Certificate

This is to certify that the work incorporated in this project entitled, "**Analysis of Channel Water collected from Niranjanpur Laksar Haridwar**" has been carried out by **Jatin Sharma** S/o **Mr. Mukesh Sharma** during B.Sc. VI semester, year 2019 in the laboratory of Department of Chemistry, Gurukula Kangri Vishwavidyalaya, Haridwar for the partial fulfillment of the award of degree of Bachelor of Science from Gurukula Kangri Vishwavidyalaya, Haridwar.

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Supervisor

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Haridwar

Candidate Declaration

I, student of B.Sc. VI sem. 2019 declare that the work being presented in the project entitled, "**Analysis of Channel Water collected from Niranjanpur Laksar Haridwar**" is an authentic record of work carried out by me in the laboratory of Department of Chemistry, Gurukula Kangri Vishwavidyalaya, Haridwar during January to March 2019. This has not been submitted anywhere else for the award of any degree.

Date: Name: **Jatin Sharma**

Place:

Acknowledgement

I am highly indebted to **Dr. Suhas** for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project.

I would like to express my gratitude towards **Gurukul Kangri Vishwavidyalaya** for their kind co-operation and encouragement which help me in completion of this project.

I would like to express my special gratitude and thanks to industry persons for giving me such attention and time.

My thanks and appreciations also go to my friend in developing the project and people who have willingly helped me out with their abilities.

Jatin
Sharma

Abstract

Nowadays many water resources are polluted by anthropogenic sources including household and agricultural waste and industrial processes public concern over the environment impact of wastewater pollution has increased several conventional wastewater treatment techniques have been applied to remove the pollution but before doing that we have to know about the chemicals or products which contaminate it. So, we started a analysis of channel water sample.

This study represents the summary of the water quality of sample of **NIRANJANPUR LAKSAR HARIDWAR** area in terms of physical and chemical analysis. The sample was collected from **NIRANJANPUR** during **January** month and assessed for different chemicals present in it. As the water was extremely contaminated and not suitable for drinking because it was smelling bad.

So, to explore the changes in water quality of channel and normal drinking water we tried to analyse the water quality of sample water.

Contents

S.No.

4. **CONCLUSIONS**
5. **REFERENCE**

Description of sample

SAMPLE SITE - Channel near pond of niranjanpur laksar

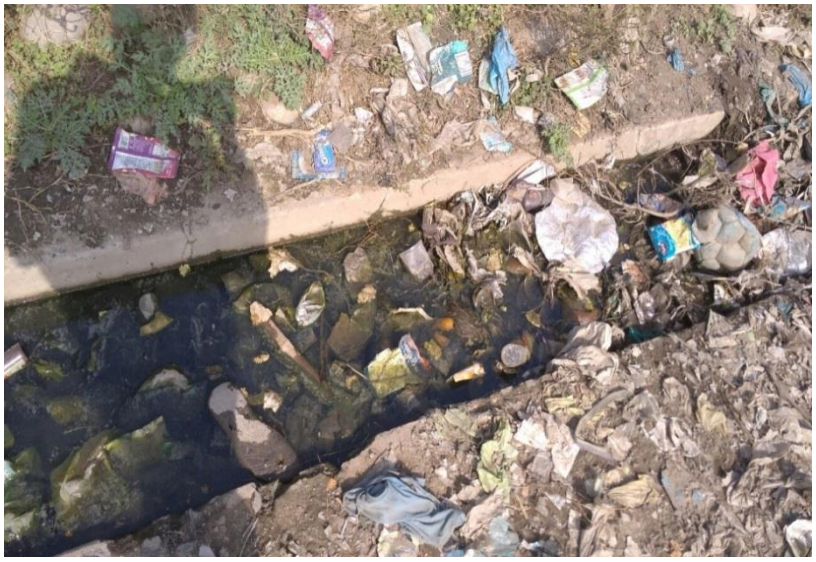
SAMPLE DESCRIPTION - Household water waste

COLOUR OF SAMPLE - Light grey

ODOUR OF SAMPLE - Foul smell

TEMPREATURE OF WATER - 15^0 C

DATE OF COLLECTED SAMPLE - 28/01/2019 at 9:00 AM



INTRODUCTION

Water Analysis

▪ An introduction

Water testing is a broad description for various procedures used to analyze water quality. Millions of water quality tests are carried out daily to fulfil regulatory requirements and to maintain safety.

