

AIM:- To estimate the soil moisture contents in the given soil sample.

APPARATUS REQUIRED:- Watch glass, drying oven, spatula, dessicator.

THEORY:- Water in a soil, measured in a number of ways - gravimetric, volumetric, neutron scattering method, soil moisture tension and electrical conductivity. However gravimetric method is the simplest and the most widely used method.

The tri weighed soil sample is dried in an oven at  $105^{\circ}\text{C}$ . The weight difference is considered to be water present in soil sample.

$$\% \text{ moisture} = \frac{\text{loss of weight of soil}}{\text{over dry weight of soil}} \times 100$$

#### PROCEDURE:-

1. First weight the empty beaker.
2. Put soil sample in the beaker and weigh immediately to avoid loss of moisture content.
3. Place the beaker in preheated oven for about 1 hour at  $105^{\circ}\text{C}$ .
4. Keep the soil in dessicator for cooling for an atleast  $\frac{1}{2}$  an hour.

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5. Weight the beaker with oven dry soil. Then the empty beaker weight is subtracted and difference of reading will give the moisture in given water sample.

Calculation :-

$$\text{Weight of empty watch glass/beaker} = z = 57.3949 \text{ gm}$$

$$\text{Weight of glass/beaker + moist soil} = x = 66.1971 \text{ gm}$$

$$\text{Weight of glass/beaker + dry soil} = y = 65.1097 \text{ gm}$$

$$\text{Amount of soil transferred} = c = (x - z) = \frac{8.8022}{1.0874} \text{ gm}$$

$$\% \text{ moisture content} = \frac{x-y}{c} \times 100 = \frac{1.0874}{8.8022} \times 100 \\ = 12.35\%$$

RESULT :-

Soil sample moisture observed is 12.35%.

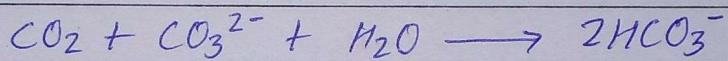
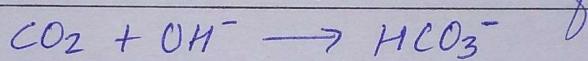
Archanghu  
20/2/17

Aim: Determination of free  $\text{CO}_2$  in a given sample of water.

Apparatus: Burette, pipette, conical flask, beakers etc

Chemicals: N/50  $\text{Na}_2\text{CO}_3$  (or N/50 NaOH), phenolphthalein-

Theory: Free  $\text{CO}_2$  is determined by titrating the sample water with N/10 NaOH or N/10  $\text{Na}_2\text{CO}_3$  solution using phenolphthalein as indicator. The  $\text{CO}_2$  reacts with NaOH or  $\text{Na}_2\text{CO}_3$  to form  $\text{HCO}_3^-$ .



The end point is appearance of pink colour.

Procedure:

1. Rinse and fill the burette with N/50  $\text{Na}_2\text{CO}_3$  solution.
2. Pipette out 100 ml of water sample in a conical flask (there should be no air bubbles). Add a few drops of phenolphthalein.
3. Titrate the soln with N/50 NaOH from the burette till the pink colour persists for atleast 30 s.
4. Note the reading and repeat to get three concordant readings.

Teacher's Signature: \_\_\_\_\_

Observations-

Volume of water sample taken for each titration = 20 ml

Normality of  $\text{Na}_2\text{CO}_3$  used = N/50

| S.No. | Volume of the soln taken in the flask (ml) | Burette Reading |            | Vol. of the titrand used (ml) |
|-------|--|-----------------|------------|-------------------------------|
|       |  | Initial (ml)    | Final (ml) |                               |
| 1.    | 20   | 0               | 6.2        | 6.2                           |
| 2.    | 20   | 6.2             | 12.4       | 6.2                           |
| 3.    | 20   | 12.4            | 18.6       | 6.2                           |

Calculations

Water Sample =  $\text{Na}_2\text{CO}_3$

$$N_1 V_1 = N_2 V_2$$

$$0.01 \times 1.80 \times N_1 \times 20 = \frac{1}{50} \times 6.2 \times 18.6$$

$$N_1 = \frac{6.2}{1000} = 6.2 \times 10^{-3} \text{ N}$$

$$\text{Strength of } \text{CO}_2 = N_1 \times \text{Eq. wt.}$$

$$= 6.2 \times 10^{-3} \times 22$$

$$\text{Ans.} = 0.1364 \text{ g/L solution of pure } \text{CO}_2 \\ = 136.4 \text{ mg/L}$$

Amount of free  $\text{CO}_2$  present = 136.4 ppm

Result:

The amount of free  $\text{CO}_2$  present in water sample = 136.4 ppm.

