# DO IN WATER

Oxygen is poorly soluble in water. The amount of oxygen in water depends on physical, chemical and biochemical activities taking place in water body .The solubility of DO in water at saturation at any temperature & pressure is given by Henry's law .The saturation value of DO in water is of the order of 8 to 15 mg/l, depending upon the temperature & pressure. At 20°C temperature and standard pressure the maximum amount of oxygen that can dissolve in fresh water is 9 ppm. If the temperature decreases, there may be more oxygen dissolved in the sample water.

**PRACTICAL RELEVANCE**

| DO level | Water quality |
|---|---|
| 0-4.0 ppm | Poor, undesirable odours, Effect aquatic life |
| 4.1-7.9 ppm | Fair |
| 8.0-12 ppm | Good |
| 12+ | Retest |

**1. Fall in DO levels causes undesirable odours, tastes and reduce the acceptability of water for domestic uses.**

**2. In aquatic life, as DO drops below 4 ppm fish and other species are affected. When DO level is below 2 ppm fishes are threatened and may get decline.**

**3. Determination of DO is important in industrial purposes. In steam generation, DO is important factor causing corrosion control of the boiler materials.**

# DETERMINATION OF DISSOLVED OXYGEN BY IODOMETRIC TITRATION METHOD

## I. SAMPLING

FOR DO determination-

(i) The sample container should be made of Glass/ BOD bottle. The sample water should be taken in a stoppered bottle very carefully without any air bubbles which could raise oxygen level by aerating the sample.

(ii) Minimum sample size should be 250ml and type Grab.

(iii) The sample should be analyzed immediately as recommended within 15 minutes.

Location: Date & Time of Sampling

| Samp. No. | Sample Described as | Sampling Source | Container | Sample Size & Type | Preservation | Max. Storage Recommended |
|---|---|---|---|---|---|---|
| | | | | | | |

## II. THEORY

Dissolved oxygen (DO) is determined by (Winkler's method) IODOMETRIC TITRATION method. However since dissolved oxygen in water is in molecular state and is not capable of reacting with $KI$, therefore an oxygen carrier is to be produced, which enables the dissolved oxygen to take part in reaction.

The method introducing adding of Conc. Soln. of $MnSO_4$ and alkaline $KI$ into the water sample. A white ppt of $Mn(OH)_2$ which is oxidized by dissolved oxygen present in water to give a brown ppt. of $MnO(OH)_2$ which acts an oxygen carrier to enable the dissolved oxygen to take part in reaction.

$$MnSO_4 + 2NaOH \longrightarrow Mn(OH)_2 + K_2SO_4$$

***Manganese Hydroxide***

$$4Mn(OH)_2 + O_2 \longrightarrow 2MnO(OH)_2$$

***Basic Manganic Oxide***

This $MnO(OH)_2$ in acidic medium dissolves to produce $[O]$ which is also in acidic medium Oxidizes $KI$ and liberates free $I_2$ in an equivalent amount of dissolved oxygen present in the water sample.

$$MnO(OH)_2 + H_2SO_4 \longrightarrow MnSO_4 + 2H_2O + [O]$$

***Nascent Oxygen***

$$[O] + H_2SO_4 + 2KI \longrightarrow K_2SO_4 + H_2O + I_2$$

***Free Iodine***

This liberated $I_2$ is then titrated against standard hypo solution using starch as an indicator.

$$\mathbf{I_2 + 2Na_2S_2O_3 \longrightarrow Na_2S_4O_6 + 2NaI}$$

| METHOD | |
|---|---|

## III. PREPARATION

**Apparatus: stoppered bottle 250 ml, pipette 5 ml, conical flask, pipette 50ml, burette 50 ml, syringe 5ml.**

**Chemicals: $MnSO_4$, Alkaline $KI$, Conc.$H_2SO_4$, $Na_2S_2O_3$, 5 $H_2O(^N/_{40})$, starch indicator.**

**(i) $MnSO_4$ soln.:- Dissolve 5 gm of $MnSO_4$ in d.w and make up the volume 100ml.**

**(ii) Alkaline $KI$ Soln.:- Dissolve 40 g $NaOH$ and 20 g $KI$ in d.w and make up the volume to 100ml.**

**(iii) Conc. $H_2SO_4$ Soln.:- Take nearly about 50ml of Conc. $H_2SO_4$ in a bottle.**

**(iv) $Na_2S_2O_3$. 5 $H_2O$ $(^N/_{40})$ soln.:- Dissolve 6.20 g of $Na_2S_2O_3$ in d.w and make up the volume to 1lit.**