- **Testing may be performed to evaluate:**

- **Ambient or environmental water quality** – The ability of a surface water body to support aquatic life as an ecosystem, See environmental monitoring, fresh environmental quality testing and bio-indicator.
- **Wastewater** – Characteristics of polluted water (domestic sewage and industrial waste) before treatment or after treatment. See environmental chemistry and wastewater quality indicator.
- **"Raw water" quality** – Characteristics of a water source prior to treatment for domestic consumption (drinking water). See bacteriological water and specific tests such as turbidity and hard water.
- **"Finished" water quality** – Water treated at a municipal water purification plant. See bacteriological water analysis and Category: Water quality indicators.
  Suitability of water for industrial uses such as laboratory, manufacturing or equipment cooling

▪ METHOD OF WATER TESTING

Physical tests

Colour, turbidity, total solids, dissolved solids, suspended solids, odour and taste are recorded.

Colour in water may be caused by the presence of minerals such as iron and manganese or by substances of vegetable origin such as algae and weeds. Colour tests indicate the efficacy of the water treatment system.

Turbidity in water is because of suspended solids and colloidal matter. It may be due to eroded soil caused by dredging or due to the growth of micro-organisms. High turbidity makes filtration expensive. If sewage solids are present, pathogens may be encased in the particles and escape the action of chlorine during disinfection.

Odour and taste are associated with the presence of living microscopic organisms; or decaying organic matter including weeds, algae; or industrial wastes containing ammonia, phenols, halogens, hydrocarbons. This taste is imparted to fish, rendering them unpalatable. While chlorination dilutes odour and taste caused by some contaminants, it generates a foul odour itself when added to waters polluted with detergents, algae and some other wastes.

Chemical tests

pH, hardness, presence of a selected group of chemical parameters, biocides, highly toxic chemicals, and B.O.D are estimated.

pH is a measure of hydrogen ion concentration. It is an indicator of relative acidity or alkalinity of water. Values of 9.5 and above indicate high alkalinity while values of 3 and below indicates acidity. Low pH values help in effective chlorination but cause problems with corrosion. Values below 4 generally do not support living organisms in the marine environment. Drinking water should have a pH between 6.5 and 8.5. Harbour basin water can vary between 6 and 9.

B.O.D.: It denotes the amount of oxygen needed by micro-organisms for stabilization of decomposable organic matter under aerobic conditions. High B.O.D. means that there is less of oxygen to support life and indicates organic pollution.

Bacteriological tests

For technical and economic reasons, analytical procedures for the detection of harmful organisms are impractical for routine water quality surveillance. It must be appreciated that all that bacteriological analysis can prove is that, at the time of examination, contamination or bacteria indicative of faecal pollution, could or could not be demonstrated in a given sample of water using specified culture methods. In addition, the results of routine bacteriological examination must always be interpreted in the light of a thorough knowledge of the water supplies, including their source, treatment, and distribution.

Whenever changes in conditions lead to deterioration in the quality of the water supplied, or even if they should suggest an increased possibility of contamination, the frequency of bacteriological examination should be increased, so that a series of samples from well-chosen locations may identify the hazard and allow remedial action to be taken. Whenever a sanitary survey, including visual inspection, indicates that a water supply is obviously subject to pollution, remedial action must be taken, irrespective of the results of bacteriological examination. For unpiped rural supplies, sanitary surveys may often be the only form of examination that can be undertaken regularly.

The recognition that microbial infections can be waterborne has led to the development of methods for routine examination to ensure that water intended for human consumption is free from excremental pollution. Although it is now possible to detect the presence of many pathogens in water, the methods of isolation and enumeration are often complex and time-consuming. It is therefore impractical to monitor drinking water for every possible microbial pathogen that might occur with contamination. A more logical approach is the detection of organisms normally present in the faeces of man and other warm-blooded animals as indicators of excremental pollution, as well as of the efficacy of water treatment and disinfection. The presence of such organisms indicates the presence of faecal material and thus of intestinal pathogens. (The intestinal tract of man contains countless rod-shaped bacteria known as coliform organisms and each person discharges from 100 to 400 billion coliform organisms per day in addition to other kinds of bacteria). Conversely, the absence of faecal commensal organisms indicates that pathogens are probably also absent. Search for such indicators of faecal pollution thus provides a means of quality control. The use of normal intestinal organisms as indicators of faecal pollution rather than the pathogens themselves is a universally accepted principle for monitoring and assessing the microbial safety of water supplies. Ideally, the finding of such indicator bacteria should denote the possible presence of all relevant pathogens.

