المحاضره السادسه

Desolve Oxygen

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Dissolved oxygen D.O :

- refers to the concentration of oxygen present in a unit volume of water, measured in milligrams per liter (mg/L). This mean the number of milligrams of oxygen dissolved in each liter of water.

Importance.

- Desolve oxygen necessary for breaking down organic pollutants.
- Low oxygen levels lead to anaerobic decomposition, producing harmful gases such as methane (CH_4) and hydrogen sulfide (H_2S),

Sources of Dissolved Oxygen

Atmospheric diffusion:

Oxygen enters water from the air at the water surface.

Transfer depends on:

Atmospheric pressure

Water depth

Surface movement and waves

Photosynthesis by aquatic plants and algae:

Oxygen is released directly into the water during photosynthesis.

Factors Affecting Dissolved Oxygen Concentration

- Salinity: Higher salt concentrations reduce oxygen solubility.
- Organic matter: More biodegradable organic matter increases oxygen consumption.
- Temperature: Oxygen solubility decreases as water temperature rises.
- Water depth and level: Shallow or turbulent water enhances oxygen mixing and replenishment.

Methods of Measuring Dissolved Oxygen

1. Chemical (Analytical) Method – Winkler Method

Principle: Based on the oxidizing property of dissolved oxygen.

Accuracy: Highly accurate; commonly used in Biological Oxygen Demand (BOD) tests.

Selection criteria: Depends on ion interference and the purpose of measurement.

Sample Collection:

Collect water in narrow-mouthed, tightly sealed glass bottles (250–300 mL).

Fill carefully to avoid air bubbles.

Measure samples immediately and keep away from sunlight.

Fix DO by adding manganese sulfate + alkali iodide-azide + concentrated sulfuric acid.

Interferences in the Winkler Method

- **Nitrite ions**: removed with azide modification
- **Ferrous ions**: removed with permanganate modification
- **Suspended solids**: removed with alum modification
- **Activated sludge**: removed with copper sulfate + sulfamic acid modification

Modifications

1. Azide Modification:

- Used for water with >50 µg/L nitrite nitrogen and ≤1 mg/L ferrous sulfate, without other oxidizers or reducers.
- Chemicals:
- $MnSO_4$ solution: 36.4 g $MnSO_4 \cdot H_2O$ → 100 mL
- Alkali iodide-azide: 70 g KOH + 15 g KI → 100 mL + 1 g NaN_3 in 4 mL water
- Concentrated H_2SO_4
- Starch solution: 5 g starch + 1.25 g salicylic acid → 1 L
- Standard $Na_2S_2O_3$ solution (0.025%): 6.205 g $Na_2S_2O_3 \cdot 5H_2O$ → 1 L

2. Permanganate Modification:

- Used for water with >1 mg/L ferrous ions or acidic water with high ion concentration; treated with potassium fluoride + azide solution.

3. Alum Modification:

- For waters with large amounts of suspended solids (mud, silt, colloids).

4. Copper Sulfate–Sulfamic Acid Modification:

- For samples containing activated sludge or biotic material; acts to flocculate or neutralize biological interference.

Instrumental Method – DO Meter

Principle:

Measures DO based on the rate of oxygen diffusion through the electrode membrane.

Accuracy:

Accurate and fast, suitable for direct field measurements in rivers, streams, and lakes.

Interferences & Limitations:

- Suitable for most water types, especially when ion interferences cannot be corrected with Winkler modifications.
- Not recommended for highly saline water (depends on partial pressure of oxygen).
- Not recommended for highly corrosive water