Environmental Planning of Urban network services Such as Water Supply, Sewerage, Solid waste managenent

Wastewater Treatment

Wastewater Treatment

What is wastewater treatment

Wastewater treatment is a process used to remove contaminants from wastewater or sewage and convert it into an effluent that can be returned to the water cycle with minimum impact on the environment, or directly reused.

- **Usually refer to sewage treatment, or domestic wastewater treatment**
- **Physical, chemical, and biological processes are used to remove contaminants**

OBJECTIVES

- The objective of municipal and industrial waste water treatment is to extract pollutants, remove toxicants, neutralise coarse particles, kill pathogens.
- Quality of discharged water is improved to reach the permissible level of water to be discharged into water bodies or for agricultural land.
- Treatment of water thus aims at reduction of BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand) etc. of receiving water bodies and prevention of bio-magnification of toxic substances in food chain.

Where does wastewater come from?

- Residence – human and household wastes from toilets, sinks, baths, and drains.
- Industries
- Commercial Institutions
- Schools, and Businesses – chemicals and other wastes from factories
- Food-service operations
- Airports
- Railway stations

How can it be treated?

- Segregated, collected and transported via a network of pipes and pump stations to a municipal treatment plant
  - Physical Water **Treatment**. In this stage, physical methods are used for cleaning the **wastewater**. ...
  - Biological Water **Treatment**. This uses various biological processes **to** break down the organic matter present in **wastewater**, such as soap, human waste, oils and food. etc
  - Chemical Water **Treatment**.
  - Sludge **Treatment**

