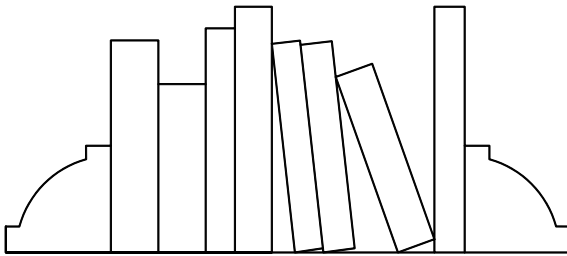


# Waste

## Lecture Outline:

17. SEWAGE DISPOSAL
- Sewage Handling
  - Raw Sewage
  - Wastewater Treatment Steps
  - Individual Septic Systems
  - Taking Stock



## Learning Objectives:

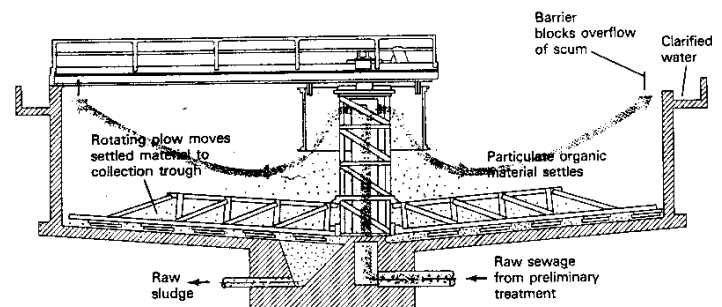
*When you are finished with this unit you should be able to:*

- Describe the health hazards associated with untreated sewage.
- List and describe the four major categories of pollutants in raw sewage.
- Describe the processes of preliminary, primary, secondary and tertiary sewage treatment.
- Outline possible methods for disinfecting sewage treatment effluent.
- Cite the goals and accomplishments of The Clean Water Act.

## Terms You Should Know:

- ❖ Pathogens
- ❖ Storm drains
- ❖ Sanitary sewers
- ❖ Raw sewage
- ❖ Particulate material
- ❖ Colloidal material
- ❖ Preliminary treatment
- ❖ Bar screen
- ❖ Grit-settling tank
- ❖ Primary treatment
- ❖ Raw sludge
- ❖ Secondary treatment
- ❖ Biological treatment
- ❖ Activated sludge system
- ❖ Disinfection
- ❖ Chlorinated hydrocarbons
- ❖ Tertiary (advanced) treatment
- ❖ Wetland systems
- ❖ Anaerobic digestion
- ❖ Sludge digester
- ❖ Biogas
- ❖ Treated sludge
- ❖ Pasteurization
- ❖ Septic system
- ❖ Clean Water Act of 1972

## **Cross section of primary clarifier.**



## Reading Assignment:

Brennan and Withgott:  
Chapter 15; pages 426-428.

## 17. SEWAGE DISPOSAL

### A. SEWAGE HANDLING

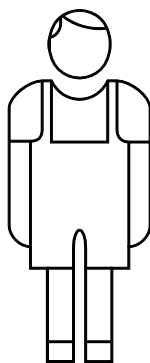
sewage =

sewage treatment =

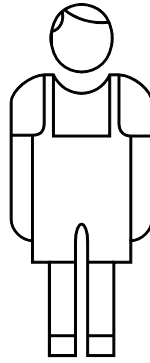
- Government prefers latter terms, feeling they are more acceptable to the public

#### 1. Health Hazard of Untreated Sewage

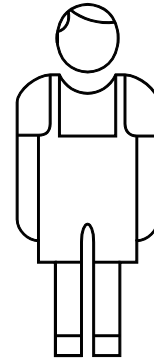
- Untreated sewage is a major health hazard—contains *PATHOGENS*
- Vector in the spread of many diseases:
  - typhoid fever
  - 
  - salmonella infections
  - 
  - infectious hepatitis
  - 
  - giardiasis
  - 
  - flatworms



sick person



well person



sick person

- **When host populations are sparse:**
  - 
  - **because contamination levels are low**
- **When host population is high:**
  - 
  - **because contamination levels are high**
- **Before the connection between sewage and disease was made, epidemics were common in most major cities**
- **Where sewage is not treated, there is still the potential for major epidemics**
- 

## **2. Historical Background**

- **Prior to 1900 common to use outhouses; these often contaminated drinking water**
- **Moved to flush toilets connected to sewers**
  - 
  - 
  - **wastewater treatment initiated to clean up polluted rivers**
- **First treatment plants built in USA about 1900**
- 
- **Because of peak flows associated with storm events most cities moved to:**

- 
- 
- **Situation under control in developed countries**
  - **A mess in the Third World**
    - ✓ many kids play in open sewers
    - ✓ ideal for disease transmission
    - ✓ some degree of immunity due to repeated exposure for locals
    - ✓ visitors do not have immunity

