SUBJECT: ENVIRONMENTAL STUDIES Lab

BRANCH: CE, CSE, EE, ME (A+P)

YEAR: 2ND Year

LIST OF PRACTICALS

SR. NO	NAME OF PRACTICALS
1	To find the pH value of a given water sample with the help of a pH meter.
2	To determine the amount of Total dissolved solids (TDS) in a given water sample.
3	To determine the amount of suspended solids (TSS) in a given water sample.
4	Determination of hardness in drinking water by O' Heiner's method.
5	To determine the alkalinity of a given water sample.
6	To determine the acidity of a given drinking water sample.
7	To determine the pH of a soil sample.
8	To segregate the various types of solid waste in a locality.
9	To study the waste management plan of different solid wastes.

Experiment No.-01

Object: - To find the pH value of a given water sample with the help of a pH meter.

Apparatus and reagents

1. pH meter
2. pH electrode
3. Stand
4. Buffer solution of pH 4 and 7
5. Beker 250ml

Principle: -

(i) The concentration of H^+ and OH^- in neutral water is equal.
(ii) The concentration of H^+ in acidic water is greater than that of OH^-.
(iii) The concentration of OH- in alkaline water is greater than the concentration of H^+.
(iv) Acids or bases decompose water into H^+ and OH^-.
(v) **pH value** – The pH value of a solution is equal to the logarithm of the reciprocal of the concentration of hydrogen ion H^+.

$$\text{Value of pH in neutral water} = \log_{10}\left[\frac{1}{H^+}\right]$$

(vi) The concentration of H^+ ion in neutral water is 10^{-7}.

$$= \log 10\left[\frac{1}{H^{-7}}\right]$$

$$= 7$$

NOTE-

•The pH value of neutral water is 7.
• The pH value of acidic water ranges from 0 to 7.
• The pH value of alkaline water ranges from 7 to 14.

pH Meter

(i) It has a joint electrode which is made by joining two electrodes.
(ii) In this one electrode is Quinhydrone and the other is Calomel electrode.
(iii) The concentration of H' between the two electrodes on dipping the joint electrode in solution. A potential difference is produced in the ratio.
(iv) The potential difference is measured in mv by a pH meter.
(v) Apparatus is calibrated directly to the ratio of this potential difference to the pH value.
(vi) The pH value of a solution can be determined with the help of a pH meter.

Procedure: -

1. First prepare the electrode for use.
2. First of all, the joint electrode is tightened in the spring clip of the stand. Thereafter, the rubber cap of the electrode is carefully detached and a solution of 7.5% potassium chloride is filled into the electrode about 5 mm below the hole in the rubber cap.
3. If the solution of potassium chloride (KCl) is already filled, then the rubber cap is put on like this. In this way the electrode is ready for use.
4. To calibrate the pH meter, the electrode is dipped in a buffer solution of pH 7.0.
5. Now adjust the temperature control slurry to the temperature of the buffer solution. heating of the buffer solution before Know from now on.
6. After this the functional selector switch (F.S. switch) is brought to the pH position and the display reading is brought to the pH of the buffer solution with the help of Calibrate knob.
7. Now Functional selector switch is called S.T.D. position by.
8. Now take the electrode out of the buffer solution, wash it with distilled water and tissue paper. clean with.
9. Thereafter, the combined electrode is placed in a standard buffer solution of pH 4.0are immersed and the temperature regulator adjusts the slurry to the temperature of the buffer solution.
10. Now F.S. The switch is brought to the pH position. The slope controller is then rotated to adjust the display reading to the pH value (4 pH) of the standard buffer solution.
11. Now check the display reading by dipping the electrode in distilled water and wiping it with a tissue paper in a buffer solution of pH 7.0. Now the pH meter is calibrated.
12. Now F.S. switch to ST.D. By bringing the electrode to the by position, remove the electrode from the buffer solution, wash it in distilled water and clean it with a tissue paper.
13. Now repeat the whole process with water sample.
14. The reading of pH meter is noted from the display. This reading is the pH value of the water sample Will happen.
15. In this way by taking three readings of the water sample, we find their average.

