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Introduction to Environmental Studies (SENG 101)

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UNIT 7B

Introduction to wastewater treatment

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- Usually refer to sewage treatment, or domestic wastewater treatment
- Process of removing contaminants from wastewater, both runoff and domestic

Where does wastewater come from

- Residences (kitchen, bathroom)
- Commercial institution
- Industrial institution (usually require
- specialized treatment process)

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Wastewater Treatment

- Wastewater is commonly used as a synonym for sewage
- **Sewage** is the waste matter (domestic wastewater or municipal wastewater) carried off by **sewer** drains **and** pipes.
- **Sewerage** refers to the physical facilities (e.g., pipes, lift stations, **and** treatment **and** disposal facilities) through which **sewage** flows
- Contain waste components that impede the application of natural functions of water.

❖Types of sewage

- **Domestic sewage:** Sullage and Sanitary waste from water closets.
- Sullage is waste water from household sinks, showers, and baths, but not waste liquid or excreta from toilets.
- **Industrial sewage:** Tannery, Cannery, and Pharmaceutical, Textile wastes
- **Municipal sewage:** Domestic sewage and waste from public places

❖Mode of Collection

- Sewage system –This is drained into system of underground water by gravity

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Introduction

- Wastewater treatment consists of applying known technology to improve or upgrade the quality of a wastewater
- Wastewater treatment involves collecting the wastewater in a central, segregated location (the Wastewater Treatment Plant) and subjecting the wastewater to various treatment processes
- The principal objective of wastewater treatment is generally to allow human and industrial effluents to be disposed off without danger to human health or unacceptable damage to the natural environment

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- With the current emphasis on environmental health and water pollution issues, there is an increasing awareness of the need to dispose of these wastewaters safely and beneficially

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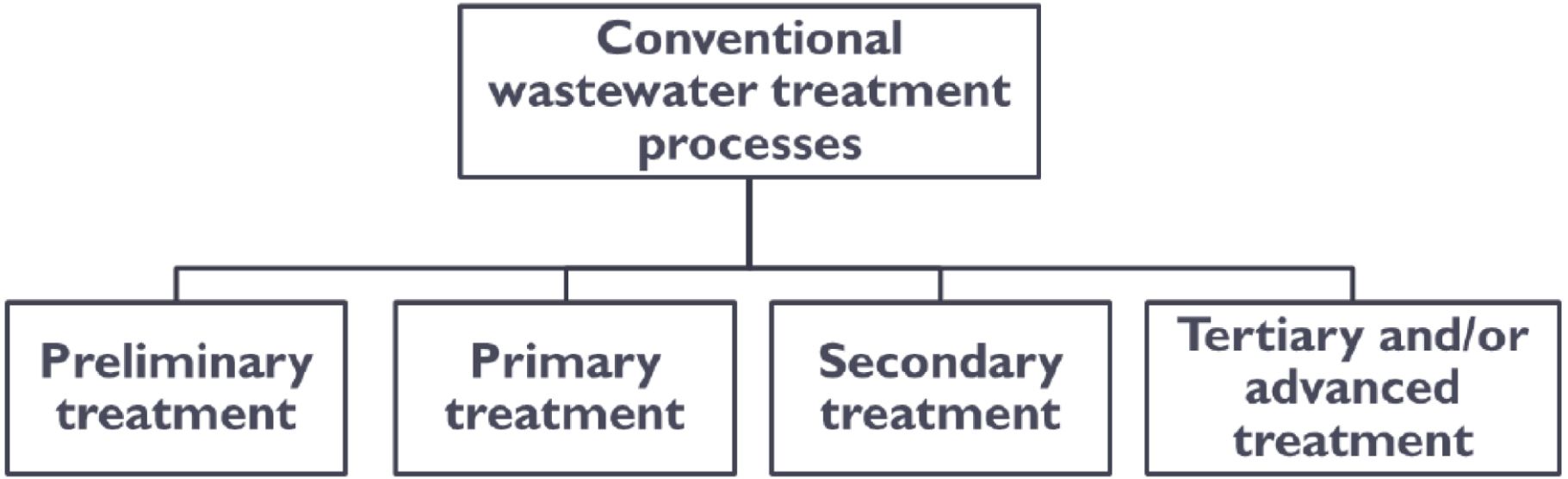
Conventional wastewater treatment



❖ Wastewater Treatment

- Wastewater has to be treated to reduce the level of pollutants

- To encourage re-use and recycle of resources present in wastewater

- Treatment plants for this normally consist of :

Primary treatment:

i. **Screens –** Coarse solids eg sticks, rags, polythene bags

- **Grit chamber-** Inorganic solids eg pebbles, sand, silt,
- **Sedimentation tank-** Design to concentrate and remove suspended organic solids

ii. Secondary Treatment:

Usually carried out using biological processes.

