

# **Wastewater Engineering**

## **Lecture - 4**



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# **Chemical and Biological Characteristics of Sewage**

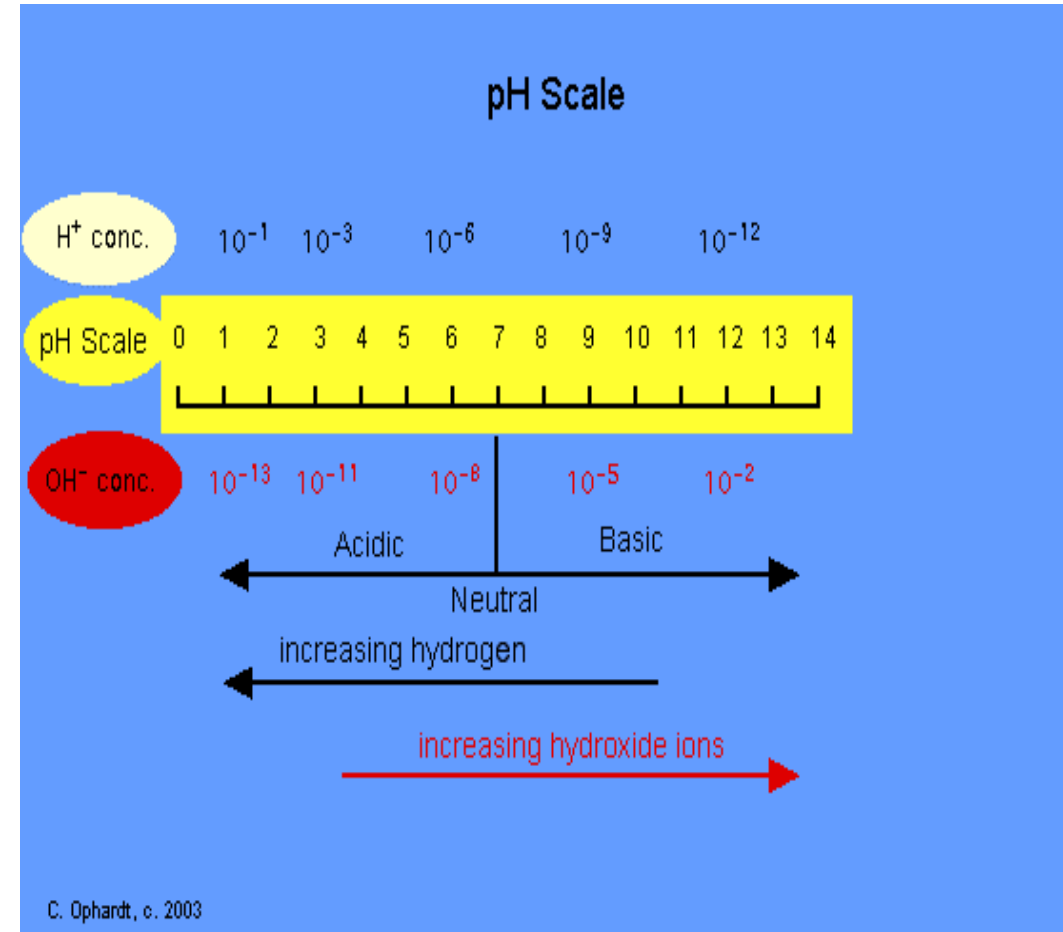
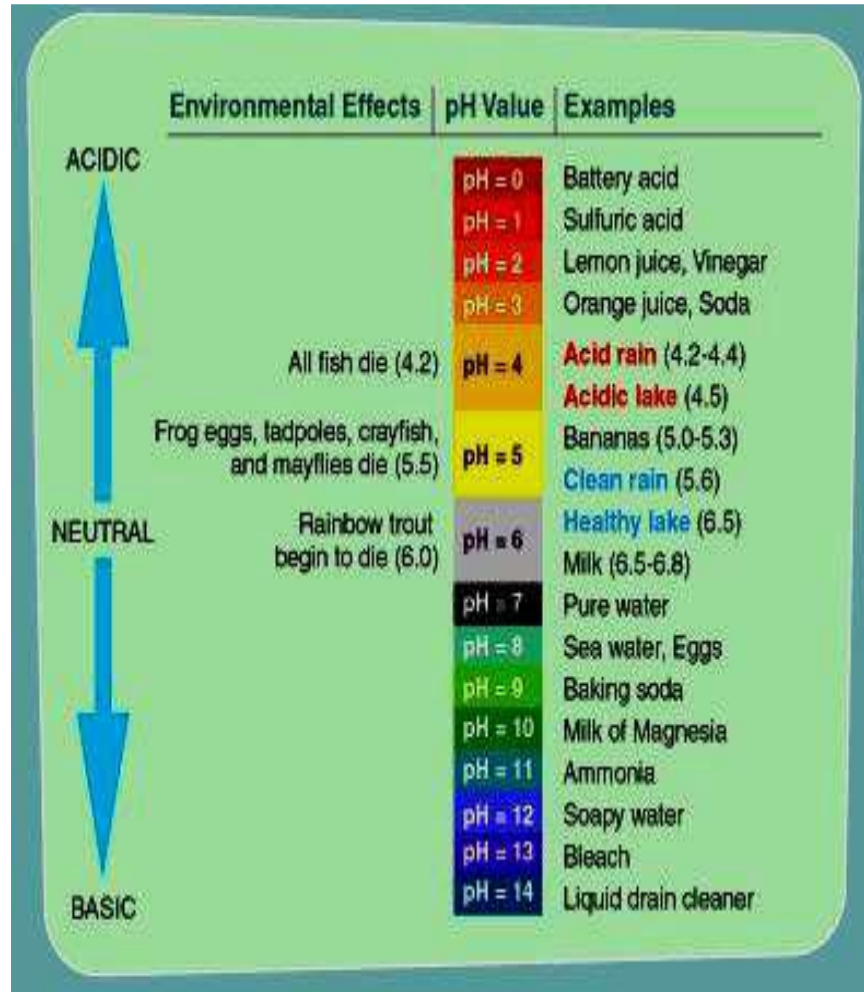
# **Chemical Characteristics of Sewage**

