



Fundamental of Environmental Engineering

Chapter 5: Overview of
Treatment and Pollution Control
in Environmental Field



Water and Wastewater Treatment

- Purification for domestic use
- Treatment for Specialized industrial use
- Treatment of wastewater




Air Pollution Control

- Purification for domestic use
- Treatment for Specialized industrial use
- Treatment of Air



Solid and Hazardous Waste Management

- Management and Treatment for domestic waste
- Management and Treatment for Specialized industrial waste



4Rs for achieving reduced material use and waste generation

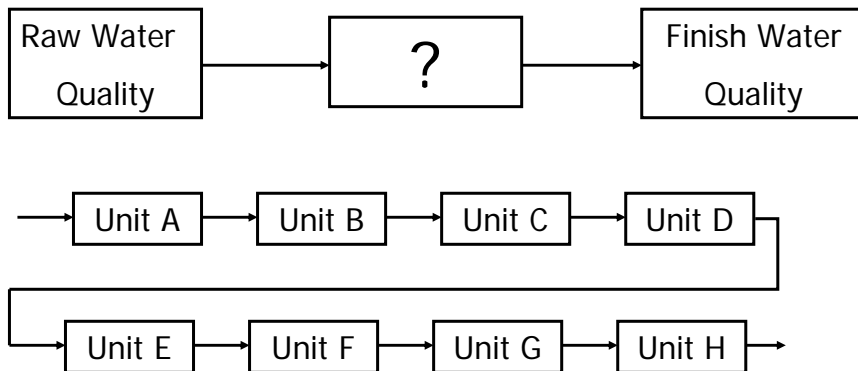
1. Reduction
2. Reuse
3. Recycling
4. Recovery



Treatment

- Physical Treatment
- Chemical Treatment
- Biological Treatment
- Combination of Treatment

Design and Unit Operations Approach



Key Concepts

“Matter is neither created nor destroyed, within the limits of our ability to measure mass”.

“Energy also is conserved in chemical reactions, within the limits of our ability to measure it”.

Physical Treatment

The physical unit operation most commonly used:

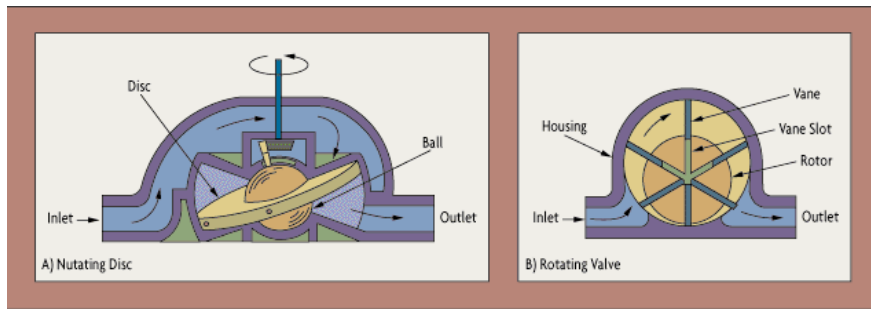
- **Flow metering**
- **Screening**
- **Comminution**
- **Mixing**
- **Sedimentation**
- **Accelerated gravity settling**

Physical Treatment (continued)

- **Floatation**
- **Filtration**
- **Physical Adsorption**
- **Gas Stripping and Scrubbing**
- **Sludge Collecting**
- **Dewatering**
- **Evaporation and Condensation**