Precautions:

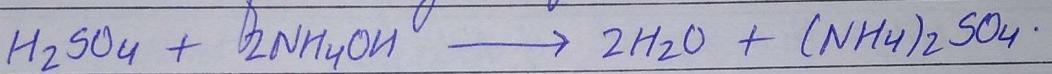
1. The reaction mixture should be stirred very gently during titration.
2. Same amount of indicator should be added while taking different readings.

Aman  
20/2/17

Aim: Determination of Ammonia in water

Apparatus: Burette, pipette, flask and standard solution of  $H_2SO_4$ .

Theory: Ammonia is found as ammonium hydroxide in solution and reacts with sulphuric acid according to the following equation.



Procedure:-

1. Rinse and fill the burette with N/50  $H_2SO_4$ .
2. Pipette out 25 ml of the water.
3. Add 2 drops of methyl red indicator and mix well.
4. Run the acid solution into the flask till the colour changes from yellow to red.
5. Repeat to get three concordant readings.

Observations:

Normality of the acid sol<sup>n</sup> = N/50

Volume of mixture taken for each titration = 25 ml

Observation Table:-

| S.<br>No. | Volume of water<br>sample taken in<br>titration flask<br>(ml) | Burette Readings   |                  | Volume of titrant<br>(H <sub>2</sub> SO <sub>4</sub> ) used<br>(Final - Initial) Reading<br>(ml) |
|-----------|---|--------------------|------------------|--|
|           |   | Initial<br>Reading | Final<br>Reading |  |
| 1.        | 10  | 0 ml               | 23.1 ml          | 23.1   |
| 2.        | 10  | 23.1 ml            | 46.2 ml          | 23.1   |
| 3.        | 10  | 0 ml               | 23.1 ml          | 23.1   |

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Result:-

The strength of ammonia in water sample is  
785.4 ppm.

Precautions:-

1. The reaction mixture should be stirred very gently during titration.
2. Same amount of indicator should be added while taking different readings.
3. Wear lab coat while performing experiment.

Teacher's Signature \_\_\_\_\_

Hence, the ammonia content in given water sample is 785.4 ppm.

$$= 785.4 \text{ ppm}$$

$$= 785.4 \text{ mg/L}$$

$$= 0.7854 \text{ g/L}$$

$$= 0.0462 \times 17$$

$$= N_1 \times 17$$

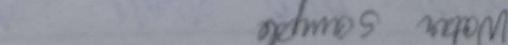
$$\text{Strength of } \text{NH}_3 = N_1 \times 23.1 \cdot \text{lit. of } \text{NH}_3$$

$$N_1 = \frac{500}{23.1} = 0.0462 \text{ N}$$

$$N_1 \times 10 = \frac{50}{23.1}$$

$$N_1 V_1 = N_2 V_2$$

$$\text{Water Sample}$$



$$\text{Normality of dil. H}_2\text{SO}_4 = N/50$$

Volume of water sample taken for each titration = 10 ml  
Calculation:

Aim: Determination of total residual chlorine in water.

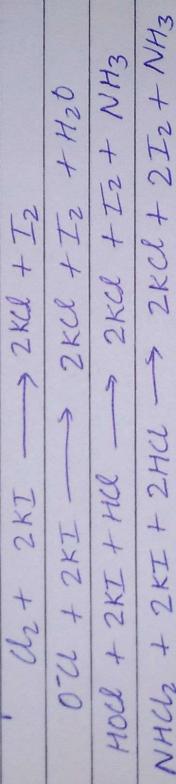
Apparatus: Burette, pipette, conical flask and beakers.

Chemicals:  $\text{Na}_2\text{S}_2\text{O}_3$ , Glacial Acetic acid,  $\text{KI}$ , conc.  $\text{HCl}$ .

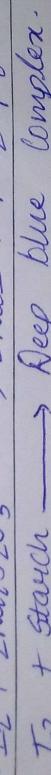
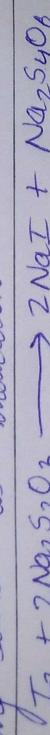
#### Theory:

The estimation of residual chlorine is based on oxidation of  $\text{KI}$  by residual chlorine i.e. by iodometric titration.