- **pH Value**
- **Organic Matter (OM)**
- **Nitrogen Contents**
- **Chlorides Contents**
- **Fats, Oils and Greases**
- **Sulphides, Sulphates and Hydrogen gas**
- **Toxics**
- **Dissolved Oxygen (DO)**

## pH Value

- pH value is an indicator of the acidity or the alkalinity of sewage. If the pH value is less than 7, the sewage is acidic and if the pH value is more than 7, the sewage is alkaline.
- Fresh sewage is generally alkaline, but with the passage of time pH tends to fall due to production of acid by bacterial action in anaerobic or nitrification processes.
- Determination of pH is important because efficiency of certain treatment methods depends on it. Especially the biological treatment, for better results the pH of sewage should be around 7.0 as microorganisms can flourish in that pH range.
- pH can be determined using pH meter ( Potentiometer)

# pH Value



# Organic Matter (OM)

Organic Matters are chemical compounds of Carbon, Hydrogen and Oxygen. Number of atoms of Carbon, Hydrogen and Oxygen are represented by **a**, **b** and **c** respectively as shown below.

**Organic matter ( $C_a H_b O_c$ ).**

75% SS  $\longrightarrow$  organic. (Suspended Solids)  
40% FS  $\longrightarrow$  organic. (Filtered Solids)

Organic mater is derived from animals & plants and man activities.

Proteins (40-60%).  
Carbohydrates (25-50%).  
Fats, Oils, and Grease (10%).

# Nitrogen Contents

- The presence of nitrogen in sewage is an indication of the presence of the organic matter and may occur in one or more of the following forms:
  1. Free ammonia called ammonia nitrogen
  2. Organic Nitrogen
  3. Nitrites (**NO<sub>2</sub>**)
  4. Nitrates (**NO<sub>3</sub>**)

# Nitrogen Contents

- The **free ammonia** indicates the very first stage of decomposition of organic matter ( thus indicating recent pollution).
- **Organic Nitrogen** indicates the quantity of nitrogen in sewage before the decomposition of organic matter.
- **Nitrates** indicates the presence of fully oxidized organic matter in sewage.
- **Nitrites** indicates the intermediate stage of conversion of organic matter of sewage into stable forms, thus indicating the progress of treatment. Their presence shows that the treatment given to the sewage is incomplete. Whereas, the presence of nitrates indicates the well oxidized and treated sewage.