Indicator organisms should be abundant in excrement but absent, or present only in small numbers, in other sources; they should be easily isolated, identified and enumerated and should be unable to grow in water. They should also survive longer than pathogens in water and be more resistant to disinfectants, such as chlorine. In practice, these criteria cannot all be met by any one organism, although many of them are fulfilled by coliform organisms, especially Escherichia coli as the essential indicator of pollution by faecal material of human or animal origin.

WATER ANALYSIS

SAMPLE PROGRAMME AND PROCEDURES

The collection of a representative sample is the most important function. The interpretation results and recommendation for prevention and corrective treatment are all based on the analysis report.

Three types of samples are often collected depending on situations:

(a)-Grab samples : Grab samples are collected at a designated place at a particular time. They represent the composition at that time and space.

(b)-Composite samples : Composite samples are a mixture of grab samples collected at one sampling point at different times. Individual samples are collected in wide mouth bottles every hour and mixed in volume proportional to the flow.

(c)-Integrated samples : Integrated samples are a mixture of grab samples collected from different points simultaneously and mixed in equal volumes.

PHYSICAL AND CHEMICAL REQUIREMENTS

For general physical and chemical examination, the sample should be collected in a chemically clean bottle made of good quality glass fitted with a ground glass stopper or a chemically inert polythene container. The volume of sample to be collected would depend on the selection of tests, however, for general examination 3.0 l sample would be sufficient.

The following precautions must be taken while collecting the sample:

(i) The sampling location is representative of the water body;
(ii) The place is devoid of floating material;
(iii) Where ever possible the sample should be collected 15cm, below the surface;
(iv) No physical activity is permitted upstream of sampling point.

Shorter the time between collection and examination, the reliable will be analytical results. For certain constituents and physical values, immediate analysis in the field is required, because the composition of water may change before it arrives at the laboratory.

The maximum limits of storage are:

Unpolluted water	72 hours
Slightly polluted	48 hours
Grossly polluted	12 hours

Frequency of sampling : Frequency depends on objectives. Yet, collection of samples of both raw and treated waters should be carried out as frequently as possible and at least once in every three months. Some waters undergo more pronounced seasonal variation and therefore require more frequent testing.

BACTERIOLOGICAL REQUIREMENTS

The sample for bacteriological examination are collected in sterilized, neutral glass, glass-stoppered 80z ,(300ml) bottles. The stopper and the neck should be protected by paper or parchment cover. If the sample is likely to contain traces of residual chlorine, an amount equal to 3.0mg of sodium thiosulphate ($Na_2S_2O_3.5H_2O$) to neutralize chlorine is added to the bottle before sterilization. The sterilization is done at 15 psi (1210C) for 20-30 minutes in an autoclave on high dome pressure cooker.

The sterilized sample bottle should be kept unopened until the time of collection. The stopper should be removed with care to eliminate chances of spoiling and contamination and should never the rinsed. After filling, the stopper should be replaced immediately.

Frequency of sampling : The frequency of sampling should be fixed depending on the magnitude of the problem involved. The number of samples to be examined from drinking water supply distribution system is normally decided on the basis of population served as given below:

Population	Treated /untreated water entering distribution system	
	Max. interval Between successive sampling	Max. no. of samples to be examined
Upto 20,000	One month	One sample for every 5000 population

20,001-50,000	15 days	One sample for every 5000 population
50,001-100,000	4 days	One sample for every 5000 population
More than 100,000	1 days	One sample for every10,000 population

BIOLOGICAL REQUIREMENTS

In general the samples for biological examination are collected in wide mouth, clean glass bottles of 2.0 litres capacity. They are never filled completely. This method is employed when total microscopic count is the aim. In some specific cases the concentrate of a sample may be collected through plankton nets made of bolting silk cloth, or the sample filtered through Sedgewick rafter funnels.

SIGNIFICANCE OF VARIOUS PARAMETERS

Natural waters are never completely pure. During their precipitation and passage over or through ground they acquire a wide variety of dissolved and suspended impurities. The concentration of these impurities are seldom large in ordinary sense but they modify the chemical behaviour of water or its usefulness.