Note-The pH value of the buffer solution varies with temperature, so the display reader should be adjusted to the pH value of the buffer solution's current temperature.

Table 1 - Change in pH value of buffer solution with temperature

Ph value	**Temperature**						
	0	**10**	**20**	**30**	**40**	**50**	**60**
4.0	**4.006**	**3.998**	**4.002**	**4.015**	**4.035**	**4.066**	**4.102**
7.0	**7.114**	**7.055**	**7.011**	**6.982**	**6.967**	**6.969**	**6.972**
9.0	**9.384**	**9.302**	**9.219**	**9.137**	**9.056**	**8.976**	**8.892**

- Table-1 shows that the change in pH value with temperature is negligible. Therefore, the display reading can be adjusted to pH values of 4, 7 and 9.2 respectively.
- The instrument should be calibrated at the pH value of the current temperature to determine the exact pH value.

Observation: -

Description of sample	No.of sample	Temperature	pH value	Average pH value
	1	-	-	-
	2	-	-	-
	3	-	-	-

Result - pH value of the given water sample is =……

Precautions: -

1. The pH should be calibrated with a standard buffer solution.
2. Use 3M or saturated solution of KCI.

Experiment No.-02

Object: -

To determine the amount of Total dissolved solids (TDS) in a given water sample.

Apparatus and reagents: -

1. Two beakers of 100ml/250ml
2. Calibrated Jar
3. Funnel
4. Funnel stand
5. Chemical balance
6. Weight box
7. Temperature controlled electric furnace (Oven)
8. Desiccator
9. Whatman's filter paper No. 44

Principle: -

To determine the amount of dissolved solids (TDS) in a water sample, a weighted method is used. Is used for. In this method first we find the weight of the water sample. After this, water and solid particles are separated by any one of the following methods.

(i) By making insoluble precipitate: - By chemical reaction in the water sample, the solid particles are separated from the water by making an insoluble precipitate.

(ii) By evaporation: – The solid particles are separated from the sample by evaporation of water.

Generally, by evaporation the solid particles are separated from the water sample. The weight of the separated solid particles is determined with the help of chemical balance.

Procedure: -

1. After cleaning and drying both the beakers properly, mark A and B on them with marker
2. With the help of chemical balance, find the weights I and 12 of both the beakers.
3. The sample water is divided into two equal parts
4. Filter a part with the help of Whatman filter paper No. 44 and collect the sifted part (filtrate) in a flask.
5. After this, 100 ml of unfiltered sample water is prepared in beaker A and 100 ml in beaker B
Add sample water.
6. Now both the beaker A and B are kept in a heat-controlled oven at 105°C for complete evaporation.
7. After this, beakers A and B are removed from the oven and kept in the desiccator to cool down to room temperature.
8. Now the weights of beakers A and B are W3 and W4 Determined by chemical balance.

Observation: -

Temperature of sample water =…….C

S.NO.	Description		Weight/Volume
1	Volume of sample water in beakers	*V*	….ml
2	Weight of beaker A	*W1*	….gm
3	Weight of beaker B	*W2*	….gm
4	Weight of beaker A and Total solids	*W3*	….gm
5	Weight of beaker B and Suspended solids	*W4*	….gm

Calculation: -

If weight is taken in grams and sample water is taken in ml.

Total Solid Particles = $\frac{W_3-W_1}{V} \times 10^6$ mg/L

And

dissolved solids = $\frac{W_4-W_2}{V} \times 10^6$ mg/L

Result: - Amount of dissolved solids in a sample of water =……mg/L

Precautions: -

1. All the apparatus should be thoroughly cleaned and dry.
2. For filtering the water sample, only Whatman filter paper No. 44 should be used.
3. The weight of the beaker should be taken carefully with the chemical balance.
4. Oven temperature should not exceed 105°C; otherwise, the crystal water of the solid particles may also evaporate.

