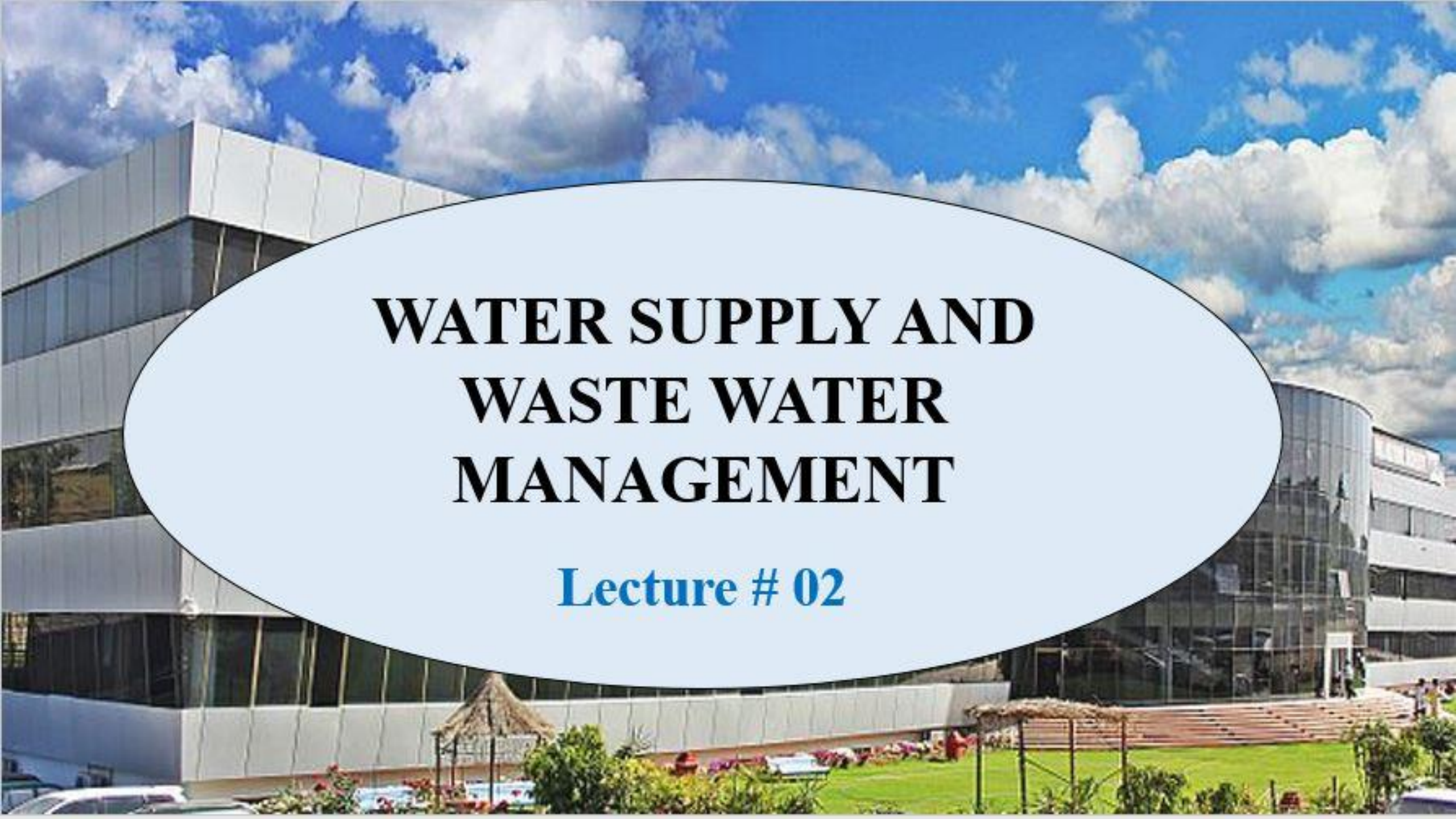


WATER SUPPLY AND WASTE WATER MANAGEMENT

Lecture # 02

WW- *Chemical Characteristics*

Points of concern regarding the chemical characteristics of wastewater are:

-Organic matter
-Measurements of organic matter
-Inorganic matter
-Gases
-pH

Organic matter ($C_a H_b O_c$).