Layout of waste water treatment plant

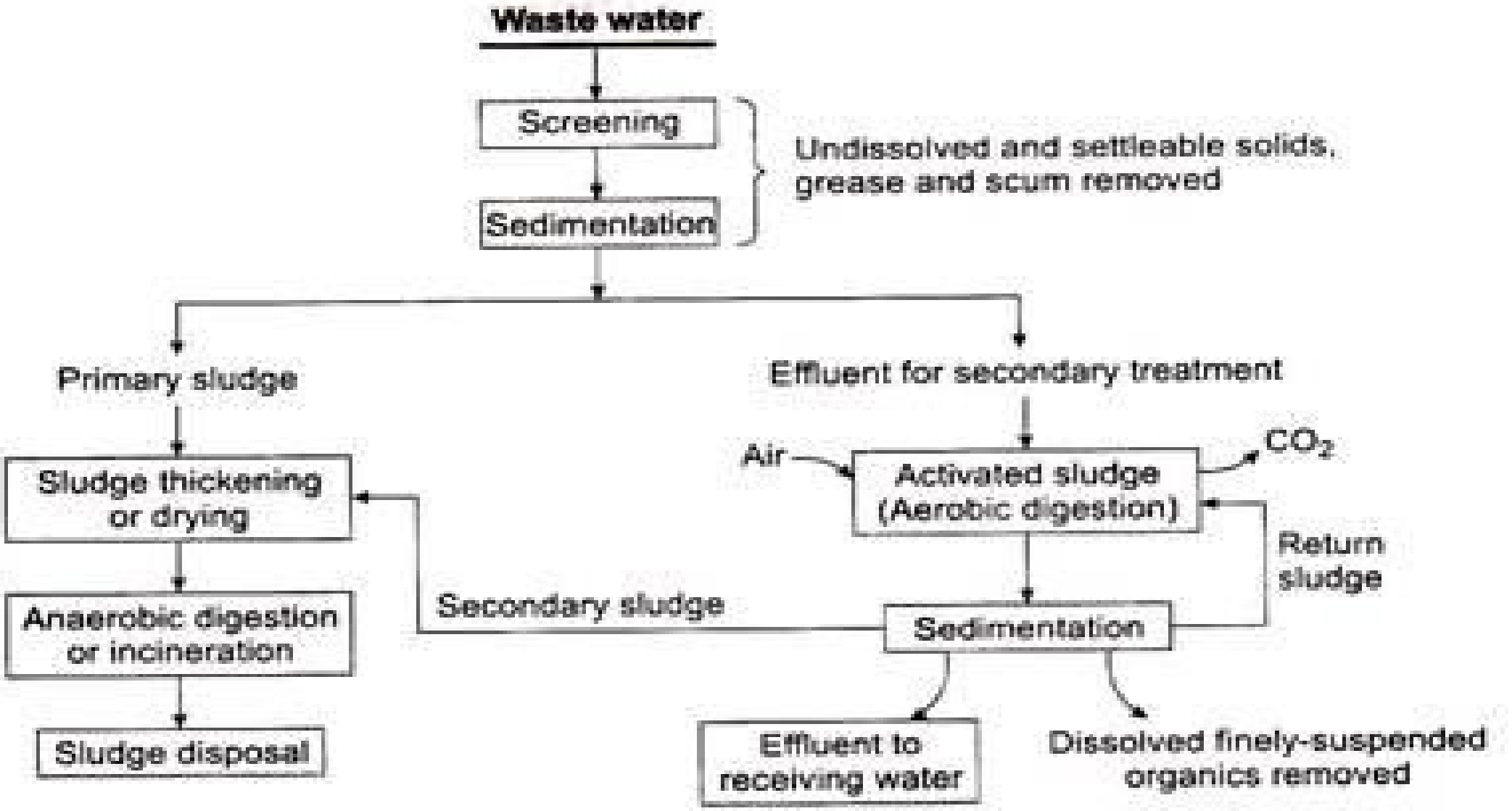


Fig. 2. Flow diagram of sewage/waste water treatment plant.

3 stages of waste water treatment

- Preliminary
  - -- Screening
- Primary
  - – Solids are separated
- Secondary
  - – Dissolved biological matter is converted into a solid mass by using water-borne bacteria
  - – 95% of the suspended molecules should be removed
- Tertiary
  - – Biological solids are neutralized then disposed, and treated water may be disinfected chemically or physically

Types of treatment

- **Mechanical treatment**
  - Influx (Influent)
  - Removal of large objects
  - Removal of sand and grit
  - Primary Sedimentation
- **Biological treatment**
  - Trickling bed filter
  - Activated sludge
- **Chemical treatment**
  - Disinfection

Primary treatment

- During primary treatment, wastewater is temporarily held in a settling tank where heavier solids sink to the bottom while lighter solids float to the surface.
- Once settled, these materials are held back while the remaining liquid is discharged or moved through to the more rigorous secondary phase of wastewater treatment.
- These large tanks are also often equipped with mechanical scrapers that continually drive collected sludge in the base of the tank to a hopper which pumps it to sludge treatment facilities

Treatment stages - Primary treatment

- Typical materials that are removed during primary treatment include

  - fats, oils, and greases (FOG)
  - sand, gravels and rocks
  - larger settleable solids including human waste, and
  - floating materials

Methods used in primary treatment

- Grit chamber
  - Remove sand and grit
  - Control wastewater velocity
    - Sand grit and stone settle
    - Keep suspended organic matter in water
  - Damage equipments in the remaining treatment stage
  - Landfill

- Primary Sedimentation Tank
  - Remove grease, oil
  - Fecal solid settle, floating material rise to the surface
  - Produce a homologous liquid for later biological treatment
  - Fecal sludge are pumped to sludge treatment plant

Treatment stages - Secondary treatment

- Degrade biological content (dissolved organic matter) of the sewage
  - Ex: human waste, food waste, soaps, detergent
- Added bacteria and protozoa into sewage
- 3 different approaches
  - Fixed film system
  - Suspended film system
  - Lagoon system

Three approaches

- Fixed Film Systems
  - grow microorganisms on substrates such as rocks, sand or plastic
  - wastewater is spread over the substrate
  - Ex: Trickling filters, rotating biological contactors

Trickling filters bed

- Spread wastewater over microorganism
- made of coke (carbonised coal), limestone chips or specially fabricated plastic media
- Optimize their thickness by insect or worm grazing