Experiment No.-03

Objective:-

To determine the amount of suspended solids (TSS) in a given water sample.

Total suspended solid (TSS) is the portion of fine particulate matter that remains in suspension in (water. These solids include anything floating through water such as gravel, silt, sand or clay. Which is suspended in water. These solid particles float in water and cannot be filtered through filter paper.

Apparatus and reagents:-

1. Two Beakers of 100ml/250ml
2. Calibrated Jar
3. Funnel
4. Funnel stand
5. Chemical balance
6. Weight box
7. Temperature controlled electric furnace (Oven)
8. Desiccator
9. Wattman filter paper No. 44

Principle:-

The amount of suspended solid particles (TSS) in a water sample is determined by weight dependent method. Let us first determine the weight of the water sample. After this, water and solid particles are separated by any one of the following methods.

Observation:-

Temperature of sample water……..C

S.NO.	Description		Weight/Volume
1	Volume of sample water in beakers	*V*	….ml
2	Weight of beaker A	*W1*	….gm
3	Weight of beaker B	*W2*	….gm
4	Weight of beaker A and Total solids	*W3*	….gm
5	Weight of beaker B and Suspended solids	*W4*	….gm

Calculation:-

If weight is taken in grams and sample water is taken in ml.

Total Solid Particles $= \frac{W_3 - W_1}{V} \times 10^6$ mg/L

And

dissolved solids = $\frac{W_4-W_2}{V} \times 10^6$ mg/L

Result:- Amount of dissolved solids in a sample of water =……mg/L

Precautions: -

1. All the apparatus should be thoroughly cleaned and dry.
2. For filtering the water sample, only Whatman filter paper No. 44 should be used.
3. The weight of the beaker should be taken carefully with the chemical balance.
4. Oven temperature should not exceed 105°C; otherwise, the crystal water of the solid particles may also evaporate.

Experiment No.-04

Objective:-

Determination of hardness in drinking water by O' Heiner's method.

Apparatus:-

1. Conical flask
2. Measuring flask
3. Burette
4. Pipette
5. Funnel
16. Burette stand

Reagents:-

1. N /50, hydrochloric acid
2. Methyl orange indicator
3. Distilled water

Principle:-

The temporary hardness of water is due to the dissolved calcium and magnesium bicarbonates $Ca(HCO_3)_2$ and Mg $(HCO_{3)2}$. Due to this the water becomes alkaline.
This hardness is determined by HCl and H2SO4. Its chemical reaction is as follows-

$$Ca(HCO_3)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O + 2CO_2$$
$$Ca(HCO_3)_2 + H_2SO_4 \rightarrow CaSO_4 + 2H_2O + 2CO_2$$
$$Mg(HCO_3)_2 + 2HCI \rightarrow MgCl_2 + 2H_2O + 2CO_2$$
$$Mg(HCO_3)_2 + H_2SO_4 \rightarrow MgSO_4 + 2H_2O + 2CO_2$$

Procedure:-

1.Wash the burette first with distilled water and then with HCI. Now by filling the N/50 HCI solution in it, note down the initial reading of the burette.
2. With the help of a pipette 50ml of hard water sample is filled in the conical flask. 3-4 drops in it Methyl orange is mixed with the indicator, due to which its colour becomes yellow.
3. Now slowly add the N/S0 HCl solution to the conical flask, drop by drop with the burette.
4. Yellow colour changes to orange colour in the conical flask at the end point.
5. Note down the volume of N/50 HCl solution used from the burette.
6. Repeat the titration to get two concordant readings.

Titration after boiling the sample

1. Take100ml of a given sample of water in a Corning beaker and boil it until the one fourth (1/4) should not be left.
2. Filter the boiled water sample and take it in a measuring flask of 100 ml and add distilled water to it and make its volume 100 ml.
3. Take 50 ml of water from the measuring flask into a conical flask and titrate it with N/50 HCl solution as before.
4. Repeat the titration to get two homogeneous readings.

