WASTEWATER

Water used to carry waste products away from homes, schools, commercial establishments, and industrial enterprises.
SOURCES OF WASTEWATER

Domestic / Residential

Industrial

Inflow and Infiltration
FLOW VS STRENGTH

Industrial  Residential  I/I

Flow

Strength
CHARACTERISTICS OF WASTEWATER

Materials Toxic to Biota
- Metals
- Ammonia
- Pesticides
- Herbicides
- Chlorine
- Acids/Bases

Human Health Hazards
- Pathogens
- Nitrate
- Toxic Materials
GOAL / PURPOSE / RESPONSIBILITY OF “TREATING” OR STABILIZING WASTEWATER

PROTECTION OF NATURAL RESOURCES

PROTECTION OF PUBLIC HEALTH
Wastewater Treatment Components

- Solids
- Oxygen Demand
- Nutrients
- Microorganisms
WASTEWATER TREATMENT REMOVES THESE “POLLUTANTS”
WASTEWATER TREATMENT PROCESSES

- Physical / Chemical
  - screenings
  - sedimentation
  - filtration
  - precipitation
  - chemical destruct

- Biological
  - waste stabilization lagoon
  - trickling filter
  - rotating biological contactor
  - activated sludge
Treatment Efficiencies

Primary (Physical) Treatment
40 - 60 % Suspended Solids
30 - 40 % BOD

Secondary (Biological) Treatment
90+ % Suspended Solids
90+ % BOD
The SETTLEABLE solids separated from liquids during processing.

CHARACTERISTICS

- ORGANIC / INORGANIC
- OXYGEN DEMAN
- ODORS
- NUTRIENTS
- PATHOGENS
- MOSTLY WATER
PURPOSE OF "TREATMENT"

- Stabilize Organics
- Eliminate Odors
- Destroy Pathogens
- Reduce Amount of Solids
- Enhance De-watering
TYPES OF “TREATMENT”

- Heat and Pressure
- Heat and Chemical
- Lime Stabilization
- Biological Digestion
TYPES OF DIGESTION

- Biological
  - Bacteria
    - Aerobic
      - Use “Free” Oxygen
    - Anaerobic
      - No “Free” Oxygen
AEROBIC DIGESTION
AEROBIC DIGESTION  
(TYPICALLY <5MGD)

**Advantages**
- Effective for “secondary” sludge
- Simple operation
- No hazardous gas production

**Disadvantages**
- Higher operating costs
- High energy demands
- No burnable gas
- Higher organic content
- Low VSR
ANAEROBIC DIGESTION
ANAEROBIC DIGESTION

**Advantages**
- Low operating costs
- Proven effectiveness
- Burnable gas produced
- High VSR

**Disadvantages**
- Long start-up time
- Affected by changes in loading and conditions
- Explosive gas produced
- High Initial Capital Cost
Anaerobic Digestion Process

Mesophilic = 86F – 106F
Thermophilic = 110F – 131F

“TWO-STAGE” Process
Not Always Two Tanks
Anaerobic Digestion Process

First

Organic Material Changed
By Acid Forming Bacteria
To Simple Organic Material

First Stage

Organic Matter + Bacteria → Organic / Volatile Acids
Second Stage

Methane-Forming Bacteria Use Organic Acids
Produce Carbon Dioxide and Methane

Anaerobic Digestion Process
Continuous Process
“TWO-STAGE” Process

Anaerobic Digestion Process

First Stage

Second Stage

Stabilization
Anaerobic Digestion Process

First Stage: Methane Forming
- Organic Matter + Bacteria → Organic Acids

Second Stage: Volatile Acids
- Organic Acids + Bacteria → CH₄ + CO₂

Volatile Acids Used at Rate Produced
Anaerobic Digestion Process

Acids Used at Rate Produced
- If Not Used – Drop in pH
- Start-up
- Upset
  “Sour”
  “Stuck”

*Methane Formers Must Be Active*
Anaerobic Digestion Process

Methane Formers:
- Slow Growers
- Very Sensitive to Changes
  - Loading (18 – 20 day SRT)
  - pH (6.8 – 7.2)
  - Temperature (86F – 106F) 95F Typ
  • Do not change more than 1 degree per day after startup

Digester Operation Depends On Maintaining Proper Balanced Environment
Anaerobic Digestion Process

**Products of Digestion**

1. Gases (7-12 cft/lb of volatile destroyed)
   a. Methane (CH4): 65-705
   b. Carbon Dioxide (CO2): 30-35%

2. Scum
   a. Lighter Solids

3. Supernatant
   a. Liquid Removal

4. Digested Sludge
   a. Stabilized