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ANALYSIS OF GROUND WATER QUALITY PARAMETERS: A CASE STUDY

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ABSTRACT

The study in this paper is based on the analysis of quality of drinking water of various areas of Village Simbhaoli, Hapur, U.P., India. In this study, the parameters for drinking water are pH test, Taste Test, Dissolved oxygen test, Colour Test, Chloride Test, sulphate Test, Turbidity test & Hardness Test. We found that pH value is 7.4 i.e more than the required pH value (7) of drinking water, taste of water is salty and color of water is yellowish while biochemical oxygen demand, chloride, turbidity, sulphate and hardness are in acceptable range. The water of area near the mill and factory is more polluted as compared to distant area. The study definitely will result in evolution of some cost effective technology or alternative method to improve the water quality.

Keywords: *pH, Dissolved oxygen, Turbidity, Biochemical Oxygen Demand.*

I. INTRODUCTION

Water is one of the five elements described in "SHASTRA" to form life. Pure water means that the water collected from a properly protected sources and subjected to an adequate system of purification, which must be free from visible suspended matter, colour, odour and taste devoid of an objectionable bacteria and contain no dissolved matter of mineral or organic origin otherwise the water quality would be dangerous to health. Water pollution means when insoluble solid particles, soluble salts, sewage garbage, low level radioactive substances, industrial wastes, algae, bacteria, etc. go into water, water gets polluted. Water fit for human consumption is called drinking water or "potable water". Water that is not specifically made for drinking, but is not harmful for humans when used for food preparation is called safe water [1]. The

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Simbhaoli is located in 82.7620° N, 77.9867° E. It falls in Hapur Division of Uttar Pradesh State with a population of approximately Seven Thousands. It is surrounded by Himmatpur in North, Baxur in East, Khudliya in West and Baddha Village in South. Hapur district has only 5% surface water and 95% ground water. In Hapur tube wells, open wells, and hand pumps are parts of ground water and some river and tanks (about 1%) are part of surface water. All parameters of water viz., pH, salinity, total dissolved solid, calcium hardness, magnesium hardness, fluoride, nitrate, etc. should be in fixed concentration. Most of the population of the village is lower middle class and not aware about the drinking water quality and uses the available water only, thus facing the problem of water born diseases like jaundice, ulcer gastrointestinal troubles, etc. Thus, the hygienic conditions of water are very poor in areas of Village Simbhaoli. The main objective of this study is to identify and analyze the harmful water quality parameters of rural areas of Simbhaoli.

II. LITERATURE REVIEW

Devendra D. et al. [2], carried out the assessment of the ground water quality in different wards of Indore City. The present work is aimed at assessing the water quality index (WQI) for the ground water of Indore City and its industrial area. The ground water samples of all the selected stations from the wards were collected for a physiochemical analysis. For calculating present water quality status by statistical evaluation and water quality index, following 27 parameters have been considered Viz. pH, color, total dissolved solids. electrical conductivity, total alkalinity, total hardness, calcium, chromium, zinc, manganese, nickel. The obtained results are compared with Indian Standard Drinking Water specification IS: 10500-2012. Water quality is dependent on the type of the pollutant added and the nature of mineral found at particular zone of bore well. Monitoring of the water quality of ground water is done by collecting representative water samples and analysis of physicochemical characteristics of water samples at different locations of Indore City. Estimation of water quality index through formulation of appropriate using method and evaluate the quality of tube well water by statistical analysis for post and pre monsoon seasons.

S. P. Gorde et al. [3], due to use of contaminated water, human population suffers from water borne diseases. It is therefore necessary to check the water quality at regular interval of time. Parameters that may be tested include temperature, pH, turbidity, salinity, nitrates and phosphates. An assessment of the aquatic macro invertebrates can also provide an indication of water quality.

Gang L. et al. [4] focussed on the development of water purification technologies and water quality regulations, the use of better source water and/or upgraded water treatment processes to improve drinking water quality have become common practices worldwide. However, even though these elements lead to improved water quality [5], the water quality may be impacted during its distribution through piped networks due to the processes such as pipe material release, biofilm formation and detachment, accumulation and resuspension of loose deposits. Irregular changes in supply-water quality may cause physiochemical and microbiological de-stabilization of pipe material, biofilms and loose deposits in the distribution system that have been established over decades and may harbor components that cause health or esthetical issues (brown water).

III. COLLECTION OF SAMPLES

Grab samples: Grab samples are single collected at a specific spot at a site over a short period of time (typically seconds or minutes). Thus, they represent a “snapshot” in both space and time of a sampling area. Discrete grab samples are taken at a selected location, depth, and time. Depth-integrated grab samples are collected over a predetermined part of the entire depth of a water column, at a selected location and time in a given body of water.