Observation:-

Table- 1- Pre-boiling Titration of Water Samples

S.No.	Volume of water sample in ml	Burette reading		Used N/50 of HCL Solution(ml)
		Initial	Last	
1	50			
2	50			
3	50			

Homogeneous reading= V_1 ml

Table- 1- After-boiling Titration of Water Samples

S.No.	Volume of water sample in ml	Burette reading		Used N/50 of HCL Solution(ml)
		Initial	Last	
1	50			
2	50			
3	50			

Homogeneous reading= V_2 ml

Calculation:-

The volume of N/50 HCI used by salts producing temporary hardness in 50ml of a given water sample.

$= (V_1 - V_2)$ ml

1000ml NHC1 = 1000 ml NCaCO3 solution

= 50g $CaCO_3$ (weight of $CaCO_3$ = 50)

(V_1-V_2)ml N/50 HC1 = $\frac{50(V_1 - V_2)}{1000 \times 50}$ g $CaCO_3$

$= \frac{V_1 - V_2}{1000}$ g $CaCO_3$

Temporary hardness in 50ml of water sample

$= (V_1 - V_2)$ mg $CaCO_3$

Temporary hardness in 1000 ml of water sample

$$= \frac{V_1 - V_2 \times 1000}{50} \text{ mg } CaCO_3$$

$$= 20\ (V_1 - V_2) \text{ mg } CaCO_3$$

Therefore, temporary hardness in water sample

$$= 20\ (V_1 - V_2)\ \text{mg/L}$$

$$= 20\ (V_1 - V_2)\ \text{PPm}$$

Result:-

Temporary hardness of water sample = $20\ (V_1 - V_2)$ PPm

Precautions:-

1. All equipment must be completely clean and dry.
2. The same amount of indicator should be taken each time.
3. The reading of the burette should be noted carefully.
4. More care should be taken when coming to the end point.

Experiment No-07

Objective:- To determine the pH of a soil sample.

Principle:- The acidic or basic property of soil is measured in terms of pH. pH value is defined as the negative logarthim of the concentration of H^+ in per litter grams mol.

$$pH = - \log [H^+]$$

or.

$$pH = \log \frac{1}{[H+]}$$

The pH scale ranges from 0-14.

pH = 7 Neutral soil

pH > 7 Alkaline soil

pH < 7 Acidic soil

pH measurement:- The pH value of soil is determined by the following methods-

By universal indicator:- pH is an indicator made up of various chemical compounds. The mixture obtained when the indicator is added to the sample solution shows a smooth change of colour at pH values from 0-14.

Procedure:-

Take 10 grams of soil in a beaker, add 25 ml of 1 N potassium chloride solution and stir it well. Now keep it for 50-60 minutes. After this, filter it and take the filtrate in a test tube and mix 4-5 drops universal indicator in it and shake it. Now measure the colour produced in it and compare it with the colour table and find the pH value of the soil.

By pH Meter:-

1. Preparation of buffer solution of pH 8.0- -19.5ml 0.2M- A buffer solution of pH 8.0 is prepared by adding Na_2HPO_4 + 0.55 ml 0.1 M citric acid.

2. Standard buffer solution (pH 4.0) - It is a solution of 0.05M potassium hydrogen thalate ($KHO_8 H_4O_4$ mol wt 204.02) in water.

If buffer tablets of pH 4.0 and pH 8.0 are available, dissolve them in distilled water to prepare a buffer solution of pH 4.0 and pH 8.0.

Measurement method:-

In a 100 ml clean and dry beaker, take 20 grams of air dry soil. Now add 50 ml distilled water to it and stir it well. Leave it like this for half an hour. From time to time keep shaking the beaker. Now note the reading on the pH scale by dipping the electrodes of the pH meter into the soil solution. Let's do it.

Note:-Before calculating the pH of the soil suspension, the pH meter should be calibrated with buffer solutions of pH 4.0 or pH 8.0.