The significance and usefulness of some of these is discussed below:

Physical test: The temperature measurements are important for understanding the problems of density, viscosity, vapour pressure, oxygen saturation value and rates of biochemical degradation. Turbidity tests are important from aesthetic consideration and from the point of economics of treatment.

Residue or solid matter: The test for residue is of very great importance in sewage treatment process to indicate the physical state of the principal constituents. The ratio of the weight of suspended solids to turbidity is often referred as coefficient of fineness.

pH Alkalinity and Acidity: Determination of pH, alkalinity and its forms, along with acidity are of interest in coagulation, softening and corrosion control.

The pH is an intensity factor and acidity and alkalinity are capacity factors.

Hardness : The study of hardness is important form the point of view of industrial utilisation of water specially in boilers, where scales are formed. Hardness in municipal supplies increases the consumption of soap, fuel, tea leaves etc. in the household and renders it unsuitable for use in air conditioning.

Chlorides: Concentration of Chlorides in municipal sewage is often significantly (15-50mg/l) higher than those in water supply. For this reason, a change in its concentration may be indicative of sewage pollution, in waters of low chloride concentration. Chlorides occur in all natural waters in widely varying amounts. Mountain streams are normally low in chloride values.

Dissolved oxygen: In raw water and domestic wastes, dissolved oxygen is a factor which determines whether the biological processes undergoing a change are aerobic or anaerobic. It is very desirable that aerobic conditions are maintained. It is a single test which will immediately indicate the sanitary status of a stream.

Organic matter: The tests of organic matter indicate type and extent of pollution, which has its origin in plant or animal matter. Tests are mostly restricted to the study of nitrogen in various forms and oxygen requirements in biodegradation of putrescible carbonaceous organic matter (BOD) . A measure of the demand is also indicated in terms of demand through strong chemical oxidants (COD) .

Conductance: Specific conductance is a measure of the total concentration of ionised constituents of water. It is related to the sum of anions and cations.

Bacteriological tests: The routine bacteriological tests are aimed at enumerating the members of coliform groups of bacteria, which are considered indicators of pollution. The natural habitat of these bacteria is the intestinal track of man and other warm blooded animals. They are present whenever the pathogens are present and by their absence excludes the probability of the presence of the pathogens.

Biological examination: The biological examination (microscopic) provides useful information for the control of water quality and treatment. It serves for one or several of the following purposes:

a. To explain the causes of colour or / and odour in water
b. To aid in the interpretation of various chemical analysis reports e.g. explain dissolved oxygen deficiency or super saturation.
c. Permitting identification of specific water when it is mixed with another.
d. To explain clogging of pipes / screen/filters.

e. Rapidly detect organic pollution and contaminated with toxic substances.
f. To indicate the progress of self purification of streams.

RESULT AND DISCUSSIONS

For the collected water sample from the channel near pond of Niranjanpur Laksar Haridwar. We carried out some of the physical chemical tests, whose results are shown further:

EXPERIMENT NO. – 1

ESTIMATION OF THE pH VALUE

GENERAL

The principles of water testing involve quantitative measurement of the impurities present in waters. Not one principle can be applied in measuring these impurities through analytical techniques. An analyst has therefore to choose one for obtaining reasonably accurate results. The most common principles used are pH metry, colorimetry, turbidimetry, volumetric analysis and bacteriological monitoring.

pH METRY

The acid or base character of any (aqueous) solution can well be defined by means of a single variable the hydrogen ion activity. Numerically the pH of a solution is the log of the number of litres of the solution that contains one-gram atomic weight(1.008gm) of hydrogen as (H+) ions.

$$pH = \log_{10}(1/H^+) = - \log_{10}(H^+)$$

Two general methods are employed for determination of pH values:

1. use of indicators- the colorimetric methods.
2. Use of electrodes-the electrometric methods

Colorimetric Method

A number of pH indicators have been used. They are unreliable for measuring pH below 3 and above 10.

Procedure:

Place 10ml of the sample in each of the tube of the pH comparator. To one add the appropriate quantity of pH indicator as indicated in the kit (0.3ml of phenol red).Check that the same indicator disc is fitted to the comparator. Place the tube with the colour standards are opposite to the tube not containing the indicator. Compare the tube with the colour standards and the select the colour nearest to the sample. Note the pH.

Electrometric

The electrometric methods are based on the use of electrodes. Of the numerous electrodes that develop potential proportional to pH are the glass electrodes and

quinhydrone electrodes .Either of this is combined with a reference electrode, calomel electrode; to complete a voltaic cell. The potential developed when the electrode combination is dipped in the solution can be measured by a potentiometer.