When the water sample containing residual chlorine (both free and combined) oxidizes  $\text{KI}$  and liberate  $\text{I}_2$  in equivalent amount.



The liberated  $\text{I}_2$  is titrated against hyposolution using starch as indicator.



The end point is disappearance of blue colour.

Result: Amount of total residual chlorine is given

Observation Table:

| S.No. | Volume of water taken in flask | Initial Burette Reading | Final Burette Reading | Volume of $\text{Na}_2\text{S}_2\text{O}_3$ used |
|-------|--------------------------------|-------------------------|-----------------------|--|
| 1.    | 10 ml                          | 0 ml                    | 8.4 ml                | 8.4 ml   |
| 2.    | 10 ml                          | 8.11 ml                 | 16.7 ml               | 8.3 ml   |
| 3.    | 10 ml                          | 16.7 ml                 | 25.0 ml               | 8.3 ml   |

Calculation:

Sample  $\text{Na}_2\text{S}_2\text{O}_3$

$$N_1 V_1 = N_2 V_2$$

$$N_1 \times 10 = \frac{1}{50} \times 8.3$$

$$N_1 = \frac{8.3}{500} = 1.66 \times 10^{-2} N$$

Total chlorine residual =  $N_1 \times \text{eq. wt.}$

$$= 1.66 \times 10^{-2} \times 35.5 \text{ g/L}$$

$$= 5.89 \cdot 30 \text{ ppm}$$

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Water sample = 589.30 mg/L

Precautions:

1. Chlorine vapours are harmful so the solution should not be sucked into the pipette.
2. The titration should be completed rapidly in order to avoid atmospheric oxidation of iodide.
3. First disappearance of blue colour may be taken as end point.

D  
20/10/14

Aim: To determine the amount of dissolved oxygen in the given sample.

Apparatus:  
Burette, Pipette, conical flask, beaker etc.

Chemicals Required:

$\text{Na}_2\text{S}_2\text{O}_3$  (N/40),  $\text{MnSO}_4$  solution,  $\text{KI}$ , starch, conc  $\text{H}_2\text{SO}_4$ .

THEORY :-

Oxygen itself is not a pollutant in water but its deficiency is an indicator of several types of pollutant in water.

Dissolved oxygen ( $\text{DO}$ ) is determined by Winkler's method or iodometric titration. The dissolved oxygen in water oxidizes  $\text{KI}$  and an equivalent amount of Iodine is titrated against a standard hypo solution. However since dissolved oxygen in water is in molecular state and is not capable of reaction with  $\text{KI}$ , therefore an oxygen carrier such as manganese hydroxide is used. The method involves introducing a basic solution of  $\text{MnSO}_4$ ,  $\text{NaOH}$  and  $\text{KI}$ , acidic reagent, into the water sample. The white ppt. of  $\text{Mn(OH)}_2$  which is formed, is oxidized by oxygen in water sample to give a brown ppt. of basic manganese oxide ( $\text{MnO(OH)}_2$ ). The  $\text{Mn(OH)}_2$  is acidic medium and liberates free iodine from the added dissolved and liberates free iodine from the added

Observation:

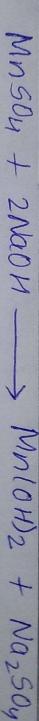
Normality of  $\text{Na}_2\text{S}_2\text{O}_3 = \text{N}/50$

Volume of soln in flask = 20ml

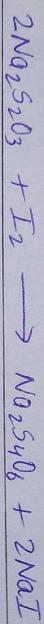
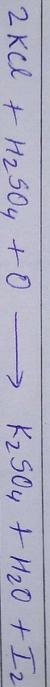
for titration

| Volume of soln<br>in flask | Initial<br>reading | Final<br>reading | Volume of<br>titrant used. |
|----------------------------|--------------------|------------------|----------------------------|
| 20                         | 0                  | 1.3              | 1.3                        |
| 20                         | 1.3                | 2.6              | 1.3                        |
| 20                         | 2.6                | 3.9              | 1.3                        |

KI is an equivalent amount of dissolved oxygen in water sample. This liberated  $I_2$  is then titrated against  $Na_2S_2O_3$  soln using starch as indicator. The reactions involved are:



Basic magnatic oxide



### Result:

The amount of dissolved oxygen in water is 10.4 ppm.