Result:-

pH of the given soil=**……**

Precautions:-

1. Solution of potassium chloride should be carefully prepared.
2. Due care should be taken while preparing a buffer solution of pH values of 4.0 and 8.0.
3. The pH meter should be calibrated before use.
4. All equipment must be clean and dry.

Experiment No.-08

Objective:-

To segregate the various types of solid waste in a locality.

Solid Wastes

1. Naturally tolerable waste:- food and kitchen waste, green waste, paper.

2. Recyclable materials:- paper, glass, bottles, cans, metals, some special plastics, etc.

3. Inert waste:-construction and demolition garbage, dirt, stone, debris

4. Mixed waste:- waste clothes, tetra packs, toys etc.

Main stages of solid waste management:-

1. First step - Segregation of waste into dry and wet waste by waste generators.

2. Second step - Door to door collection of garbage and after sorting send it for processing.

3. Third step - Segregation of recyclable materials like plastic, paper, metal, glass from dry waste.

4. Forth step- Establishment of waste processing facilities such as compost making, bio-methane preparation, and plants to generate energy from the waste.

5. Fifth step-Build a landfill facility for dispose of the waste.

The main objective of an efficient solid waste management system is to segregate the waste material and generate electricity in the processing centre from the residual waste and reduce the amount of waste dumped in landfills.

If the garbage is collected and sent to the processing center without sorting it, then its processing is very difficult because such waste is also accompanied by debris from building construction and their demolition which is directly used in the processing system. Cannot be brought in.

There needs to be complete coordination between activities such as collection, sorting and transportation of waste so that it can be used at the processing center in that area.

The volume reduction of solid waste can be done by the following methods-

1. Mechanical method

2. Thermal method

3. On the basis of utility

1. Mechanical method- Compaction of solid waste can be done by mechanical method to reduce the volume of solid waste. Due to compaction, the density of solid waste increases. This increases the life of the landfill.

2. Thermal method – By this method the volume of solid waste can be reduced up to 90%. Burning of solid waste causes air pollution. Hence this method is used less.

3. On the basis of utility - In this method, in order to reduce the volume of solid waste, first of all, the useful material from this solid waste is separated by screening.

• Iron, copper, brass and aluminium etc. from solid waste are separated and recycled or sold.

• The ash from power plants is mixed with cement or used alone.

•The solid waste from sugar mills is separated from the bagasse and used to make paper.

• The pieces of glass are recycled and molded into new moulds.

• Pieces of plastic can be recycled and molded into new shapes.

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Experiment No.-09

Objective:-

To study the waste management plan of different solid wastes.

Solid Wastes

Solid waste is any substance that is thrown away because it is of no importance. Solid waste is a substance produced by the activities of humans and animals. Such as garbage, rubbish and sludge from the effluent treatment plant. Solid waste by-products of normal and basic activities of living things is produced as a co-product.

Classification:-

It can be classified into the following categories-

1. Municipal solid waste – Urban waste includes waste from hospitals, urban waste, domestic waste, market waste, waste from gardening etc.

• **Garbage generated from homes –** this includes polythene, empty cans, bottles, paper, pieces of cloth, fruits and vegetables pieces are included.

• **Hospital waste-** Hospital waste contains surgical organs, tissues, blood, medicines, needles, etc.

• **The waste generated from building construction-** The waste generated from building construction includes bricks, stones, wood, iron and debris.

2. Biomedical waste- Biomedical wastes means any waste which is originated through the diagnosis, treatment or vaccination of animals.

3. Industrial wastes- Slag of blast furnace in industrial wastes contains coal ash, untidy waste, lead from used batteries, Extraction of strontium, harmful chemicals. The major sources of industrial waste are chemical industry, iron and mineral refining industry.

4. Hazardous wastes- Hazardous waste Free from mercury (Hg), arsenic, thallium, calcium etc.wastes are harmful wastes. Substances containing carcinogenic, mutagenic or tetragenic substances be more than in prescribed quantities.