**(v) Starch soln.:- Dissolve 1 g powdered starch with d.w to form a paste and add 100 ml of boiled water to it with constant stirring, then boil for 5 minutes and then cool.**

## III. PROCEDURE

### (A) Standardisation of $Na_2S_2O_3$ soln.

1. Rinsed & filled up the burette with $Na_2S_2O_3$ soln.
2. Rinsed & pipetted out 20 ml stnd $K_2Cr_2O_7$ Soln and taken in a conical flask.
3. 3 ml KI soln (by Pipette) and then 3ml conc. $H_2SO_4$ soln (by cyringe) are added to it and covered the mouth with watch glass. The mixture is Shaken well and now the soln become DEEP BROWN Colour (due to liberation of Iodine)

$$K_2Cr_2O_7 + 6KI + 7H_2SO_4 = 4K_2SO_4 + Cr_2(SO_4)_3 + 7H_2O + 3I_2$$

deep brown

4. It is then titrated (liberated $I_2$) against $Na_2S_2O_3$ Soln until the brown colour fades to pale yellow colour.
5. Now, 3ml Starch Soln is added (by cyringe), then the soln turns DEEP BLUE Colour. Continued the titration until blue colour disappears leaving a COLOURLESS Soln (End point)

$$I_2 + 2Na_2S_2O_3 = Na_2S_4O_6 + 2NaI$$
$$I_2 + Starch = Starch\ I_2$$

blue complex

### (B) Determination of DO

1. Rinsed & filled up the burette with stand $Na_2S_2O_3$ Soln.
2. A Known amount of Sample water (Say 250ml) is taken a stoppered bottle.
3. 3 ml $MnSo_4$ Soln (by pipette) is added, dipping the end well below the surface of water. Also, 3ml Alkaline - Iodide-azide Soln (by pipette) is added and shaken well.
4. Appearance of brown ppt (of basic manganic oxide) indicates the presence of DO. The ppt is allowed to form ad settle down.

$$MnSo_4 + 2NaoH = Mn(OH)_2 + Na_2SO_4$$
$$Mn(OH)_2 + O_2 = 2MnO(OH)_2$$

brown ppt.

5. 3ml conc $H_2SO_4$ Soln (by Cyringe) is added to it and stoppered the bottle. The Mixture is Shaken well to dissolve the ppt completely and now the soln become DEEP BROWN Colour (due to liberation of Iodine)

$$Mn(OH)_2 + H_2So_4 = MnSo_2 + 2H_2O + [O]$$
$$[O] + 2KI + H_2SO_4 = K_2SO_4 + H_2O + I_2$$

deep brown

6. Rinsed & measured out 100 ml of the above soln and taken in a conical flask.
7. It is then titrated (liberated $I_2$) against stand $Na_2S_2O_3$ Soln until deep brown colour fades to pale yellow colour.
8. Now, 3ml starch indicator soln (by cyringe) is added, when the Soln turns DEEP BLUE Colur. Continued the titration until blue colour disappears leaving a colourless Soln (End point)

$$I_2 + 2Na_2S_2O_3 = Na_2S_4O_6 + 2NaI$$
$$I_2 + Starch = Starch\ I_2$$

blue complex

$$Starch\ I_2 + 2Na_2S_2O_3 = 2Na_2S_4O_6 + 2NaI + Starch$$

colourless

| Sl.No. | Vol.of Sample soln. Taken, ml $V_1$ | Vol.of titrant $Na_2S_2O_3$ used, ml $V_2$ | | | str. of $Na_2S_2O_3$ $N_2$ | str. of water $N_1$ |
|---|---|---|---|---|---|---|
| | | initial | final | diff | | |
| | | | | | $(^N/_{40})$ | ? |

$V_1N_1 = V_2N_2$
(water) (hypo)

⇨ $N_1 = \frac{V_2}{50} \times \frac{1}{40}$ (N)