Composite samples: Composite samples should provide a more representative sampling of heterogeneous matrices in which the concentration of the Analysis of interest may vary over short periods of time and/or space. Composite samples can be obtained by combining portions of multiple grab samples or by using specially designed automatic sampling devices. Sequential (time) composite samples are collected by using continuous, constant sample pumping or by mixing equal water volumes collected at regular time intervals. Flow-proportional composites are collected by continuous pumping at a rate proportional to the flow, by mixing equal volumes of water collected at time intervals that are inversely proportional to the volume of flow, or by mixing volumes of water proportional to the flow collected during or at regular time intervals.

Advantages of composite samples include reduced costs of analyzing a large number of samples, more representative samples of heterogeneous matrices, and larger sample sizes when amounts of test samples are limited.

Integrated (discharge-weighted) samples: For certain purposes, the information needed is best provided by analyzing mixtures of grab samples collected from different points simultaneously, or as nearly so as possible, using discharge-weighted methods such as Equal-Width Increment (EWI) or Equal Discharge-Increment (EDI) procedures and equipment. An example of the need for integrated sampling occurs in a river or stream that varies in composition across its width and depth. To evaluate average composition or total loading, use a mixture of samples representing various points in the cross-section, in proportion to their relative flows. The need for integrated samples also may exist if combined treatment is proposed for several separate wastewater streams, the interaction of which may have a significant effect on treatability or even on composition. Mathematical prediction of the interactions among chemical components may be inaccurate or impossible and testing a suitable integrated sample may provide useful information.

IV. METHODOLOGY

Measurement of pH using a pH meter

- The electrodes are either immersed in, or have been rinsed with, distilled water. Remove them from the water and blot dry.
- Rinse the electrodes and a small beaker with a portion of the sample.
- Pour sufficient of the sample into the small beaker to allow the tips of the electrodes to be immersed to a depth of about 2 cm. The electrodes should be at least 1 cm away from the sides and the bottom of the beaker.
- Measure the temperature of the water sample and set the temperature adjustment dial accordingly (if the instrument does not have automatic temperature compensation).
- Turn on the pH meter.
- Read the pH of the water sample on the dial of the meter. Make sure that the needle has stopped moving before the pH is recorded.

A. Tastes

Simple method of taste is used and the standard method of taste is not used.

B. Dissolved Oxygen Electrometric method

Battery-powered meter. This is a meter designed specifically for dissolved oxygen measurement. Other meters, such as a specific ion meter or an expanded scale pH meter, may also be used.

C. Biochemical Oxygen Demand

A bioassay test, involving measurement of oxygen consumed by micro-organisms while stabilizing biologically decomposable organic matter under aerobic conditions

D. Color

Colored water is not acceptable for drinking (Aesthetic as well as toxicity reasons) Industrial wastewater requires color removal before discharge into watercourses

Visual Comparison Method

- Color of the sample is determined by visual comparison with known concentration of colored collations prepared by diluting stock platinum cobalt solution

OR

- properly calibrated glass colored disk is used for comparison
- This method is useful for potable water and water in which color is due to naturally occurring materials

E. Sentence Case

An Argent Metric Method

Principle: Chloride is determined in a natural or slightly alkaline solution by titration with standard silver nitrate, using potassium chromate as an indicator. Silver chloride is quantitatively precipitated before red silver chromate is formed.

Chloride mg/L = $(A\text{-}B) \times N \times 35.45 \times 1000$

ml sample

Where A = ml $AgNO_3$ required for sample

B = ml $AgNO_3$ required for blank

N = Normality of $AgNO_3$ used

F. Sulphate

Spectorphotometric Method

Principle: Sulphate ions are precipitated as $BaSO_4$ in acidic media (HCl) with Barium Chloride. The absorption of light by this precipated suspension is measured by Spectrophotometer at 420 nm or scattering of light by Nepthelometer [7].

Calculate

mg / L SO_4 = mg $SO_4 \times 1000$

ml sample

G. Turbidity

Turbidity in water is caused by suspended matter such as Clay, Silt Finely divided organic and inorganic matter Soluble colored organic compounds Plankton and other microscopic organisms

Nephelometric Method

Nephelometric method of turbidity measurement is based in a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions.

H. Hardness

Methods of Analysis

Hardness by calculation

1. Calcium can be estimated by AAS, ICP and EDTA titrimetric methods
2. Magnesium can be estimated by AAS, ICP and Gravimetric method

Total Hardness by Calculation:

$$mg\ CaCO_3 / L = 2.497\ [Ca\ mg/L] + 4.118\ [Mg\ mg/L].$$

V. MATHEMATICAL ANALYSIS

A. Chloride

Table 1: Samples for Chloride

S. No.	Volume of Samples (ml)	Burette Reading (ml)		Volume of EDTA (ml)
		Initial	Final	
1	20	0	3.3	3.3
2	20	0	3.3	3.3
3	20	0	0.2	0.2