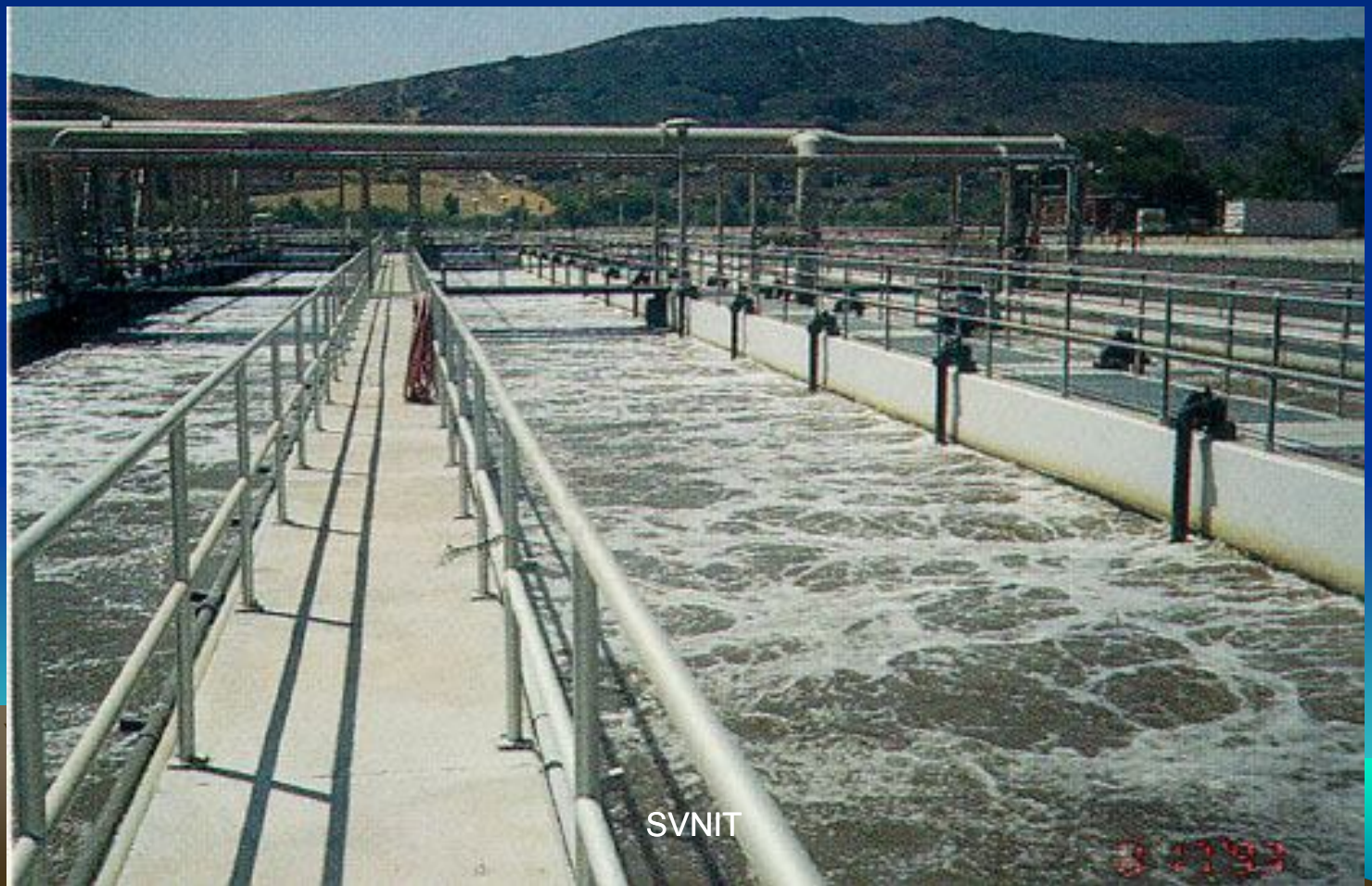
- Suspended Film Systems
  - stir and suspend microorganisms in wastewater
  - settled out as a sludge
  - pumped back into the incoming wastewater
  - Ex: Activated sludge, extended aeration

Activated sludge

- mixed community of microorganisms
- Both aerobic and anaerobic bacteria may exist
- Biological floc is formed

