

# Module – 1

## Water Technology

Module:1	Water Technology	5 hours	SLO: 1,14
Characteristics of hard water - hardness, DO, TDS in water and their determination – numerical problems in hardness determination by EDTA; Modern techniques of water analysis for industrial use - Disadvantages of hard water in industries.			

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## Characteristics of water

- Hardness, DO, TDS and their determination
- Numerical problems in hardness determination by EDTA;
- Modern techniques of water analysis for industrial use
- Disadvantages of hard water in industries.

# Sources of Water



**Naturally available water can be classified as:**

**a) Surface water :**

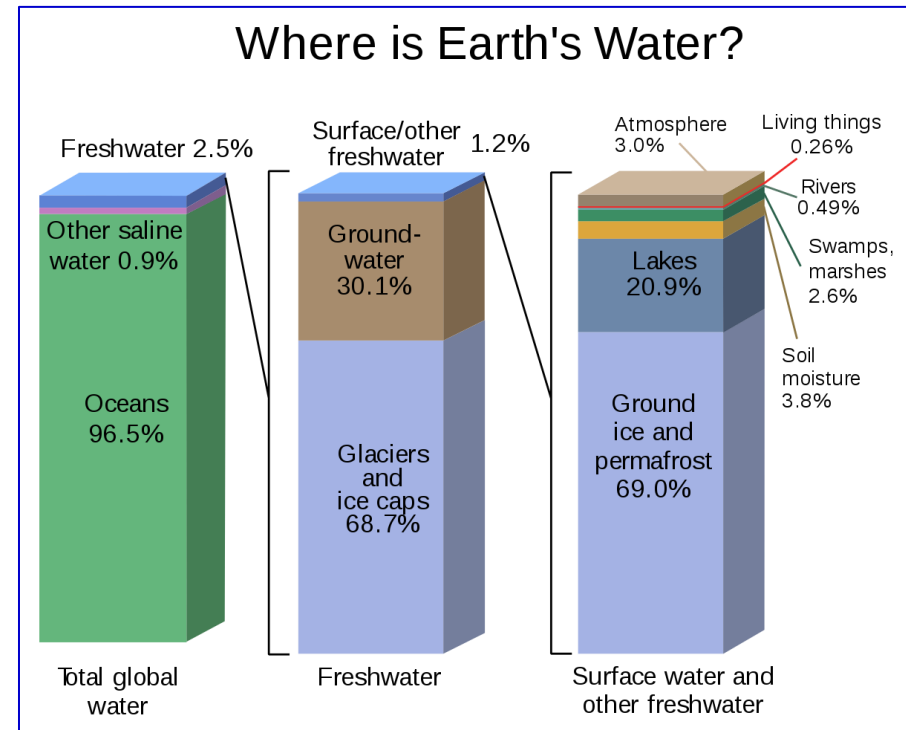
- Flowing water - streams, rivers
- Still water - ponds, lakes and reservoirs

**b) Underground water**

- springs and wells

**b) Sea water and**

**c) Rain water**



# Sources of Water



**Rainwater :** It is the purest form of natural water but contains dissolved toxic gases like  $\text{CO}_2$ ,  $\text{SO}_2$ ,  $\text{NO}_2$  etc. and other solids. Also its supply is unpredictable.