### Precautions:

1. The water should be taken in the stoppered bottle very carefully without trapping air bubbles which could damage label by aerating the sample.
2.  $MnSO_4$  and alkaline iodine - azide solutions are added to the water sample just below the surface of water.
3. Most of the precipitate of  $Mn(OH)_2$  should be dissolved in  $H_2SO_4$ .

Calculations

Hypo

$O_2$  in water

$$N_1V_1 = N_2V_2$$

$$\frac{1}{50} \times 1.3 = N_2 \times 20$$

$$N_2 = 1.3 \times 10^{-3} N$$

Strength of dissolved oxygen,  $N_2 \times \text{eq. wt.}$

$$= 1.3 \times 10^{-3} \times 3$$

$$= 10.4 \times 10^{-3} g/l$$

$\text{mg/l}$

$= 10.4 \text{ ppm}$

Aim: To determine biological oxygen demand (BOD) of a given sample of water.

Apparatus: Burette, pipette, conical flask, beaker.

Chemicals: MgSO<sub>4</sub> solution (2.25 g/l), CaCO<sub>3</sub> solution (2.25 g/l)  
FeCl<sub>3</sub> soln (0.25 g/l) phosphate buffer soln, BOD bottle,  
Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>.

#### Theory:

The BOD in a water sample is directly related to the extent of pollution by average or better oxygen demanding waste. If the oxygen in water is lesser than BOD, the decomposition of microorganisms takes place in water and have produce highly objectionable end products including H<sub>2</sub>S, NH<sub>3</sub> and CO<sub>2</sub>. Therefore, sufficient oxygen must be present or supplied externally to maintain aerobic conditions so that organic matter decompose into an acceptable products. To know the amount of oxygen required by given sample volume of pure water whose oxygen content is already known.

The BOD is given by:

$$BOD = \frac{(D_1 - D_2) \times \text{Volume of sample after dilution}}{\text{Volume of sample before dilution}}$$

Teacher's Signature :

Observation

- Volume of sample for each titration = 20 ml
- Normality of  $\text{Na}_2\text{S}_2\text{O}_3$  used =  $N/50$

| Volume of soln<br>in flask | Burette reading<br>initial | Burette reading<br>final | Volume of<br>titrant used |
|----------------------------|----------------------------|--------------------------|---------------------------|
| 20                         | 0                          | 1.2                      | 1.2                       |
| 20                         | 1.2                        | 2.4                      | 1.2                       |
| 20                         | 2.4                        | 3.6                      | 1.2                       |

Calculations

$$N_1 V_1 = N_2 V_2$$

$$\frac{1}{50} \times 1.2 = N_2 \times 20$$

$$N_2 = 1.2 \times 10^{-3} N$$

$$\text{Strength of } D = N_2 \times E g^{-1} l^{-1}$$

$$\begin{aligned} &= 1.2 \times 10^{-3} \times 8 \\ &= 9.6 \text{ mg/l} \\ &= 9.6 \text{ ppm} \end{aligned}$$

$$B.O.D = 10.4 - 9.6 = 0.8 \text{ ppm}$$

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The dilution of water sample with pure water is necessary because usable water oxygen may not be sufficient to decompose it aerobically.

Result:

The BOD of the given water sample is = 0.8 ppm

Precautions:

1. Whole of the precipitate of  $Mn(OH)_2$  should be dissolved in  $H_2SO_4$ .
2. Nitroso and alkaline iodine azide solution added to the water sample just below the surface of water.

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Aim: Determination of pH in drinking water sample.

Apparatus: pH meter, glass electrode, thermometer, beakers, stirrer.

Theory: The pH is defined by the formula

$$\text{pH}_{\text{sample}} = \text{pH}_{\text{reference}} + \frac{E_{\text{sample}} - E_{\text{reference}}}{F(RT \ln 10)}$$

where,  $E$  = Electrode potential

$R$  = universal gas constant

$T$  = Absolute temperature

$F$  = Faraday constant.

The value of pH, the logarithmic of the reciprocal of the hydrogen ion concn in solution is determined by measuring the difference in potential between two immersed electrodes in a sample solution.

### Result:

The pH of the given sample is 7.2.

### Precautions:

1. Immediately after testing, the electrodes should be washed off with a gentle stream of distilled H<sub>2</sub>O.
2. For storage, after cleaning the electrodes are suspended in distilled water & the system is protected against evaporation. The digging out of electrodes should be avoided.

Teacher's Signature: \_\_\_\_\_

Observation Table

| Sample         | pH  |
|----------------|-----|
| Drinking water | 7.2 |