5 physical components of activated sludge process

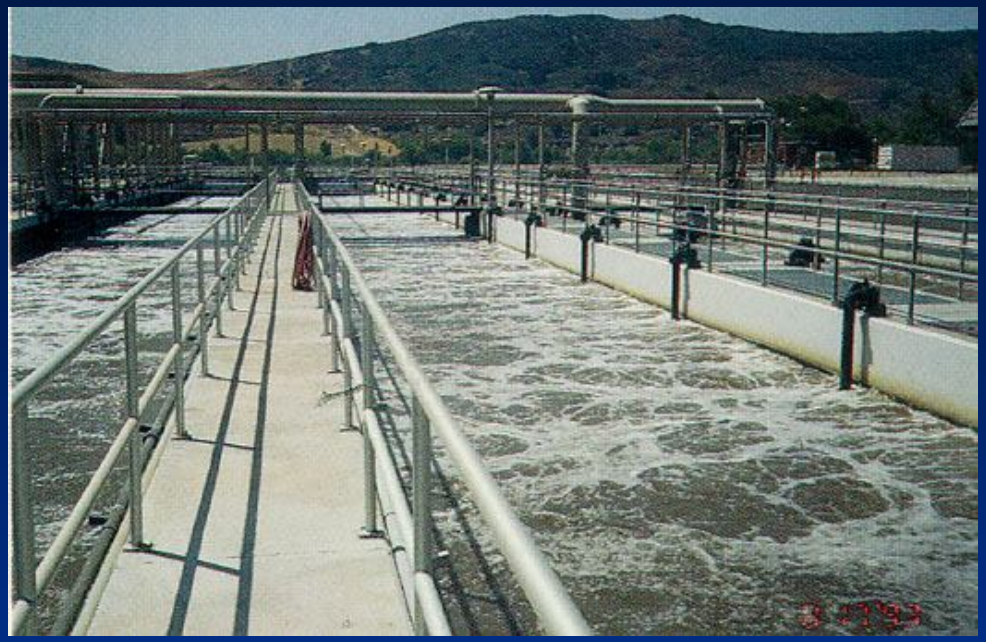
- aeration tank
  - oxygen is introduced into the system



- aeration source
  - ensure that adequate oxygen is fed into the tank
  - provided pure oxygen or compressed air

- secondary clarifiers
  - activated-sludge solids separate from the surrounding wastewater

- Activated sludge outflow line
  - Pump activated sludge back to the aeration tank
- Effluent outflow line
  - discharged effluent into bay or tertiary treatment plant



SVNIT

- Lagoon Systems
  - hold the waste-water for several months
  - natural degradation of sewage
  - Usually reeds are preferred

Treatment stages – Tertiary treatment

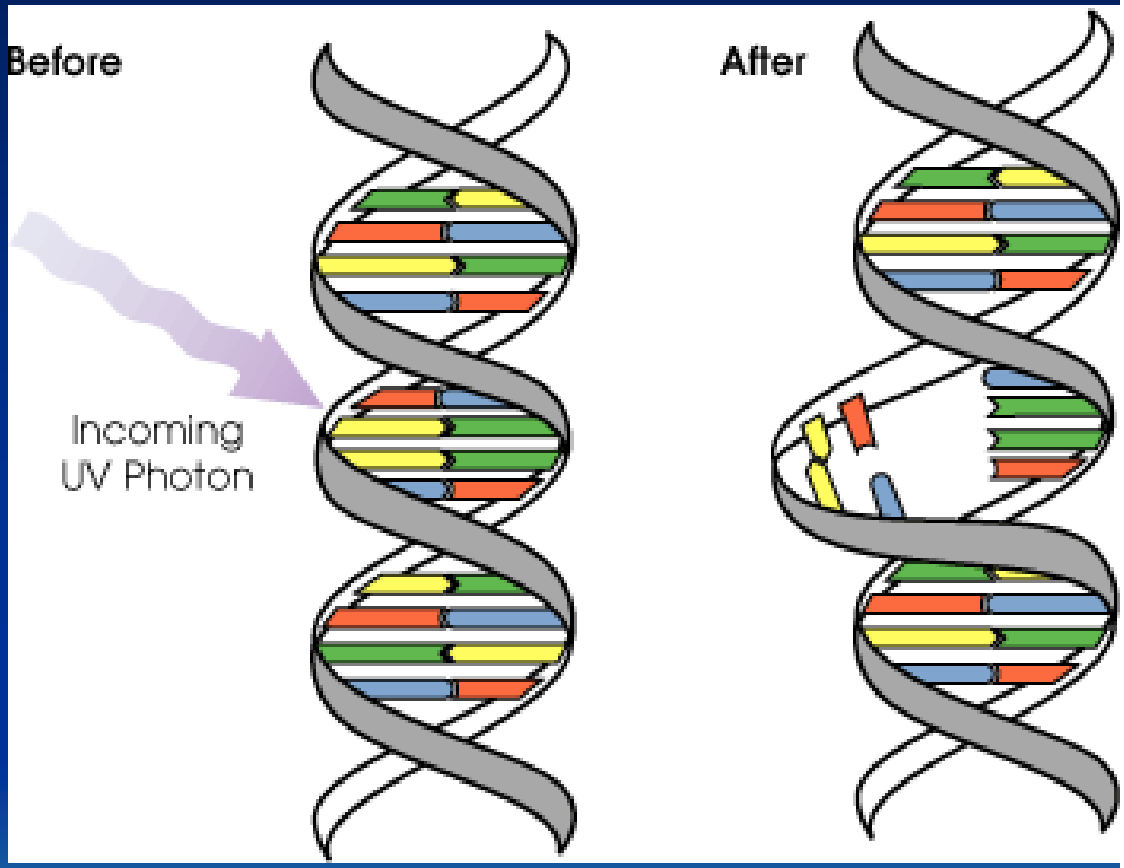
- remove disease-causing organisms from wastewater
- 3 different disinfection process
  - Chlorination
  - UV light radiation
  - Ozonation