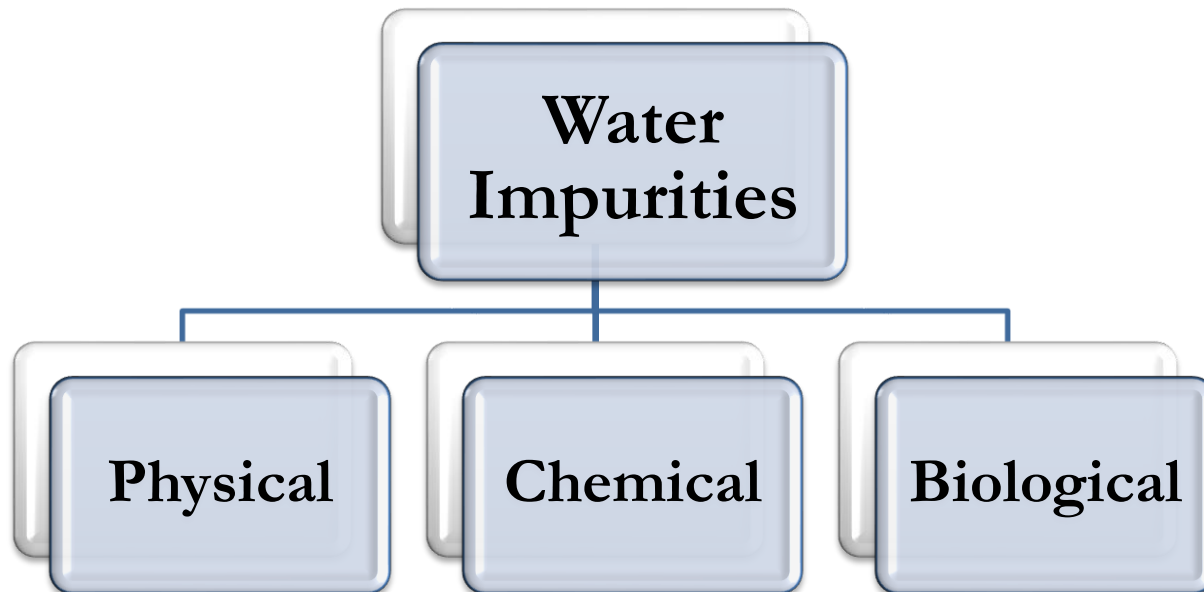
**Sea water :** It is the most impure form of water containing about 3.5% dissolved salts of which about 2.6% is NaCl. Other salts present include sulphates, bicarbonates, bromides of sodium, potassium, magnesium etc.

It is therefore, necessary to depend on ground and surface water after removing different impurities that are present in them, as required.

# Water Impurities



- ❖ The substances that pollute water are called “**Water Impurities**”
- ❖ Water is being polluted by throwing wastes into rivers, oil leakage by water transport, etc.



# Impurities in water



Water has different physical, chemical and biological Impurities which can cause problems in both domestic and industrial applications.

## o Physical

- Inorganic such as clay, sand
- Organic such as oil globules, vegetable/animal matter
- Colloidal such as  $\text{Fe}(\text{OH})_3$ , Complex proteins, amines

## o Chemical

- Anions such as  $\text{Cl}^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{CO}_3^{2-}$ ,  $\text{HCO}_3^-$ ,  $\text{NO}_3^-$  of Ca & Mg
- Cations such as  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Fe}^{3+}$ ,  $\text{Al}^{3+}$
- Dissolved gases such as  $\text{O}_2$ ,  $\text{N}_2$ ,  $\text{CO}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{NH}_3$

## o Biological

- Microorganisms such as algae, fungi, bacteria  
(Pathogenic causing Malaria, diarrhea, typhoid etc.)

# Water Quality Indicators - *Physical*



- **Colour** — Inorganic salts
- **Odour** — Organic & Inorganic compounds
- **Transparency** — Suspended solids
- **Taste** — **Bitter** — Fe, Mn, Al sulphates, **Soapy** —  $\text{NaHCO}_3$



# Water Quality Indicators - *Chemical*



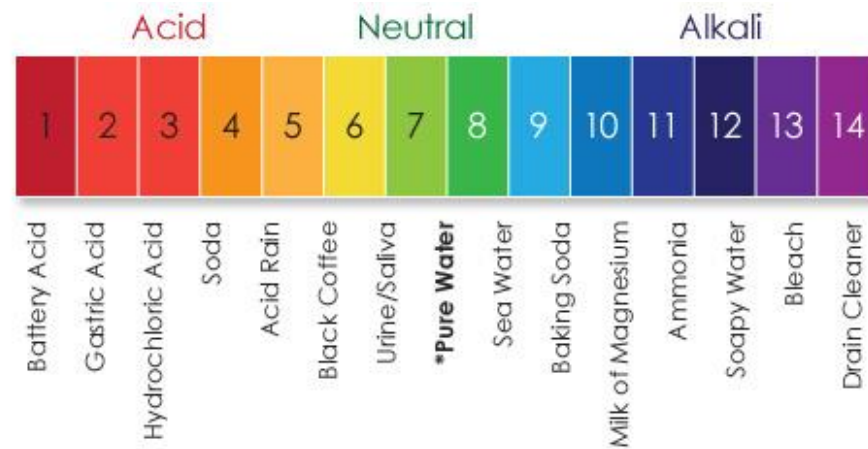
- pH
- Dissolved Oxygen (DO)
- Biological Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Total Dissolved Solids (TDS)
- Hardness