## **B. RAW SEWAGE**

### **1. What is Raw Sewage?**

**Raw sewage: 99.9% water; 0.1% waste**

- 
- if storm water added, even more dilution
- The waste can be divided into four distinct categories:

#### **1. DEBRIS AND GRIT:**

debris—

grit—

#### **2. PARTICULATE ORGANIC MATERIAL:**

- visible OM (from food wastes)
- 
-

- microbes that have begun to digest waste

-

### **3. COLLOIDAL AND DISSOLVED ORGANIC MATERIAL:**

- same sources as in particulate organic material—but smaller in size
- will not settle in still water

### **4. DISSOLVED INORGANIC MATERIAL:**

- nutrients; N, P, K from excretory wastes

-

### ***In addition to the 4 categories:***

-

-

-

## **C. WASTEWATER TREATMENT STEPS**

- A sewage treatment plant should remove all four types of pollutants for complete treatment:

debris + grit →

particulate OM →

coll & diss OM →

diss inorganic →

then chlorinate →

- Preliminary and primary treatments are physical steps
- 
- In USA most cities now have secondary treatment; increasing numbers are installing tertiary treatment

a. Preliminary Treatment:

*Removal of debris and grit*

- Removed first because it can damage or clog pumps
- **RAW SEWAGE** moves through a **BAR SCREEN** (bars 1 inch apart)
  - debris raked off and incinerated
  - then sewage flows through a **GRIT SETTLING TANK**;
  - 
  -

b. Primary Treatment:

*Removal of particulate organic material (OM)*

- Water flows through large tanks called **PRIMARY CLARIFIERS**
  - 
  - 30 to 50% of OM settles out  
removed
  - fatty and oily materials float to top  
skimmed off
- The settled OM and fatty materials called **RAW SLUDGE**

**c. Secondary Treatment:**

***Removal of colloidal and dissolved OM***

- Also called **BIOLOGICAL TREATMENT**
- Uses organisms, decomposers to break down colloids to CO<sub>2</sub> and H<sub>2</sub>O
  - need O<sub>2</sub> rich system

**Secondary systems:**

1.

2.

**1. Fixed film systems:**

- also called attached growth
- 
- biomass grows on media and sewage passes over it

**2. Suspended growth systems:**

- activated sludge system
- for large cities

**d. Disinfection**

- Kill pathogens prior to discharge
- Chlorine gas is common; but has problems:
  - 
  -

- **Newer agents:**
  - 
  - 
  -
- **In 1972 5% of US sewage raw**
  - **25% only primary treatment**
- **Clean Water Act → bring all treatment up to secondary level**
- **But inorganic nutrients alone will cause eutrophication!! Need tertiary treatment!**

#### e. Tertiary or Advanced Treatment

##### *Removal of dissolved inorganic materials*

- **Where water is scarce →**
  -
- **P removal if you want to prevent eutrophication**
  -
- **N removal under many circumstances**
  -

#### 1. Tertiary Treatment Alternatives

##### *Irrigation:*

- 
- 
-



***Constructed Wetlands:***

- 
- natural filter
- 
- climate may restrict
- artificial wetlands are best bet

**2. Sludge-Treatment Options**

- For dealing with **RAW SLUDGE** from primary treatment
  -
- Consider both **TREATMENT** and **DISPOSAL**
- Common to press out water; incinerate or landfill the solids (or maybe dump in the ocean)
- The **RAW SLUDGE** can be converted to **HUMUS**—that is rich in nutrients—**FERTILIZER!!**

***Conversion to humus:***

- air →
- + air →

**D. INDIVIDUAL SEPTIC SYSTEMS**

- Millions of homes in rural and suburban areas have septic systems
-

- **Waste water flows into septic tank**
  - 
  - **water containing colloidal OM + dissolved nutrients flow into drain field and gradually percolate into soil**
  - **septic tank should be pumped out every 2 to 3 years**

***Septic tank problems:***

- - **soil too clayey**
  - 
  - 
  - **water table too high**
- **Encouragement of conversion from septic tanks to sewers:**
    - 
    - 
    -

## **E. TAKING STOCK**

### **1. Progress**

- 
- **Clean Water Act (CWA) Goals:**
  1. **Keep aquatic ecosystems fit for their normal biota**
  - 2.
- **CWA sets goals and schedules for cleanup**
  - **provides federal money for sewers and upgrading sewer plants**

–

- **Today many water bodies are cleaner today than in 1960s and early 1970s**
- 
- **Still hear of beaches closed to swimming—*E. coli*.**
- **Idaho funds sewers with Idaho Water Pollution Control Fund (source of funds is the inheritance tax)**