale on which 7 is neutral, lower values are more acid and higher values more alkaline. The pH is equal to −log10 *c*, where *c* is the hydrogen ion concentration in moles per litre.

Turbidity**:** is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air. The measurement of turbidity is a key test of water quality.

Dissolved solids" refer to any minerals, salts, metals, cations or anions dissolved in water. Total dissolved solids (TDS) comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulphates) and some small amounts of organic matter that are dissolved in water.

Differences in water temperature and density cause stratification. A property that is unique to water versus other substances is that it is most dense at 4 degrees Celsius, or 39 degrees Fahrenheit, and is less dense at either higher or lower temperatures.

A chlorine residual is a low level of chlorine remaining in water after its initial application. It constitutes an important safeguard against the risk of subsequent microbial contamination after treatment—a unique and significant benefit for public health. Calcium and magnesium dissolved in water are the two most common minerals that make water "hard." The hardness of water is referred to by three types of measurements: grains per gallon, milligrams per liter (mg/L), or parts per million (ppm).

II. EXPERIMENTAL METHODOLOGY

The water samples were analyzed for various parameters in the laboratory of Environmental Engg, Career Point University, Kota. Various physical and chemical parameters like Temperature, pH, Turbidity, Total Dissolved Solids (TDS), Hardness, Residual Chlorine, have been monitored for the tap water of different locations. Plastic bottles of 1 liter capacity with stopper were used for collecting samples. Each bottle was washed with 2% Nitric acid and then rinsed three times with distilled water. The bottles were then preserved in a clean place. The bottles were filled leaving no air space, and then the bottle was sealed to prevent any leakage. Each container was clearly marked with the name and date of sampling.

Sampling Points:

- Vigyan Nagar
- Anantpura
- Dadabari
- Nayapura
- Kunhari
- Rajeev Gandhi Nagar
- Thermal Colony
- CPU Campus

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III. WATER QUALITY PARAMETERS

The results of the analyzed parameters of tap water of the different locations of Kota city are compared with the related standards for drinking water prescribed by IS:10500 and USPHS. The drinking water standard is given in the table 1

Table 1: Drinking water parameters

S.No.	Parameters	Desirable limits mg/l	Permissible limits mg/l
1	Odour	Unobjectionable	-
2	Taste	Agreeable	-
3	Turbidity(NTU)	5	10
4	pH	6.5-8.5	No relaxation
5	Hardness	300	600
6	Residual Chlorine	0.2	-
7	TDS	500	2000

- Temperature of the tap water from Vigyan Nagar, Anantpura, Dadabari, Nayapura, Kunhari, Rajeev Gandhi Nagar, CPU Campus, Thermal Colony.
- pH value of the tap water from Vigyan Nagar, Anantpura, Dadabari, Nayapura, Kunhari, Rajeev Gandhi Nagar, CPU Campus, Thermal Colony .
- Total Dissolved solids of the tap water from Vigyan Nagar, Anantpura, Dadabari, Nayapura, Kunhari, Rajeev Gandhi Nagar, CPU Campus, Thermal Colony.
- Turbidity of the water samples from Vigyan Nagar, Anantpura, Dadabari, Nayapura, Kunhari, Rajeev Gandhi Nagar, CPU Campus, Thermal Colony.
- Total hardness of the water samples from Vigyan Nagar, Anantpura, Dadabari, Nayapura, Kunhari, Rajeev Gandhi Nagar, CPU Campus, Thermal Colony.
- Presence of residual chlorine in the water samples from Vigyan Nagar, Anantpura, Dadabari, Nayapura, Kunhari, Rajeev Gandhi Nagar, CPU Campus, Thermal Colony.

IV. METHODOLOGY FOR THE MEASUREMENT OF TEMPERATURE

Procedure:

- Temperature was measured with the thermometer immersed directly in the water body,after a period of time sufficient to permit constant reading.

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- Make measurement of the temperature of a water body at a particular depth with the thermometer immersed directly in the water body. After sufficient time has elapsed to allow the thermometer to come to the exact temperature of the water, take a reading.

V. METHODOLOGY FOR MEASUREMENT OF pH VALUE (ELECTROMERIC METHODS)

Apparatus

- pH meter - With glass and reference electrode (saturated calomel), preferably with temperature compensation.
- Thermometer - With least Count Of 0.5°C.