# pH of water



- Concentration of  $H^+$  ions



## Domestic

Drinking water 6.5 – 8.5

pH < 7 acidic → Dissolved  $CO_2$  (acidity)

pH > 7 Basic → Dissolved hydroxides and carbonate salts (alkalinity)

## Industrial Applications

pH ~ 8.5

acidic → Corrosive

Basic → Prone to scale formation

# Dissolved Oxygen



Dissolved oxygen (DO) is the amount of oxygen dissolved in a given quantity of water at a particular temperature and atmospheric pressure.

## ○ DO depends on

- Aeration
- Photosynthetic activity of the water
- Respiration of animals and plants
- Speed of water flow
- Roughness of surface over which water flows
- Temperature of the water body

# Dissolved Oxygen



## ○ **Oxygen Demanding Wastes**

### - **Chemical Oxygen Demand (COD)**

Chemicals/Organic wastes present in water consume the DO

### - **Biological Oxygen Demand (BOD)**

Organic wastes reaching water consume oxygen from water bodies for their decomposition by bacteria through biochemical oxidation

## ○ **These are useful measures to check water quality**

# Dissolved Oxygen (DO)



Oxygen that is freely available in the form of  $O_2$  in water

## Source

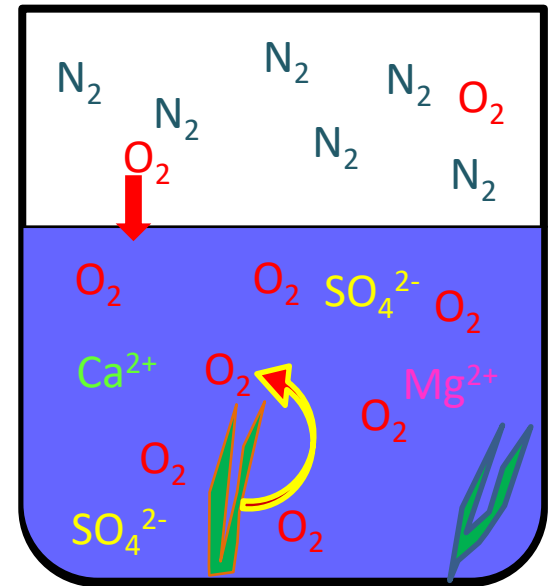
- i) Atmosphere
- ii) Emitted from photosynthesis process of algae & aquatic plants

DO in water  $\propto$  Pressure (henry's law)

$\propto 1/\text{Temperature}$  (molecular vibrations)

Cold and Fresh water

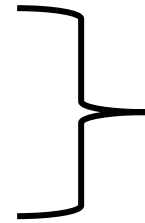
Warm and Salty water



# Parameters affect DO

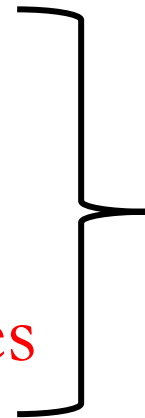


- Pressure
- Aquatic plants



**Positive effect**

- Temperature
- Salinity
- Dead plants
- Chemically oxidizable Impurities



**Negative effect**

# Importance of DO in water



- It is necessary for healthy aquatic life
- Concentration of DO determines the type of fish and aquatic life in the region
- Higher DO → Healthy aquatic life
- Lower DO → Presence of larva and worms
- Industry → higher DO leads to the corrosion of boilers

# Importance of DO in water