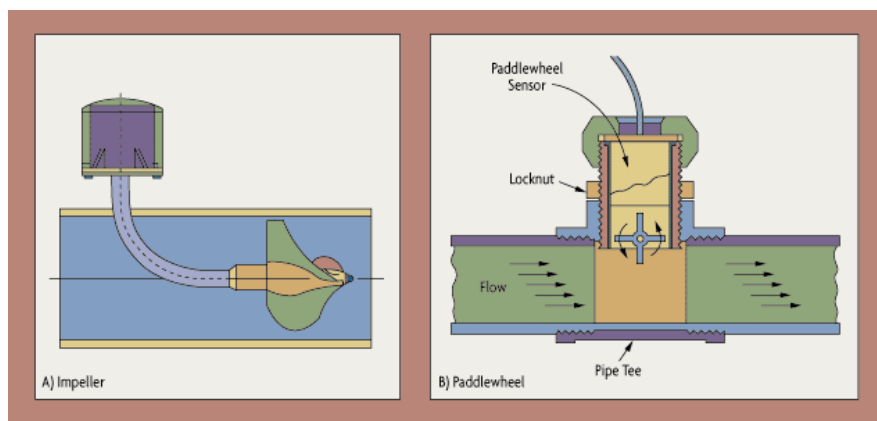
Flow metering

Mechanical Flowmeter



Nutating-Disc Meter

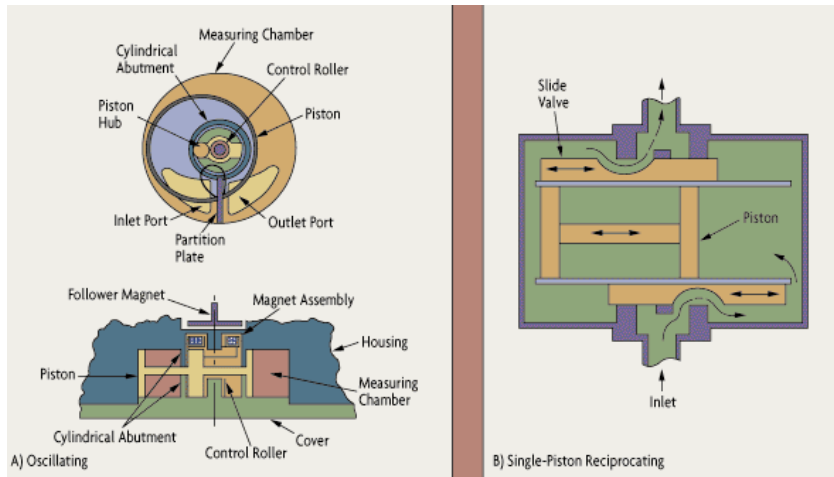
Flow metering (cont.)



Rotary Flowmeter

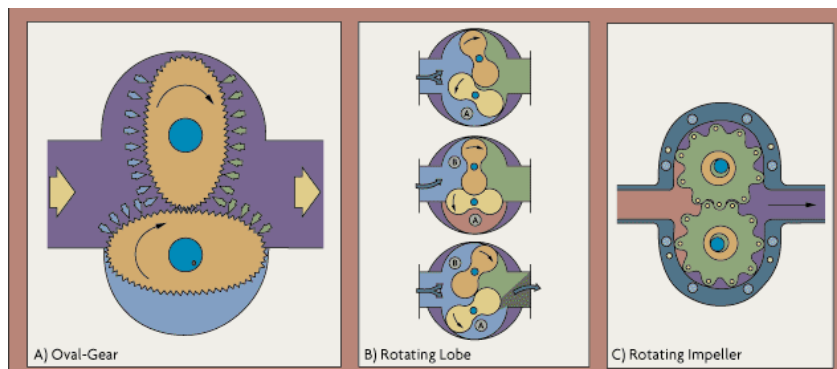
Flow metering (cont.)

Positive Displacement Flowmeter



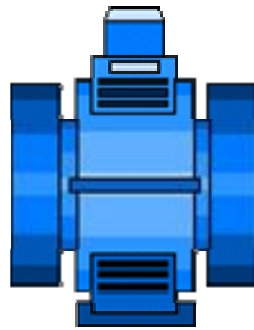
Oscillating-Piston Meter

Flow metering (cont.)



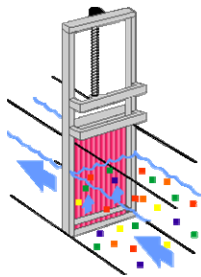
Rotating Positive Displacement Meter

Flow metering (cont.)

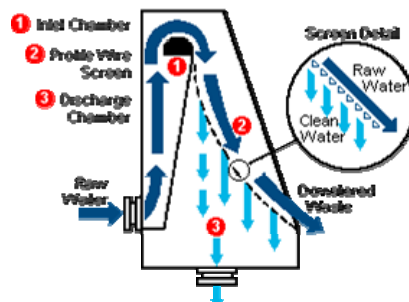


Electromagnetic Flowmeter

Screening



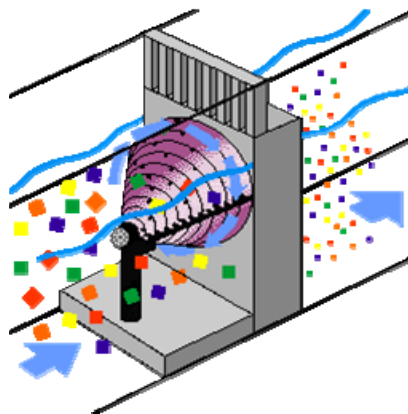
Bar Screen



Screening (cont.)



Comminution



Flowminutor

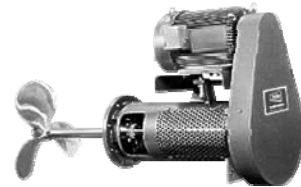
Mixing



Portable Mixer (Agitator)



Vertical Mixer



Side Mixer

Mixing (cont.)



Types of Mixer Blades

Sedimentation



Inclined-Plate Sedimentation



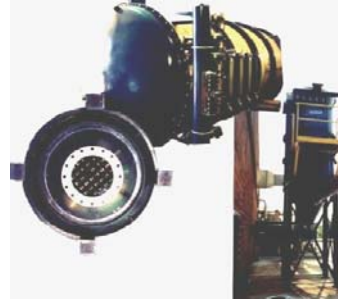
Rectangular Sedimentation

Sedimentation (cont.)



Sedimentation (cont.)

