DISSOLVED OXYGEN

TITLE

To determine the amount of Dissolved Oxygen (DO) in water.

DISSOLVED OXYGEN

The dissolved oxygen (DO) is oxygen that is dissolved in water. The oxygen dissolves by diffusion from the surrounding air; aeration of water that has tumbled over falls and rapids; and as a waste product of photosynthesis. A simplified formula is given below:

Photosynthesis (in the presence of light and chlorophyll):

Carbon dioxide + Water ----------> Oxygen + Carbon-rich foods

CO_2 H_2O O_2 $C_6H_{12}O_6$

Fish and aquatic animals cannot split oxygen from water (H2O) or other oxygen-containing compounds. Only green plants and some bacteria can do that through photosynthesis and similar processes. Virtually all the oxygen we breathe is manufactured by green plants. A total of three-fourths of the earth's oxygen supply is produced by phytoplankton in the oceans.

- Fish, invertebrates, plants, and aerobic bacteria all require oxygen for respiration.
- Much of the dissolved oxygen in water comes from the atmosphere. After dissolving at the surface, oxygen is distributed by current and turbulence. Algae and rooted aquatic plants also deliver oxygen to water through photosynthesis.
- The main factor contributing to changes in dissolved oxygen levels is the build-up of organic wastes. Decay of organic wastes consumes oxygen and is often concentrated in summer, when aquatic animals require more oxygen to support higher metabolisms.
- Depletions in dissolved oxygen can cause major shifts in the kinds of aquatic organisms found in water bodies.
- Temperature, pressure, and salinity affect the dissolved oxygen capacity of water. The ratio of the dissolved oxygen content (ppm) to the potential capacity (ppm) gives the percent saturation, which is an indicator of water quality.

METHODS OF DETERMINATION OF DO IN WATER:

(1) Winkler Method

(2) Azide modification of Winkler Method

(3) Rideal Stewart method

(4) DO-meters

(1) Winkler Method

Its principle is that oxygen oxidizes manganese (Mn^{+2}) to higher oxidation state then this higher oxidation state manganese converts iodide ion (I^{-1}) to iodine I_2 and amount of free iodide librated is equivalent to DO.

$$Mn^{+2} + 2OH^{-1} \longrightarrow Mn(OH)_2$$

$$Mn(OH)_2 + 1/2O_2 \longrightarrow MnO_2 + H_2O$$

$$MnO_2 + 2I^{-1} + 4H^{+1} \longrightarrow Mn^{+2} + I_2 + H_2O$$

Then by titration with $S_2O_3^{-2}$, thiosulphate ion (thiosulphate ion comes from sodium thiosulphate), iodine can be calculated.

$$2S_2O_3^{-1} + I_2 \longrightarrow S_4O_6^{-2} + 2I^{-1}$$

If we use 0.025 N $Na_2S_2O_3$ then 1ml of titrant = 1mg of DO

(2) Azide modification of Winkler Method

If nitrites NO_2^{-1} will present in water, they will change the results because they convert iodide ions to iodine before performance of experiment. To remove NO_2^{-1} sodium azides are added.

PROCEDURE

1. Take BOD bottle (300 ml volume)
2. Fill the bottle with water sample.
3. Add 1 ml $MnSO_4$ solution to it and mix uniformly with the help of pipette.
4. Add 1ml alkali azide iodide solution. On addition, if white ppts. are formed, then there is no DO in water. Formation of Reddish brown ppts. Indicates the presence of DO.
5. If Reddish brown ppts are formed, stopper the bottle and shake it upside down for 20 times and allow the ppts. To settle down for about 2 inches.
6. Add 1 ml Concentrated H_2SO_4 and again shake for about 8 times.
7. Take 200 ml of this water sample in a titration flask and titrate it with 0.025 N $Na_2S_2O_3$ till the appearance of light yellow color.
8. Then add 1ml starch solution. The color of solution becomes blue on this addition.
9. Again titrate it with 0.025N $Na_2S_2O_3$ till the disappearance of blue color.
10. Note the volume of titrant used.

ml of titrant used = DO in mg/liter

The above formula is applicable if we use 200ml of water sample solution and 0.025N $Na_2S_2O_3$. General formula is given by

$$\text{DO (mg/l)} = \frac{\text{mean vol of titrant used x N x 8000}}{\text{F x vol of sample in ml}}$$

Where,

$$\text{F} = \frac{\text{vol of BOD bottle - vol of reagents used}}{\text{vol of BOD bottle}}$$

OBSERVATIONS AND CALCULATIONS

DISSOLVED OXYGEN

Sample No.	Sample Description	Sample Volume (ml)	Volume of Titrant ($Na_2S_2O_3$)used (ml)	Dissolved Oxygen (DO) (mg/lit)	Mean Dissolved Oxygen (DO) (mg/lit)
1	Lab Prepared	200 100			
2	Lab Prepared	200 100			
3	Lab Prepared				

Comments:

Questions:

1) What are the factors upon which solubility of oxygen depends?

2) Why starch is added when light yellow colour appears?

3) Write the significance of this test in Environmental Engineering.

4) What type of titration is involved in above test?

5) What is azide modification?