Specimen Calculation

Vol of Silver Nitrate for sample (V1) = 3.3 ml

Vol of Silver Nitrate for Blank (V2) =0.2ml

Normality of EDTA = 0.0282N

Vol of sample =20.0ml

Chlorides mg/l = [(V1- V2)×N×35.45×1000]/vol of samples taken

Chlorides mg/l =[(3.3-0.2)×0.0282×35.45× 1000]/20

Trial No.	Day	Volume of Sample (ml)	Burette Reading Initial (ml)	Burette Reading Final (ml)	Volume of Titrant (ml)	Dissolved Oxygen (ml)
1.	0	200	0	8.2	8.2	8.2
2.	0	200	0	7.9	7.9	7.9
3.	0	200	0	7.9	8.0	8.0
4.	0	200	0	8.0	7.9	7.9
5.	0	200	0	3.2	3.2	3.2
6.	0	200	0	3.2	3..2	3.2

= 155mg/l

Table 2: Samples for Hardness

S. No.	Volume of Samples (ml)	Absorbance
Bllank	0	0.0185
Std1	10	0.0902
Std2	20	0.2377
Std3	30	0.4604
Std4	40	0.6177
Std5	50	0.8024
1	25	0.7824
2	25	0.7301
3	25	0.7142

B. Hardness

Specimen Calculation = 29.8ml

Volume of EDTA = 0.02N

Normality of EDTA = 20.0ml

Equivalent weight of $CaCO_3$ = 50

Total Hardness

= [Volume of EDTA×N×50×1000]/Vol. of sample taken

Calcium Hardness as $CaCO_3$ equivalent (mg/L)

= [29.8× 0.02× 50 ×1000]/20

= 1490mg/l as $CaCO_3$ eq.

C. Sulphates

Table 3: Samples for Sulphates

S. No.	Volume of Samples (ml)	Burette Reading (ml)		Volume of EDTA (ml)
		Initial	Final	
1	20	0	29.3	29.3
2	20	0	29.8	29.8
3	20	0	29.8	29.8

Calculation

Y = mx + c whereas

Y = Absorbance of sample

m = Slop of straight line

x = Concentrate of sulphate in mg

0.7824 = 0.15x+0

Therefore x = 07824/0.15 =5.216

Concentration of Sulphate = [x×1000]/ml of sample

= 5.216×1000/25

= 208.64 mg/1

D. Turbidity

Table 4: Samples for Turbidity

Sample No.	Temp. of Sample (Degree Celcius)	Turbidity
1	24	8.0
2	27	2.3
3	27	44

E. Biochemical Oxygen Demand

Calculation for BOD

Initial D_0 of the diluted sample, D_0 = 7.9 ml

D_0 at the end of 5 days for the diluted sample D_5 = 3.2 ml

Blank Correction = C_0-C_5 = 0.2 ml

Initial D_0 of Blank Co = 8.2 ml

D_0 at the end of days for the blank, C_5 = 8.0 ml

BOD = {D_0-D_5-BC}×Vol of diluted Sample/Volume of sample taken

BOD = (7.9-3.2-0.2)×200/10

= 90 mg/1

5.2 Calculation for D_0

Vol of thiosulphate V_1 = 7.9 ml

Normality of Sodium thiosulphate N = 0.025 N

Volume of sample = 203.0 ml

$$D_0 = V1 \times N1 \times 1000/200$$
$$= 7.9 \times 0.2 \times 1000/200$$
$$= 7.9 \text{ mg/l}$$

Table 5: Results

Parameters	Unit	Test Result	Requirements	Methods
pH	-	7.4	7	Electrometric method
Taste	-	Salty	Tasteless	Taste Method
Dissolved oxygen	mg/l	7.9	8.2	Electromet-ric Method
BOD	mg/l	90	100-120	Dilution procedure
colour	-	Light Yellowish	Colourless	Visual Comparison Method
Chloride	mg/l	155	250	Argent metric Method
Sulphate	Mg/l	208.64	400	Spectorphot-ometric Method
Turbidity	NTU	8,2.3,44	5	Nephelome-tric
Hardness	mg $CaCO_3$	1490	1500	AAS

VI. CONCLUSION

In this paper, Water Analysis of Simbhaoli village is done by various methods. Amount of dissolved oxygen is normal but the colour of drinking water is light yellowish which is to be considered, the hardness of water is checked as an equivalent of $CaCO_3$. In the test, the value of ph is 7.4 which is more then the required 7 ph of water. Taste of water is salty which is not suitable for drinking water. Biochemical oxygen demand is 90 mg/l which is acceptable. Colour of water is light yellowish. Chloride, Sulphate, turbidity and Hardness is 155, 208.64, 2.3 and 1490 respectively. All are in acceptable range as shown in result table 6. In the test procedure, mainly the samples are used from area, where sugar mill and wine factory release the waste and the waste goes into the ground water. The water of area near the mill and factory is more polluted and as compared to the distant area. In this analysis, the role of mill waste in water pollution is not estimated and the various effect of water contamination in the health of people living in the village and also the effect of water pollutants on the agriculture land. There are certain methods that must be followed by the people and local body to control the drinking water pollution.

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