Procedure:

Standardise the pH meter by immersing the electrode in buffer solution of known pH, normally 4.0 and 9.2. Read the pH and correctly adjust with the control knob, till the metre needle indicates the correct value for the pH of buffer solution.

Rinse the electrodes in distilled water and immerse them in the sample. Let the needle settle at one point. Read the pH value.

Observation:

The pH value of the water sample = 8.2

Result:

The pH value of the water sample is **8.2 .**

EXPERIMENT NO. – 2

DETERMINATION OF THE CARBONATE, BICARBONATE AND HYDROXIDE ALKALINITY

Object: Determination of the carbonate, bicarbonate and hydroxide alkalinity.

Apparatus used: 1.Conical flask
2.Beaker
3.Filer paper
4.Burette
5.Pipette

Theory: Alkalinity of water and waste waters is the capacity to neutralize acids. In natural waters the alkalinity is due to the presence of hydroxide (OH^-), carbonate (CO_3^-), and bicarbonate (HCO_3^-). Bicarbonates present the major form since they are formed in considerable amounts from the action of CO_2 upon the basic materials in the soil.

The chemical reaction is given as –

$$CO_2 + CaCO_3 + H_2O \rightarrow Ca(HCO_3)_2$$

Natural waters may also contain appreciable amounts of carbonates and hydroxide alkalinities, particularly surface waters blooming with algae. The algae take up CO2 for its photosynthetic activities and raise the pH.

The carbonate alkalinity may be present with either hydroxide or bicarbonate alkalinity, but hydroxide and bicarbonate alkalinity cannot be present in the sample.

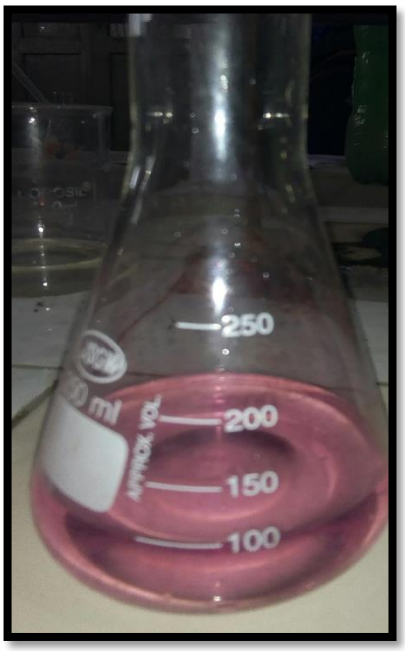
Reagents:

(i) methyl orange indicator
(ii) N/50 sulphuric acid
(iii) phenolphthalein indicator

Procedure:

(A). Take 100ml of the sample in a conical flask. If the sample is turbid, filter through filter paper. Add one drop of methyl orange indicator in the sample . Keep a blank with the same quantity of indicator for comparison. Titrate with N/50, H_2SO4 solution. Note the first change in the colour from yellow to orange. Record the ml of N/50, H_2SO4 used.

Since, the change in colour is from yellow to orangish red care must be taken to record the first change in colour. Use as little of indicator as possible.



Calculation:

$$\text{Total alkalinity (CaCO3) mg/l} = \frac{\textbf{ml N/50 H2SO4 used X1000}}{\textbf{ml sample}}$$

$$\text{Total alkalinity} = \frac{8\times 1000}{100}$$

$$= 80 \text{ mg/l}$$

Result:

The total alkalinity is **80 mg/l** present in the sample due to **Bicarbonates** because pH value of sample is 8.2 (between 4 - 8.3).

EXPERIMENT NO. – 3

DETERMINATION OF TOTAL, SUSPENDED, DISSOLVED, VOLATILE AND FIXED RESIDUE IN A WATER SAMPLE

Object: Determination of total suspended dissolve, volatile and fixed residue in a collected water sample.

Apparatus used:

1. Crucible
2. Beaker
3. Measuring cylinder
4. Dessicator
5. Whatman filter paper.
6. Muffle furnace

Theory: The methods are gravimetric. Great care must be taken to obtain a representative sample. The quality of sample to be taken depends on the amount of suspended matter.