5. Animal wastes- Slaughterhouse waste, animal carcasses, fish waste, leather and wool waste etc.

6. Plastic wastes - polystyrene, polyethylene, PVC etc. examples of plastic waste.

Management of solid waste:-

Management of solid wastes is very important to reduce their adverse effects.

Three R's are used for solid waste management, which are as follows-

• Reduce

• Reuse

• Recycle

(i) Reduction in the use of raw materials - Reduction in the use of raw materials will definitely reduce the waste generation. Also, due to reduction in demand from reuse and recycling, the rate of production will also decrease.

(ii) Re-use of waste materials – Reuse of plastic items, cans, bottles etc. this will reduce the amount of waste and also reduce the pressure on production.

(iii) Recycling of waste materials - By recycling the waste materials are converted into new useful products. For example, by melting and recasting old glass and aluminium bottles, new useful products are made.

Solid Waste Disposal Methods:-

Complete disposal of solid waste can be done by the following methods-

1. By sanitary landfilling — In this method, the waste is covered with soil or plastic by laying in form of thin surfaces.

In modern landfills, the lower layer is made impermeable with plastic or soil. It protects the ground water from being polluted by washing. Washing is taken out with the help of a pump and sent for treatment.

After the landfill is completely filled, it is covered with clay, pebbles etc. so that water cannot enter it. Many wells are dug near the landfill to monitor the ground water.

Methane gas formed by decomposition is used to produce electricity or heat.

2. Composting - Due to lack of sufficient landfill space in metropolitan cities, decomposing waste is decomposed in the presence of oxygen to prepare compost rich in nutrients and minerals.

3. Incineration — Incinerator is a device used to burn waste at high temperature. Hazardous pollutants like 'dioxin' and 'furan' are released during incineration of garbage.

Flyash is also formed after combustion. To avoid these pollutants, rubber, plastic, battery etc. is already separated from waste.

Experiment No.-05

Object:-

To determine the alkalinity of a given water sample.

(A) Apparatus-

1. Burette
2. Pipette
3. Conical flask
4. Measuring cylinder
5. Standard flask
6. Beaker
7. Wash bottle

(B) Reagents-

1. Standard Sulfuric Acid (Standard H_2SO_4)
2. Sodium Carbonate (Na_2CO_3)
3. Phenophthalein
4. Bromo cresol green
5. Methyl red

Principle-

The alkalinity of water is measured by its ability to neutralize an acid. The alkalinity of water is due to the presence of-

(i) Hydroxide (OH^-) only

(ii) Carbonates (CO_2^{--}) only

(iii) Bicarbonates (HCO_3^-) only

(iv) Hydroxides and carbonates (OH^- and CO_3^{--}) and

(v) Carbonates and Bicarbonates (CO_3^{--} and HCO_3^{--})

• When the pH value of water is more than 8.3, then phenophthalein indicator is added to it to determine its alkalinity, due to which its color becomes pink.

• This pink color is due to (OH^-) ions.

• When acid of known concentration is added to it, the pink color disappears.

• Now let's add mixed indicator to it. When mixed indicator is mixed, its color turns blue. Adding acid again. The color of the solution changes from blue to orange at the end point of the reaction.

• The formation of an orange color indicates that the water (carbonate and bicarbonate) CO_3^{--} and HCO_3^- completely have become neutral

Procedure:-

1. With the help of a measuring flask, take 50 ml of a sample of water and put it in a conical flask of 250 ml.

2. The burette is filled with 0.02 N H_2SO_4 solution.

3. A few drops of phenolphthalein indicator are added in to the conical flask. The color of the water turns pink.

4. In the conical flask, drop by drop with the help of a burette add 0.02 N H_2SO_4 solution until, until the pink color disappears.

5. The volume of 0.02 N H_2SO_4 used is noted down from the burette.

6. Now a few drops of mixed indicator are added to the conical flask, due to which the color of the solution becomes blue.