Procedure

After required warm-tip period, standardize the instrument with a buffer solution of pH near that of the sample and check electrode against at least one additional buffer of different pH value. Measure the temperature of the water and if temperature compensation is available in the instruments adjust it accordingly. Rinse and gently wipe the electrodes with solution. If field measurements are being made, the electrodes may be immersed directly in the sample stream to an adequate depth and moved in a manner to ensure sufficient sample movement across the electrode sensing element as indicated by drift free readings (< 0.1 pH unit). If necessary, immerse them into the sample beaker or sample stream and stir at a constant rate to provide homogeneity and suspension of solids. Rate of stirring should minimize the air transfer rate at the air-water interface of the sample. Note and record sample pH and temperature However, if there is a continuous drift, take a second reading with the fresh aliquot of sample without stirring and report it as the pH value.

VI. METHODOLOGY FOR MEASUREMENT OF TURBIDITY

Apparatus

- Sample Tubes - The sample tubes should be of clear and colorless glass.
- Turbidity meter- The turbidity meter shall consist of a nephelometer with a light source for illuminating the sample and one or more photo electric detectors with a readout device to indicate the intensity of light scattered at right angles to the path of the incident light. The turbidimeter should be so designed that little stray light reaches the detector in the absence of turbidity and should be free from significant drift after a short warm-up period.

Procedure

- Turbidity meter Calibration-Follow the manufacturer ‘s operating instructions. Measure the standards on turbidimeter covering the range of interest. If the instrument is already calibrated in standard turbidity units, this procedure will check the accuracy of calibration.
- Turbidity less than 40 units - Shake the sample to disperse the solids. Wait until air bubbles disappear. Pour sample into turbidimeter tube and read turbidity directly from the instrument scale or from calibration curve.

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VII. METHODOLOGY FOR MEASUREMENT OF TOTAL DISSOLVED SOLIDS

Apparatus

Preparation of Glass Fiber Filter Disc- Place the glass fiber filter on the membrane filter apparatus or insert into bottom of a suitable Gooch crucible with wrinkled surface up. While vacuum is applied, wash the dish with three successive 20 ml volumes of distilled water. Remove all traces of water by continuing to apply vacuum after water has passed through. Remove filter from membrane filter apparatus (or both crucible and filter, if Gooch crucible is used) and dry in an oven at 103-105°C for 1 hour. Transfer to a 16 desiccator and weigh after half an hour. Repeat the drying cycle until a constant mass is obtained (mass loss is less than 0.5 mg in successive weighing). Weigh immediately before use. After weighing, handle the filter or crucible filter with forceps or tongs only.

Procedure

- If determinations are to be carried out at 180°C then the filter or crucible/filter shall be dried at 180°C.
- Sample Volume- In potable waters non-filterable residue is usually small. Relatively large volume of water is passed through filter so as to obtain at least 2.5 mg residue. For deciding volume to be taken, turbidity values may be taken into consideration. If turbidity values of a sample is less than 50 units, filter 1 liter sample and if turbidity value exceeds 50 units, filter sufficient sample so that nonfilterable residue is 50 to 100 mg.
- Stir volume of sample with a magnetic stirrer or shake it vigorously. Assemble the filtering apparatus and begin suction. Wet the filter with a small volume of distilled water to seat it against the fitted support.
- Shake the sample vigorously and quantitatively transfer the predetermined sample volume selected according to 4.2 to the filter using a graduated cylinder. Remove all traces of water by continuing to apply vacuum after sample has passed through.
- With suction on, wash the graduated cylinder, filter non-filterable residue with portions of distilled water allowing complete drainage between washings. Remove all traces of water by continuing to apply vacuum after the wash water has passed through.
- After filtration, transfer the filter along with contents to an oven maintained at either 103-105°C or 179-181°C for at least 1 hour. Cool in a desiccator and weigh. Repeat the drying cycle till constant mass is obtained. Alternatively, remove crucible and filter from crucible adapter, wipe dry from outside with filter paper and dry at 103-105°C or 179-181°C in an oven. Cool in a desiccator and weigh. Repeat the drying cycle to constant mass till the difference in the successive mass is less than 0.5 mg.

VIII. METHODOLOGY FOR MEASUREMENT OF TOTAL HARDNESS EDTA METHOD (ETHYLENEDAIMINE TETRAACETIC ACID)

Reagents

- Buffer solution- Dissolve 16.9 g ammonium chloride (NH_4Cl) in 143 ml concentrated ammonium hydroxide (NH_4OH), add 1.25 g of magnesium salt of EDTA and dilute to 250 ml with distilled water. Store the solution in a polyethylene bottle tightly stoppered to prevent loss of ammonia or pick-up of

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carbon dioxide for no longer than 1 month. Dilute 10 ml of the solution to 100 ml with distilled water and check that the pH value is 10.0 ± 0.1.