In these process, microorganisms use the organics in the wastewater as food supply and convert them into biological cells or biomass.

The common techniques include;

- ***Activated sludge process***
- ***Trickling filter process***
- ***Waste stabilisation ponds***
- ***Constructed Wetlands***
- ***Soil Aquifer treatment***

iii. Tertiary treatment :

- Removal of **nitrates** and **phosphates**

These include

- ➢ *Membrane filtration*
- ➢ *Reverse osmosis* ➢ *Ultra filtration*

iv. Advanced Treatment:

- Recommended when there are other pollutants, which could not be removed during the first three treatment processes

❖ Pathogens in wastewater

- Are disease-causing organisms, in plants, animals and human beings
- Categorized in 5 major groups:

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- viruses, bacteria, protozoa, fungi and helminths

❖Infective Dose for Pathogens

- (ID) is the amount of pathogen (measured in number of microorganisms) required to cause an infection in a host
- Infective doses of pathogens range from 1 cfu for viruses to 1,000s cfu for bacteria

Bacterial Growth

- **Bacterial growth** is the division of one piece of bacteria into two daughter cells in a process called binary fission.

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- Provided no mutational event occurs the resulting daughter cells are genetically identical to the original cell.
- Both daughter cells from the division do not necessarily survive.

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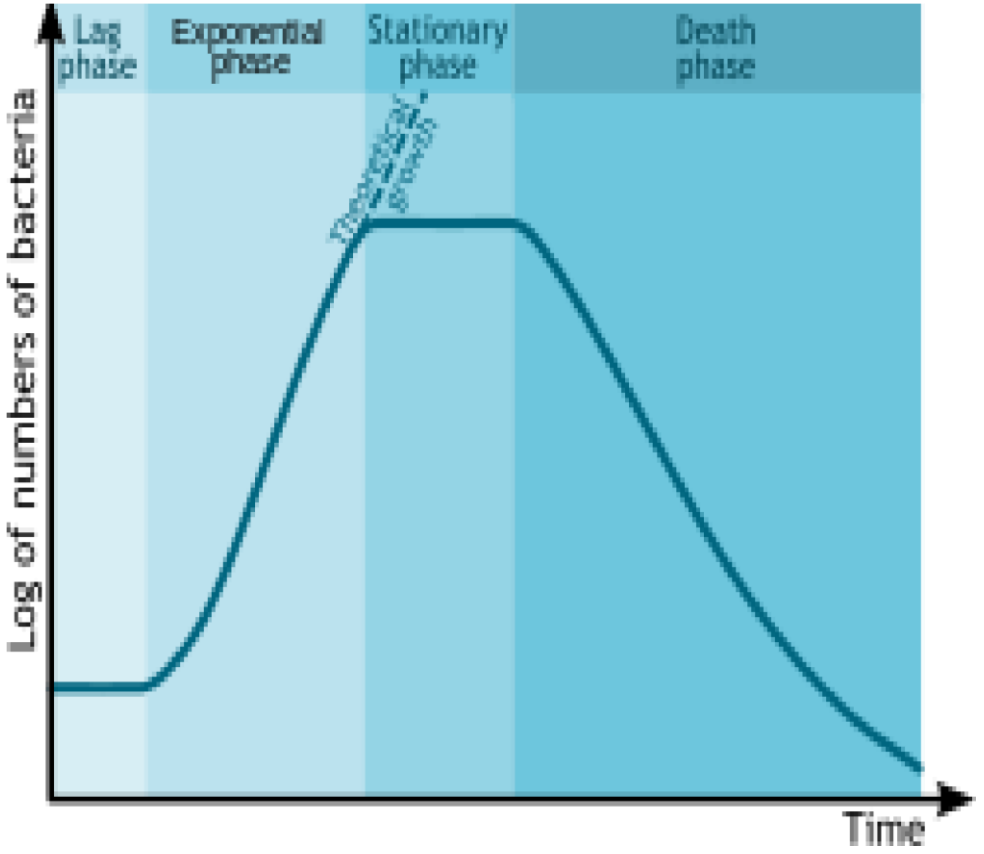