75% SS ⟶ organic. (Suspended Solids)
40% FS ⟶ organic. (Filtered Solids)

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

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

Chemical Characteristics- *OM*

Measurements of organic matter:-

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_5 is the oxygen equivalent of organic matter. It is determined by measuring the dissolved oxygen used by microorganisms during the biochemical oxidation of organic matter in 5 days at 20°C

Chemical oxygen demand (COD)

It is the oxygen equivalent of organic matter. It is determined by measuring the dissolved oxygen used during the chemical oxidation of organic matter in 3 hours.

Chemical Characteristics- *OM*

Total organic carbon (TOC)

This method measures the organic carbon existing in the wastewater by injecting a sample of the WW in special device in which the carbon is oxidized to carbon dioxide then carbon dioxide is measured and used to quantify the amount of organic matter in the WW. This method is only used for small concentration of organic matter.

Theoretical oxygen (ThOD)

If the chemical formula of the organic matter existing in the WW is known the ThOD may be computed as the amount of oxygen needed to oxidize the organic carbon to carbon dioxide and a other end products.

ThOD > COD > BOD

Q. The amount of CO_2 generated in kg while completely oxidising 1 kg of methane.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Soln

mol wt of CH_4 → $12 + 4(1)$
$= 16$

mol of CO_2 → $12 + 2 \times 16$
$= 44$

Q. In previous problem also find Th. O_2 demand of methane.

→ $$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

mol wt of $CH_4 = 12 + 4(1)$
$= 16$

mol wt of $2O_2 = 2 \times (16 \times 2)$
$= 64$

Chemical Characteristics- *OM*

Biological Oxygen Demand (BOD):

The following are the theoretical equations used to calculate the BOD.
The Figure shown is used to describe the change of BOD with time. From the figure the following correlations are derived:

$L_0 \rightarrow$ or (BOD ultimate) or UBOD.

$Y_t = BOD_t$ (BOD exerted).

$L_t = L_0 e^{-kt}$ (BOD remain).

$BOD_t = L_0 - L_t = L_0 - L_0 e^{-kt} = L_0(1-e^{-kt})$

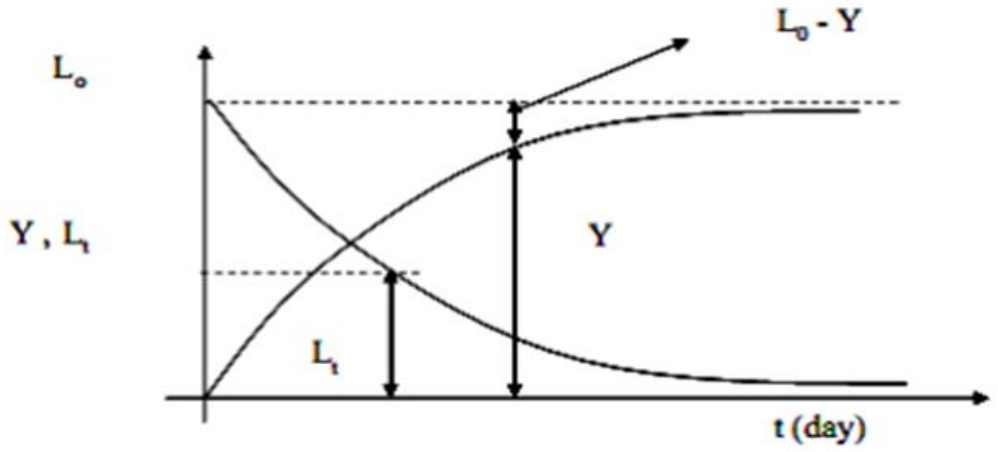
$BOD_5 = L_0 (1-e^{-k5})$

$K = 0.23d^{-1}$ usually, $k_T = k_{20}\, \theta^{T-20}$, $\theta = 1.047$ or as given

Note that:

Lo > Lt

Tem = 20C



Environmental Engineering -II

Example

Determine the 1-day BOD and ultimate BOD for a wastewater whose 5-day 20 °C BOD is 200 mg/L. The reaction constant K= $0.23d^{-1}$ what would have been the 5-day BOD if it had been conducted at 25°C?