- Standard calcium solution- 1.00 ml = 1.00 mg calcium carbonate (CaCO3). Dry analytical grade calcium carbonate (CaCO3) in an oven at 180°C for 1 hour. Weigh 1.000 g, suspend it in distilled water and add 1:1 hydrochloric acid AR quality, drop wise slowly to dissolve the solid. Use minimum amount of acid. Boil for a few minutes, cool, add a few drops of methyl red indicator and adjust to orange colour with 3N ammonium hydroxide or 1 : 1 hydrochloric acid. Dilute to 1 000 ml with distilled water.
- Eriochrome black T indicator solution- Dissolve 0.40 g eriochrome black T and 4.5 g hydroxylamine hydrochloride (NH2OH HCl) in 100 ml 95 percent ethanol. This indicator is stable for more than 2 months. Alternatively, dissolve 0.5 g eriochrome black T in 100 ml triethanolamine or 2-methoxyethanol or mixed 0.5 g EBT dye and 100 g sodium chloride in a pestle and mortar. Store in a tightly stoppered bottle. All indicator formulations tend to deteriorate especially when exposed to moisture. If the end point color change is not sharp enough it is either due to the presence of some interfering ions or due to deterioration of the indicator. In the latter case, addition of inhibitor sodium cyanide or sodium sulphide (NaCN or Na2S) does not sharpen the end point color change.

Procedure

- Standardization — Pipette 25.0 ml of standard calcium solution in a porcelain basin and adjust the volume to 50 ml with distilled water. Add 1 ml buffer solution.
- Add 1 to 2 drops of indicator. Titrate slowly with continuous stirring until the redish tinge disappears, adding last few drops at 3 to 5 second interval. At the end point the colour is sky blue.

Calculation:

$$\text{Total hardness as (CaCO3), mg/l} = \frac{100(V_1 - V_2)}{V_3} \times CF$$

Where:

V_1= volume in ml of the EDTA standard solution used in the titration for the sample

V_2= volume in ml of the EDTA standard solution used in the titration for blank,

V_3= volume in ml of the sample taken for the test,

CF=X_1/X_2= correction factor for standardization of EDTA

X_1= volume in ml of standard calcium sol. Taken for standardization,

X_2= volume in ml of EDTA solution used in the titration

XI. METHODOLOGY FOR MEASUREMENT OF RESIDUAL CHLORINE

Reagent & Apparatus: Orthotolidine, reagent, Comparatur tube, color chart from the test kit.

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Procedure:

- Take the sample in a comparator tube.
- Add 5 to 10 drops of orthotolidine reagent to one of the comparator tube and compare the color in the comparator which gives mg/L of chlorine and proceed.

XII. RESULT

TABLE 2: TEST READINGS

SerialNo.	Place	Temp.(ºC)	Turbidity (NTU)	TDS (mg/l)	Hardness (mg/l)	pH	Residual Chlorine (ppm)
1	Thermal Colony	21	2.3	117	6.88	7.33	0.0
2	Vigyan Nagar	24	0.5	124	7.2	7.0	2.0
3	Rajeev Gandhi Nagar	28	2.1	304	17.88	7.30	0.0
4	Nayapura	26	0.9	366	21.52	7.32	0.0
5	Kunhari	20	3.2	120	7.05	7.36	2.0
6	Dadabari	22	2.3	123	7.23	7.23	1.0
7	Anantpura	23	2.7	125	7.35	7.12	0.5
8	CPU	31	0.8	115	6.76	7.10	0.0

XIII. CONCLUSION

The average ranges of physical, chemical and biological characteristics of water quality are as per the ground water quality. The pH ranges from 7.0 to 7.36. The Turbidity, TDS ranged from 2.31 to 2.56 NTU, 115 to 366 mg/l respectively. The value of Turbidity was found to be within the permissible limit in all. Hardness, ranged from6.76 to 21.52mg/l and it is found that the water supplied to these areas is soft. The value of Residual Chlorine was from 0.0 to 2.0 ppm which is quite harmful as the permissible limit is 0.2 ppm according to the guidelines of IS: 10500. The parameters studied resemble the drinking water quality.

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