Chlorination

- Most common
- Advantages: low cost & effective
- Disadvantages: chlorine residue could be harmful to environment

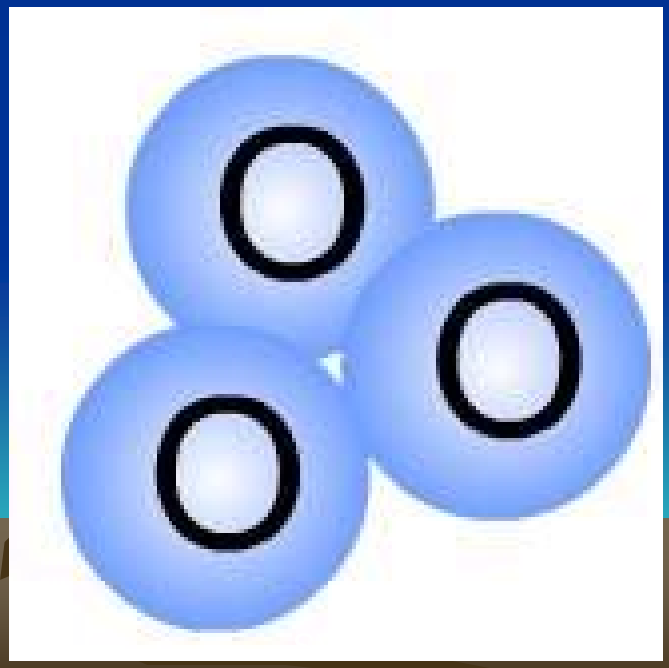
UV light radiation

- Damage the genetic structure of bacteria, viruses and other pathogens.
- Advantages: no chemicals are used
- water taste more natural
- Disadvantages: high maintenance of the UV-lamp



Ozonation

- Oxidized most pathogenic microorganisms
- Advantages: safer than chlorination
  fewer disinfection by-product
- Disadvantage: high cost



What can effluent use for?

- discharged into a stream, river, bay, lagoon or wetland
- used for the irrigation of a golf course, green way or park
- If it’s sufficiently clean, it can be used for groundwater recharge

Advanced Treatment

- Nitrogen removal
  - Ammonia (NH_3) → nitrite (NO_2^-)→ nitrate (NO_3^-)
- Phosphorous removal
  - Precipitation with iron or aluminums salt
- Lead to eutrophication (Eutrophication is the process in which a water body becomes overly enriched with nutrients, leading to the plentiful growth of simple plant life.)
- May cause algae bloom

Sludge treatment

- Primary sludge usually have strong odors
- Secondary sludge have high concentration of microorganism
- Goals of treatments are:
  - Reduce odors
  - Remove water reduce volume
  - Decompose organic matter

- Untreated sludge are about 97 percent water
- Settling can reduce about 92 to 96 percent of water
- dried sludge is called a sludge cake

3 different sludge treatments

- Aerobic digestion
- Anaerobic digestion
- composting

Aerobic digestion

- Bacterial process
- Need oxygen
- Consume organic matter
- Convert into carbon dioxide (CO_2)

Anaerobic digestion

- Bacterial process
- Do not require oxygen
- Consume organic matter
- Produce biogas, which can be used in generators for electricity