Water	100ml to 500ml
Sewage	50ml to 500ml
Waste effluent	50ml to 100ml

Procedure:

(a) Total residue:

Place the required quantity of the sample in a dry constant weight dish or crucible. Evaporate to dryness in an oven at $103^0C - 105^0C$ and dry to constant weight. Cool the dish in a dessicator. Weigh and note the increase in weight.

$$\textbf{Total residue mg/l} = \frac{(\textbf{Weight of crucible with residue} - \textbf{Weight of empty crucible})\textbf{mgX1000}}{\textbf{ml sample}}$$

According to the sample:

Weight of empty crucible = 33097 mg

Weight of crucible with residue = 33126 mg

Then the total residue is present in the water sample:

$$\text{Total residue mg/l} = \frac{(33126 - 33097) \text{ X } 1000}{25}$$

$$= \frac{29 \text{ X } 1000}{25}$$

$$= 1160 \text{ mg/l}$$

(b) Total solids, Volatile and fixed:

Ignite the residue obtained in (a) at 600^0C in a muffle furnace (15 – 20 min), cool and weigh.

Total volatile residue mg/l =

$$\frac{\textbf{[(Weight of crucible with total residue-weight of empty crucible) – (weight of crucible with residue heated to } 600^0\textbf{C – weight of empty crucible)]mg X 1000}}{\textbf{ml sample}}$$

According to the sample:

Weight of crucible with total residue= 33126 mg

Weight of empty crucible = 33097 mg

Weight of crucible with residue heated to 600^0C = 33101 mg

Then the total volatile solid is :

$$\text{Total volatile residue mg/l} = \frac{[(33126 - 33097) - (33101 - 33097)]\text{mg X } 1000}{25\text{ml}}$$

$$= \frac{[29 - 4] \text{ X } 1000}{25}$$

$$= 1000 \text{ mg/l}$$

Fixed residue mg/l = Total residue - Volatile residue

= 1160 - 1000

= 60 mg/l.

Suspended and Dissolved solids:

Filter the sample through Whatman filter paper No. 44 or 41. Take a suitable quantity in a weighted dry crucible. Evaporate to dryness at $103^0C – 105^0C$.

Cool the container to a constant weight. Weigh and note the increase in weight.

Dissolved residue mg/l =

$$\frac{(\textbf{Weight of crucible with residue} - \textbf{Weight of empty crucible})\textbf{mgX1000}}{\boldsymbol{ml\ sample}}$$

According to the sample:

Weight of crucible with residue = 33105 mg

Weight of empty crucible = 33097 mg

Then, the dissolved residue is:

$$\text{Dissolved residue mg/l} = \frac{(33105 - 33097)\times 1000}{25}$$

$$= \frac{7\ \text{X}1000}{25}$$

$$= 280 \text{ mg/l}$$

Suspended residue mg/l = Total residue - Dissolved residue

= 1160 - 280

= 880 mg/l

Result:

The value of the **Total, Suspended, Dissolved, Volatile and Fixed Residue** in the water sample are respectively **1160 mg/l , 880 mg/l . 280 mg/l , 1000 mg/l , 60 mg/l.**

EXPERIMENT NO. – 4

DETERMINATION OF THE TYPE AND EXTENT OF ACIDITY

Object: Determination of the acidity in the collected water sample.

Apparatus used: 1 .Beaker
2. Funnel
3. Conical flask
4. Pipette
5. Measuring cylinder.

Theory: The acidity in natural waters is primarily due to dissolved CO2 and is defined as capacity to neutralize bases. However in water polluted by trade wastes acidity may be because of mineral acids (below pH 4.5).

Reagents:

1. methyl orange indicator
2. phenolphthalein indicator
3. N/50 sodium hydroxide solution

Procedure:

We took about 100ml of collected water sample in a conical flask and add to it one drop of methyl orange indicator. If it gives an orangish red colour, then mineral acidity is present in the sample. Then titrate it with N/50 NaOH to a yellow end point. And note the ml of N/50 NaOH solution used.

In another flask, we took 100 ml water sample and 0.5 ml phenolphthalein indicator. If it does not give any colour, titrate with N/50 NaOH to light pink (first permanent change) end point. Then, note the ml solution used. If phenolphthalein gives a pink colour on addition in the sample, then acidity is not present.

Observation:

According to the procedure, it does not show the orangish red colour on adding the methyl orange indicator. So, the mineral acidity is absent in the taken water sample.