7. Now again 0.02 N H_2SO_4 is added to the burette, drop by drop, until the blue color of the solution changes to red-orange.

8. The volume of 0.02 N H_2SO_4 used is noted down from the burette.

9. It is used to determine the total alkalinity.

Observation:-

Table 1. Phenolphthalein alkalinity

S.No.	Volume of water sample in ml	Burette reading		Volume of H_2SO_4 (ml
		Initial	Last	
1	50			
2	50			
3	50			

Homogeneous reading= V_2 ml

Table 2. Total alkalinity

S.No.	Volume of water sample in ml	Burette reading		Volume of H_2SO_4 (ml)
		Initial	Last	
1	50			
2	50			
3	50			

Homogeneous reading= V_2 ml

Calculation:-

$$N_1V_1=N_2V_2$$

Phenolphthalein alkalinity-

$$P = \frac{\text{Volume of 0.02 N H2SO4(V1) x N x 50 x 1000}}{\text{Volume of water sample in ml}}$$

$$= \frac{\text{0.02 N x V1x 50 x 1000}}{50} mg/L$$

$$= 20\ V_1\ \text{mg/L or PPm}$$

Total alkalinity-

$$T = \frac{\text{Volume of 0.02 N H2SO4(V2)x N x 50 x 1000}}{\text{Volume of water sample in ml}}$$

$$= \frac{\text{0.02 x V2 x N x 50 x 1000}}{50} mg/L$$

$$= 20\ V_2\ \text{mg/L or PPm}$$

Result:-

The alkalinity of the given water sample is as follows-

1. Phenolphthalein alkalinity = $20V_1$PPm
2. Total alkalinity = $20V_2$PPm

Precautions:-

1. All equipment must be clean and dry.
2. Firstly the burette should be washed with 0.02 N H_2SO_4 acid.
3. The pipette should be washed with a water sample.
4. Equal amount of indicator should be used in all titrations.
5. The end point should be noted carefully.

Experiment No.-06

Objective:-

To determine the acidity of a given drinking water sample.

Apparatus and reagents:-

(A) Apparatus

1. Burette

2. Pipette

3. Conical flask

4. Burette stand

(B) Reagents

1. 0.02 N sodium hydroxide

2. Phenolphthalein indicator

3. Methyl orange indicator

Procedure:-

1. A clean and dry burette is filled with 0.02 N NaOH solution.

2. Take 50ml of water sample in a clean and dry conical flask with the help of a pipette and add 2-3 drops of methyl orange indicator.

3. Now add 0.02 N NaOH solution slowly from the burette to the conical flask. The color of the solution changes from orange red to yellow at the end point. Note the reading from the burette.

4. Now put 2 drops of phenolphthalein indicator in the conical flask and add 0.02 N NaOH to it from the burette until pink color comes. This will be the end point of the titration. Note the reading from the burette.

Observation:-

Table 1. Methyl orange Acidity

S.No.	Volume of water sample in ml	Burette reading		Volume of 0.02N NaOH (ml)
		Initial	Last	
1	50			
2	50			
3	50			

Homogeneous reading= V_2 ml

Table 2. Total acidity

S.No.	Volume of water sample in ml	Burette reading		Volume of 0.02N NaOH (ml)
		Initial	Last	
1	50			
2	50			
3	50			

Homogeneous reading= V_2 ml

Calculation:-

$$\text{Methyl orange acidity} = \frac{V1 \times N \times 50 \times 1000}{Volume\ of\ water\ sample}$$

$$\text{Phenolphthalein Acidity/Total Acidity} = \frac{V2 \times N \times 50 \times 1000}{Volume\ of\ water\ sample}$$

Result:-

Acidity of the given water sample = ...mg/L

Precautions:-

1. All apparatus should be cleaned with distilled water and dried.

2. The burette should be washed with NaOH solution (0.02 N).

3. The pipette should be washed with water sample.

4. Equal amount of indicator should be used in all the titrations.

5.The end point should be noted carefully.