SLUDGE MANAGEMENT

SUMMARY
BACKGROUND

Sludge is the **solid material** that has settled in clarifiers.

Sources:

- Primary clarifiers (TSS removed by gravity)
- Secondary clarifiers (Biomass)
# CHARACTERISTICS

**Primary Sludge Characteristics**
- Contains both organic (BOD) and inorganic solids (sand, silt, etc.)
- Upto 5% solids (95% water)

**Secondary Sludge Characteristics**
- Dead bacteria
- Activated Sludge: 1% solids
- Trickling Filter & RBC: 5% solids
EPA has standards for sludge, depending on final use or disposal (CFR 503)

- Apply to agricultural use,
- compost,
- landfilling,
- incineration
Reasons for Regulation

*Toxics tend to concentrate in sludge:*
- Heavy metals
- PCBs
- Pesticides

*Restrictions on sludge use, depending on concentration of toxics and pathogens*
- Pollutant Concentration Requirements
- Pathogen Reduction Requirements (Class A and B)
- Vector Attraction Reduction Requirements
Goals of Sludge Management

• Stabilize primary and secondary sludges
• Kill pathogens
• Decrease water content
  – Untreated: 0.5 to 8 % solids
  – Treated: 6 to 12% solids
Sludge Processing

• Thickening
• Stabilization
• Disinfection
• Dewatering
• Final Disposal
Sludge Processing: Thickening

**Objective:** Remove water before stabilization, decrease volume

**Processes:**
- Gravity thickening (same equipment as sedimentation, but smaller)
- Dissolved air flotation (DAF)
- Centrifuge
Sludge Processing: Stabilization

Objective: Kill pathogens, eliminate odors, stabilize organics, and concentrate solids

Process:
• Anaerobic digestion
Anaerobic Digestion

• Most common method of stabilization
• Sludge is placed in a sealed tank
• Anaerobic bacteria grow and degrade sludge solids
• **Produces: CH$_4$ (Methane), CO$_2$ (Carbon Dioxide), and H$_2$S (Hydrogen Sulfide)**
Methane Use

Methane (CH4) can be burned as fuel

• Heat digester
• Run electric generator
• Flare

Wastewater Treatment Plants get about 50-100% of its electricity from burning digester gas
Types of Digesters

• **Standard**
  – 30 to 60 days digestion time
  – Not mixed or heated

• **High rate**
  – 15 to 30 days digestion time
  – Mixed and heated
Sludge Processing: Disinfection

Objective: Kill pathogens that survive stabilization process

• Physical processes:
  – Heat

• Chemical processes:
  – Chlorination
  – Lime
Sludge Processing: Dewatering

Objective: Remove water from stabilized sludge

Processes:
• Vacuum filter
• Centrifuge
• Belt press
• Drying beds
Sludge Processing: Final Disposal

**Objective:** Dispose of sludge in environmentally sound way

**Processes:**
- Landfill
- Land application
- Composting
Final Disposal Processes: LANDFILL

• Place sludge in a typical solid waste landfill
• No beneficial use with this method
Final Disposal Processes: LAND APPLICATION

• Sludge is injected or tilled into soil
• Done on either non-agricultural or agricultural land
Final Disposal Processes:
COMPOSTING

- Sludge solids are composted with other solids
- Compost is sold or given away