# Chlorides Contents

- **Chlorides** are generally found in sewage and are derived from kitchen wastes, human feces and urinary discharges.
- The normal chloride content of sewage is 120 mg/lit, whereas the permissible limit of chloride content in water is 250 mg /lit.
- However, large amount of chlorides may enter from industries like ice cream plants, meat salting etc.
- Hence, when the chloride content of a given sewage is found to be high, it indicates the presence of industrial wastes thereby indicating strength of sewage.

# Fats, Oils and Greases

- Fats, oils and greases are derived in sewage from the discharge of animals and vegetable matter, or from the garages, kitchens of hotels and restaurants, etc.
- Such matter form scum on the top of the sedimentation tanks, clogs the voids of the filter media and affects the diffusion of oxygen. They thus interfere with the normal treatment methods. Hence these detection and removal is important.



# Toxics

- Copper, lead, silver, chromium, arsenic and boron etc. are some of the toxic compounds affects quality of water bodies to which wastewater is discharge.
- These chemicals also badly affects performance of biological treatment plants.



## **Sulphides, Sulphates and Hydrogen Gas**

- Sulphides and sulphates are formed due to the decomposition of various sulphur containing substances in sewage.
- This decomposition also leads to production of hydrogen sulphide gas, causing bad odour, besides causing corrosion of concrete sewer pipes.
- In aerobic digestion of sewage, the aerobic and facultative bacteria oxidizes the sulphur and its compounds present in the sewage to initially form sulphides, which ultimately breakdown to form sulphates ions, which is a stable and unobjectionable end products.
- In an-aerobic digestion of sewage the anaerobic and facultative bacteria reduce the sulphur and its compounds into sulphides, with evolution of H<sub>2</sub>S gas along with methane and carbon dioxide, thus causing bad odour

## Dissolved Oxygen (DO)

- **DO** is the amount of oxygen in the dissolved state in the wastewater.
- Although wastewater generally does not have DO, its presence in untreated wastewater indicates that the wastewater is fresh.
- Similarly, its presence in treated wastewater effluent indicates that the considerable oxidation has been accomplished during the treatment stages.
- While discharging the treated wastewater into receiving waters, it is essential to ensure that at least **4 mg/l** of DO is present in it.
- If DO is less, the aquatic animals like fish etc. are likely to be killed near the vicinity of disposal.
- The presence of DO in wastewater is desirable because it also prevents the formation of bad odour.

# Biological Characteristics of Wastewater

➤ Micro-organisms play both positive and negative effects in wastewater. The main microorganisms of concern in wastewater treatment are:

1. Bacteria,
2. Fungi,
3. Algae,
4. Protozoa,
5. Viruses, and
6. pathogenic microorganisms groups.

# Biological Characteristics of Wastewater

**1. Bacteria:-** Bacteria are spherical, rod, spiral and filamentous shape.

➤ **Some important bacteria are:**

**1. Pseudomonas:-** reduce  $\text{NO}_3$  to  $\text{N}_2$  , So it is very important in biological nitrate removal in treatment works.

**2. Bdellovibrio:** destroy pathogens in biological treatment.

**3. Acinetobacter:** Store large amounts of under aerobic conditions and release it under an anaerobic condition so, they are useful in phosphate removal.

**4. Nitrobacter:** transform  $\text{NO}_2$  - to  $\text{NO}_3$

**5. Coliform bacteria:-** The most common type is E-Coli or Echerichia Coli, (indicator for the presence of pathogens).



# Biological Characteristics of Wastewater

## 2. Fungi:

- Important in decomposing organic matter to simple forms.

## 3. Algae:

- Useful in oxidation ponds for treatment of wastewater. **(positive effect)**
- Cause taste and problems when decayed. **(negative effect)**
- Cause eutrophication phenomena. **(negative effect)**

## 4. Protozoa:

- Feed on bacteria so they help in the purification of treated waste water.
- Some of them are pathogenic.

## 5. Viruses:

- Viruses are a major hazard to public health. They cause lots of dangerous diseases.



# Measurement of Organic Matters (OM)

- Many parameters have been used to measure the concentration of organic matter in wastewater. The following are the most common used methods:
- **Biochemical oxygen demand (BOD):** BOD is the measure of dissolved oxygen used by microorganisms during the biochemical oxidation of organic matter in 5 days at 20 C.
- **Chemical oxygen demand (COD):** COD is the measure of the dissolved oxygen used during the chemical oxidation of organic matter in 3 hours.

**Thank You**