Solution:-

- $BOD_t = UBOD - BODr = UBOD\ (1-e^{-kt}) = L_0(1-e^{-kt})$

$200 = L_0\ (1-e^{-0.23x5})$

$L_0 = 293$ mg/L (this is UBOD)

- Determine the 1-day BOD:-

$BOD_t = L_0\ (1-e^{-kt})$

$BOD_1 = 293\ (1-e^{-0.23x1}) = 60.1$ mg/L

- Determine the 5-day BOD at 25°C:-

$K_T = K_{20}\ (1.047)^{T-20} \Rightarrow K_{25} = 0.23\ (1.047)^{25-20}$

$BOD_5 = L_0\ (1-e\ -kt\ ) = 293\ (1-e^{-0.29x5}) = 224$ mg/L

WW- *Biological Characteristics*

The environmental engineer must have considerable knowledge of the biological of waste water because it is a very important characteristics factor in wastewater treatment.

The Engineer should know:-

1. The principal groups of microorganisms found in wastewater.
2. The pathogenic organisms.
3. Indicator organisms (indicate the – presence of pathogens).
4. The methods used to amount the microorganisms.
5. The methods to evaluate the toxicity of treated wastewater

WW- *Biological Characteristics*

Main groups of Microorganisms:-

The main microorganisms of concern in wastewater treatment are Bacteria, Fungi, Algae, Protozoa, Viruses, and pathogenic microorganisms groups.

Bacteria:-

Types: Spheroid, rod curved rod, spiral, filamentous. Some important bacteria:-

Pseudomonas:- reduce NO_3 to N_2, So it is very important in biological nitrate removal in treatment works.

Zoogloea:- helps through its slime production in the formation of flocs in the aeration tanks.

Sphaerotilus natuns:Causes sludge bulking in the aeration tanks

Bdellovibrio: destroy pathogens in biological treatment.

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

WW- *Biological Characteristics*

Nitrosomonas: transform NH_4 into NO_2^-
Nitrobacter: transform NO_2^- to NO_3^-
Coliform bacteria:- The most common type is E-Coli or Echerichia Coli, (indicator for the presence of pathogens).
E-Coli is measured in (No/100mL)

Fungi:

- Important in decomposing organic matter to simple forms.

Algae:

- Cause eutrophication phenomena. (negative effect)
- Useful in oxidation ponds. (positive effect)
- Cause taste and problems when decayed. (negative effect)

Protozoa:

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

WW- *Biological Characteristics*

- Bacteria (Prokaryotes)
  - more abundant – more active (5-15 billion per litre of sewage)
  - Minute single cell organisms, no defined nucleus
  - Spherical shape (cocci), straight rod shape (bacillus), spiral shape (spirillum), curved shape (vibrio)
  - Pathogenic, non pathogenic
  - Aerobic, anaerobic, facultative

- Bacterial flora of human faeces
  - Total bacterial population in 1 g of faeces estimated to be 1.8×10^{18} E-coli (Escherichia coli)
  - **E-coli – Indicator organism**

WW- *Biological Characteristics*

Viruses:

Viruses are a major hazard to public health. Some viruses can live as long as 41days in water and wastewater at 20 °C. They cause lots of dangerous diseases.

Pathogenic organisms:

The main categories of pathogens are:-
Bacteria, Viruses, protozoa, helminthes

THANK YOU