Bacterial growth curve\Kinetic Curve

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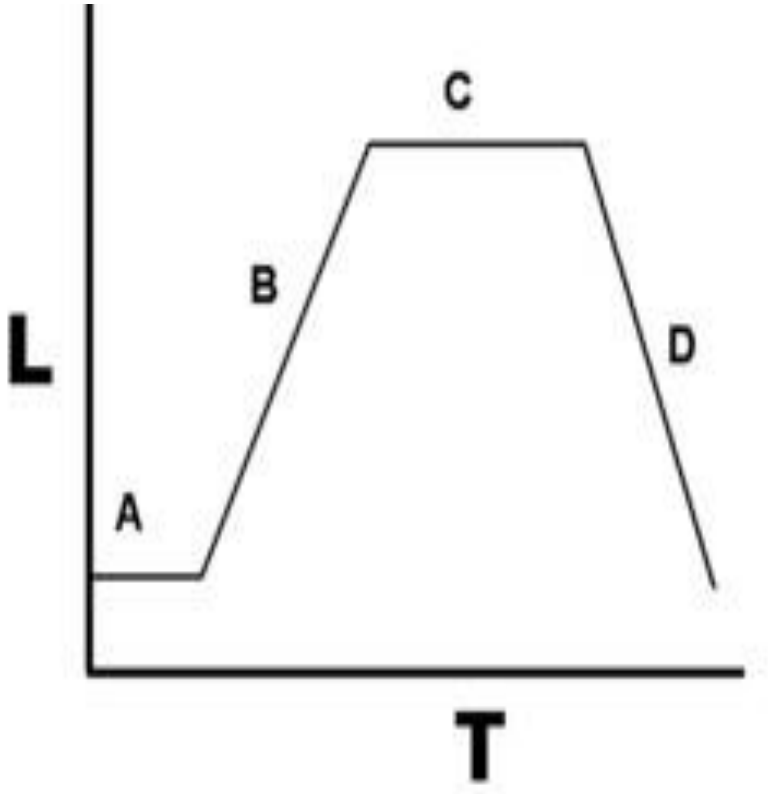

Growth is shown as *L* = log(numbers) where numbers is the number of colony forming units per ml, versus *T* (time.)

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Bacterial Growth in Batch Culture

- **Lag phase**
- **Log phase**
- **Stationary phase**
- **Death phase**

(i) lag phase

- Bacteria adapt themselves to growth conditions. It is the period where the individual bacteria are maturing and not yet able to divide.

- During the lag phase of the bacterial growth cycle, synthesis of RNA, enzymes and other molecules occurs.

(ii) **Log phase**

(logarithmic phase, *exponential phase*) is a period characterized by cell doubling.

- If growth is not limited, doubling will continue at a constant rate so both the number of cells and the rate of population increase doubles with each consecutive time period.

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Stationary Phase

This is often due to a growth-limiting factor such as the depletion of an essential nutrient, and/or the formation of an inhibitory product such as an organic acid.

- Stationary phase results from a situation in which growth rate and are equal.

- **Death Phase**

  At this stage, bacteria run out of nutrients and die.

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❖ Wastewater Treatment Technologies ❖ Wastewater Treatment by Algal-Based Ponds

- Combines the primary, secondary and tertiary treatment stages of wastewater treatment in one system

- System essentially consists of :

i. Anaerobic-No DO, designed to enhance settling & biodegradation emitting gases

ii. Facultative-BOD loading, increasing surface area

iii. Maturation ponds-Operating in series, total retention time 10-20 days

- Facultative and maturation ponds may be incorporated in the design based on:

i. *Strength of the wastewater* ii.

Desired effluent quality

❖ **Performance in Pathogen Removal**

- Algal-based systems are generally considered to be very efficient in the removal of pathogens

i. *Vibrio cholerae,* ii.

Salmonella, iii.

Enteroviruses, iv.

Entamoeba histolyca, v.

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Ascaris and *vi. Taenia*
species

❖ Wastewater Treatment by Macrophyte-Based Ponds

- Macrophyte-based ponds are stabilization ponds
- Have floating macrophytes as part of the treatment system

- Main objectives of using aquatic weeds in wastewater treatment are nutrient recycling

❖ Disease and Disease Control

- A disease is an abnormal condition, affecting the body of an organism.
- It is often associated with symptoms
- According to **WHO**, Health is a state of complete physical, mental and social well being and not merely the absence of

disease or infirmity ❖ **Categories of Water Associated Diseases**

- Water-associated diseases can be classified under 4 different categories :

i. ***Water-borne diseases*** –Normally associated with the ingestion faecally contaminated water e.g. cholera, typhoid fever etc.

ii. **Water-Washed diseases:**

- Diseases linked to H20 scarcity and resultant poor personal hygiene
- Intestinal (shigella, typhoid, cholera) and non intestinal (yaws, trachoma, fungal infections) infection

iii. Water-Based Helminths diseases :

- Diseases caused by pathogens that have a complex life-cycle which involves an intermediate aquatic host which can be worm or a snail. E.g. Schistosomiasis, Guinea worm

iv. Water-Related (Water Vector Borne) diseases :

- Caused by pathogens carried by insects that live near H_2O and act as mechanical vectors e.g. Malaria, yellow fever

THANK YOU