While when we add phenolphthalein indicator in the water sample it does not show any colour and when titrated with N/50 NaOH solution, it shows the pink colour. So, acidity is present in taken water sample due to CO_2.

Observation table

Sample volume ml	Methyl orange indicator			Phenolphthalein indicator		
	Initial burette reading	Final burette reading	ml NaOH used	Initial burette reading	Final burette reading	ml NaOH used
100ml	0.00	0.00	0.00ml	0.00ml	2.2 ml	2.2 ml
100ml	0.00	0.00	0.00ml	0.00ml	2.1 ml	2.1 ml
100ml	0.00	0.00	0.00ml	0.00ml	2.3 ml	2.3 ml

Calculation:

Mineral acidity mg/l($CaCO_3$ scale) = $$\frac{\textbf{ml of NaOH solution used with methyl orange X 1000}}{\textbf{ml sample}}$$

CO_2 Acidity mg/l ($CaCO_3$) = $$\frac{\textbf{ml of NaOH used with phenolphthalein X 1000}}{\textbf{ml sample}}$$

The average volume used of N/50 NaOH = $\frac{2.2 + 2.1 + 2.3}{3}$

= 2.2 ml

Then, the CO_2 Acidity mg/l ($CaCO_3$) = $\frac{2.2 \text{ X } 1000}{100}$

= 22 mg/l

Result: The total **Acidity** is **<u>22 mg/l</u>** present in the sample due to **CO_2** because pH value of sample is 8.2 (between 4 - 8.3).

EXPERIMENT NO. – 5

ESTIMATION OF THE HARDNESS OF WATER

Object: Determination the estimation of the hardness of water.

Apparatus used:
1. Beaker.
2. Funnel
3. Gas burner
4. Conical flask
5. Tripod stand and wire gauge
6. Match box

Theory:

Hardness of water is caused by the presence of bivalent metallic ions, with anions as:

Cations	Anions
Ca++	HCO3-
Mg++	SO4- -
Fe++	Cl-
Mn++	NO3-

There are two types of hardness present in the water:

(i) Permanent hardness
(ii) Temporary hardness

Temporary hardness is caused by the presence of HCO_3^- of Ca^{++} and Mg^{++} .

While permanent hardness is mainly due to presence of SO_4^{--}

When the total hardness has a value greater then total alkalinity, the amount of hardness equivalent to alkalinity is called carbonate hardness and the excess amount is non-carbonate hardness. When total hardness is equal or less than the total alkalinity, there is no carbonates hardness present in the water sample.

Reagent:

i.	Erichrome black T indicator
ii.	Ammonia buffer
iii.	Standard EDTA solution

Procedure:

We took about 100ml sample of water in a conical flask. As the sample is lightly turbid so, filter it first and then proceed. Now add 1.0 ml of ammonia buffer solution to bring its pH to 11.0 and also add 3 drops of Erichrome black T indicator. Then, titrate it with standard EDTA solution till the colour changes from wine red to blue.

Take about 100ml sample and boil it for a sufficient long period, then cool and filter it. And note down the ml used of EDTA solution in the titration.

Observation:

Observation are given in the below table:

Sample details	**Observations**				**Total hardness mg/l (CaCO3)**
Source	**Volume**	**Initial burette reading**	**Final burette reading**	**ml of EDTA solution used**	
Unboiled sample					
Channel Water	100ml	0.00ml	17ml	17ml	170mg/l
Boiled sample					
Channel Water	100ml	0.00ml	9.3ml	9.3ml	93 mg/l

Calculation:

Total Hardness mg/l, ($CaCO_3$ scale) $= \frac{\boldsymbol{ml\ of\ EDTA\ used\ (unboiled\ sample)\times 1000}}{\boldsymbol{ml\ \ sample}}$

$= \frac{17\times 1000}{100}$

= 170 mg/l

Permanent hardness mg/l, ($CaCO_3$ scale) $= \frac{\textbf{ml of EDTA used (boiled sample)X1000}}{\textbf{ml sample}}$

$= \frac{9.3\times 1000}{100}$

= 93 mg/l

Temporary Hardness mg/l, ($CaCO_3$ scale) = Total hardness – Permanent hardness

= 170 – 93

= 77 mg/l

Results:

In the collected water sample, we found that:

(i) **Total hardness** = **<u>170 mg/l</u>**

(ii) **Permanent hardness** = **<u>93mg/l</u>**

(iii) **Temporary hardness** = **<u>77 mg/l</u>**