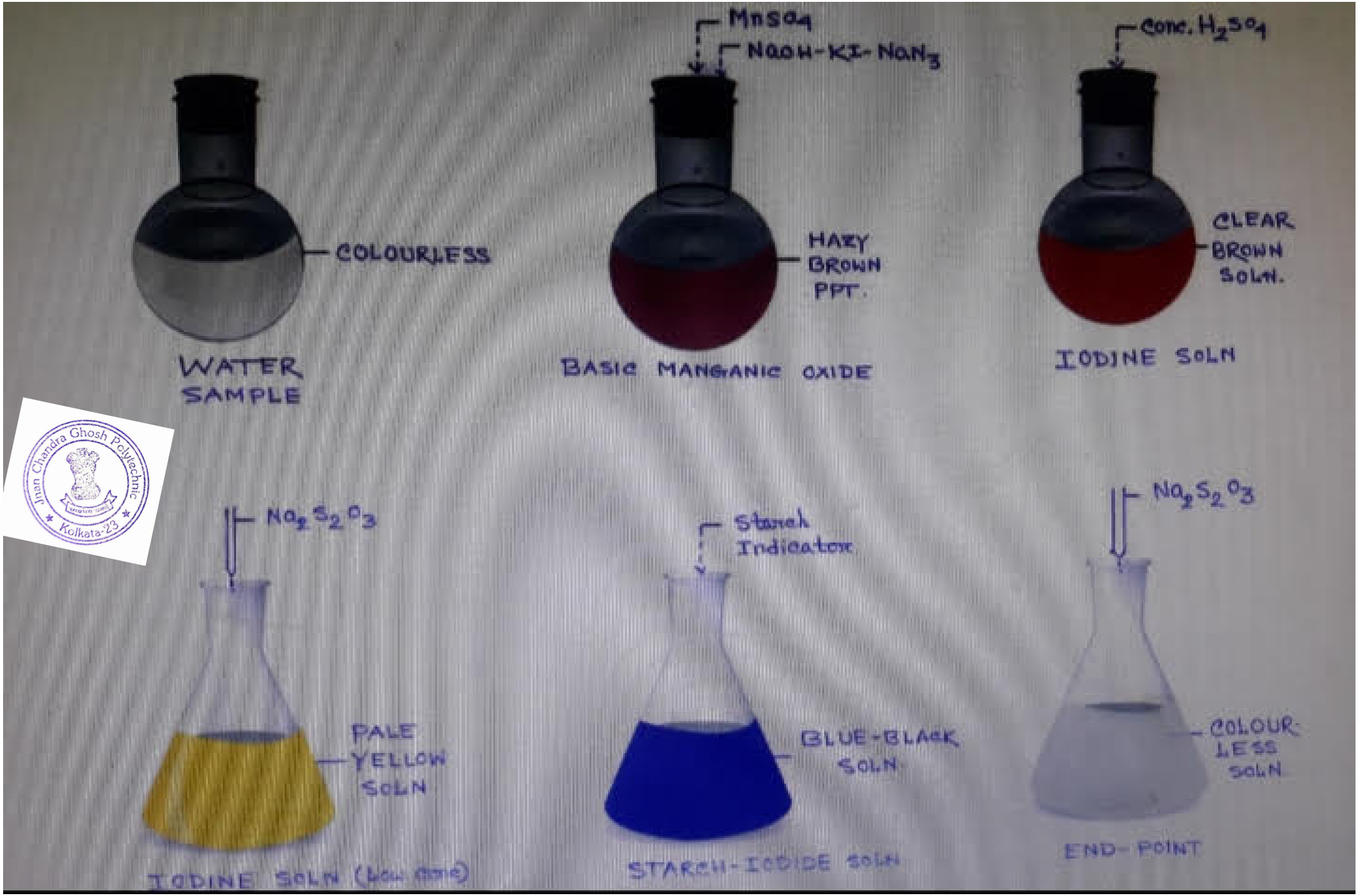
Strength of dissolved Oxygen $= \frac{V_2}{50X40}$ ~~(N)~~ X 8 g/l [eq. wt. of $O_2$ = 8]

$= \frac{V_2}{50X40}$ X 8 ~~g/L~~ X 1000 mg/L

= mg/L

## V. RESULTS & COMMENTS

| Standard Value: as per | Experimental Value |
|---|---|
| Comments | |



# DETERMINATION OF THE DISSOLVED $O_2$ IN WATER BY IODOMETRIC TITRATION METHOD