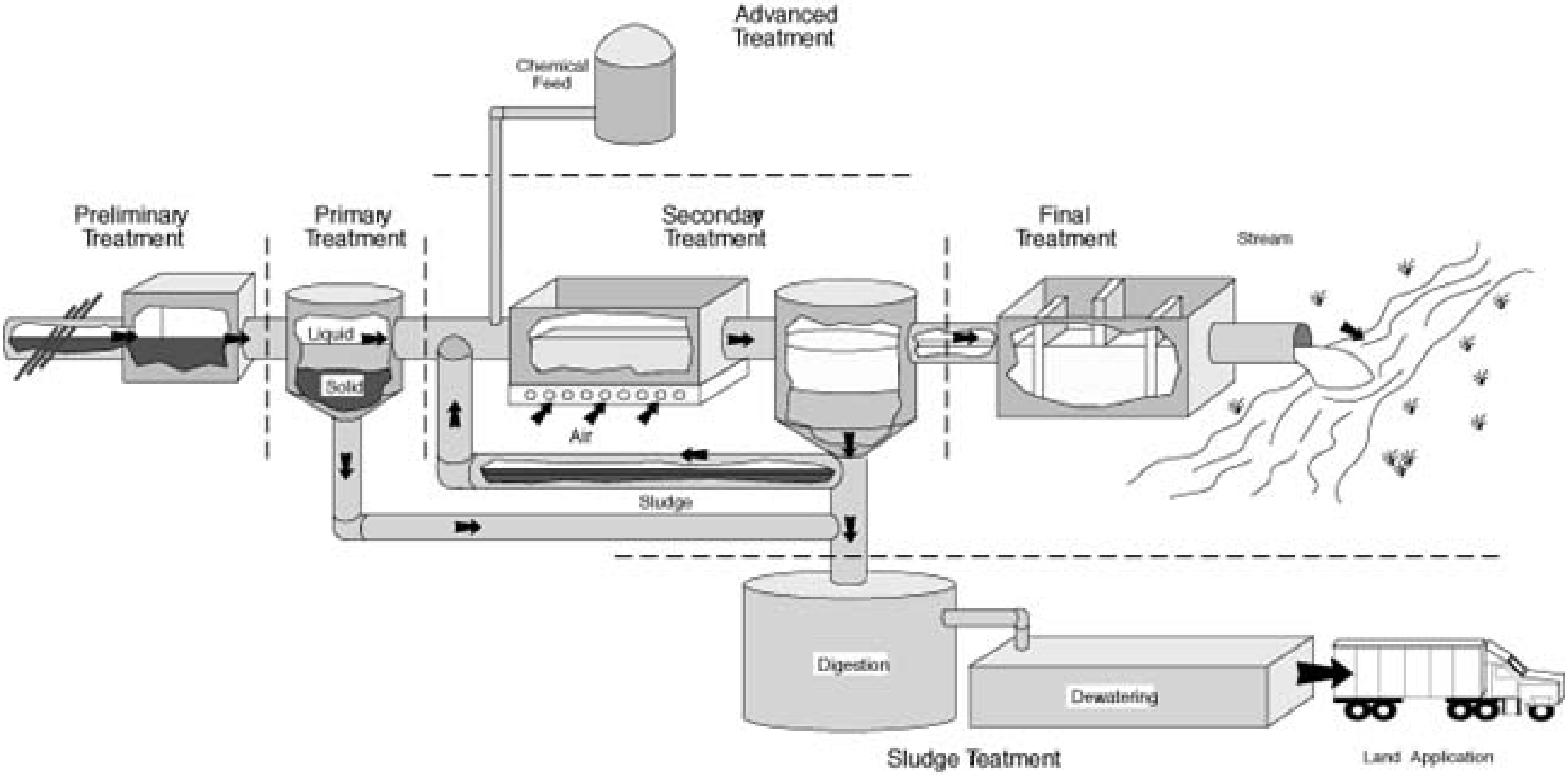
Composting

- aerobic process
- requires the correct mix of carbon, nitrogen, oxygen and water with sludge
- Generate large amount of heat

Sludge disposal

- Superheat sludge and convert into small granules that are rich in nitrogen
  - Sell it to local farmer as fertilizer
- Spread sludge cake on the field
- Save landfill space

Summary


Advanced Treatment
Chemical Feed
Preliminary Treatment
Primary Treatment
Secondary Treatment
Final Treatment
Stream
Liquid
Solid
Air
Sludge
Digestion
Dewatering
Sludge Treatment
Land Application

ACTIVITY

- Divide in groups of 5
- Preliminary, Primary, Secondary, Tertiary System.
- Each group to take one system and explain all its components, its importance, working and significance.

Thanks