Dust Collectors



Accelerated gravity settling

Yardney Centrifugal Separator

Theory of Operation

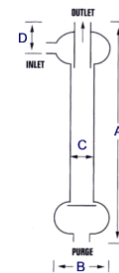
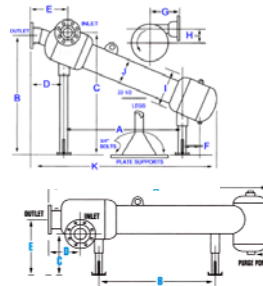
Clean water is drawn out through the separator's vortex action

Solid mix enters unit tangentially inducing centrifugal action

Solids drop into the collection chamber

Centrifugal action moves heavier particles to sides of the separator

Solids are purged as required from the collection chamber

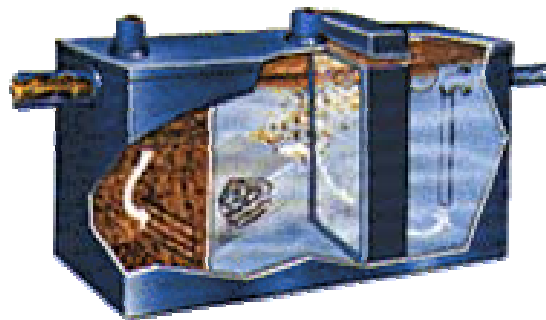


Accelerated gravity settling (cont.)



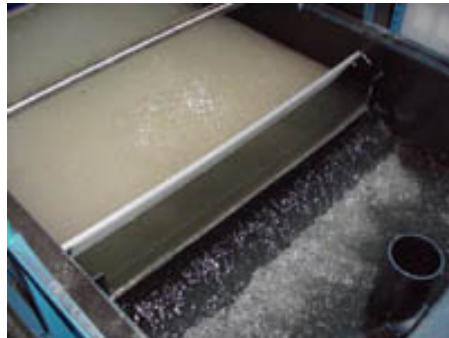
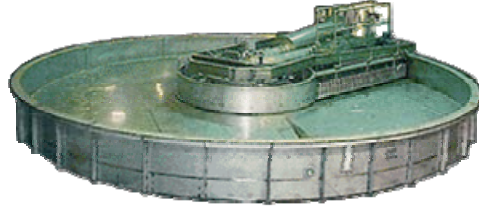
Cyclone

Floatation



Oil Separator

Flotation (cont.)



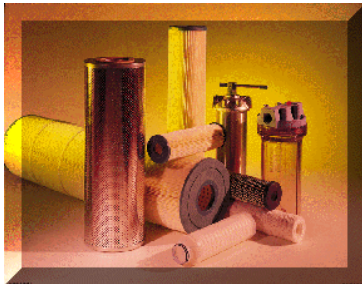
Filtration



Filtration (cont.)



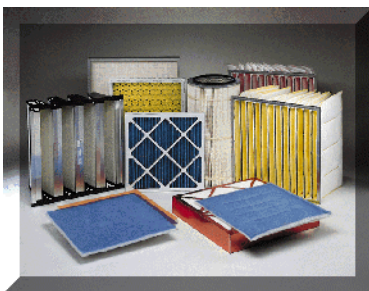
Filtration (cont.)



Filtration (cont.)



Filtration (cont.)



Physical Adsorption



Gas Stripping and Scrubbing



Sludge Collecting



Dewatering



Filter Press



Belt Press



Thickener

Evaporation and Condensation



Commercial Dryer



Chemical Treatment

- Neutralization
- Coagulation-Flocculation
- Precipitation
- Oxidation-Reduction
- Chemical Adsorption
- Disinfection
- Combustion

Neutralization

pH Adjusting Package



Coagulation-Flocculation



Jar Test

Precipitation



Heavy Metal Treatment Package

Oxidation-Reduction



Advanced Oxidation Process

Oxidation-Reduction (cont.)

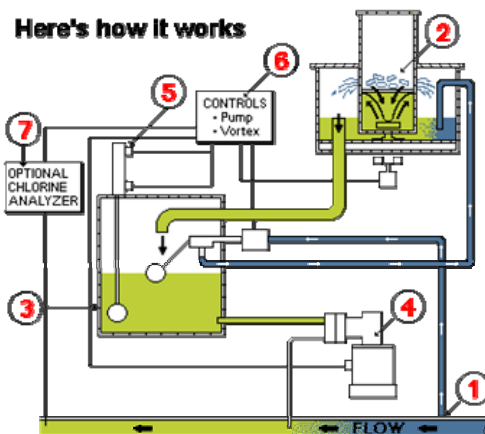
Oil Mist and Smoke



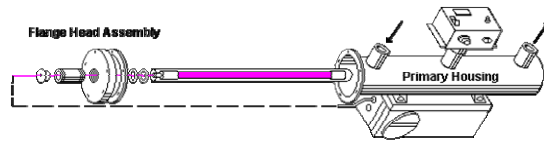
Disinfection



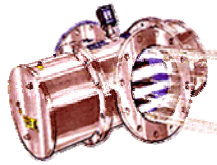
Chlorinator



Disinfection (cont.)



UV Sterilizer



Disinfection (cont.)



UV Sterilizer

Combustion



Incinerator



Biological Treatment

-Aerobic processes:

Suspended- and attached- growth

-Anoxic processes:

Suspended- and attached- growth

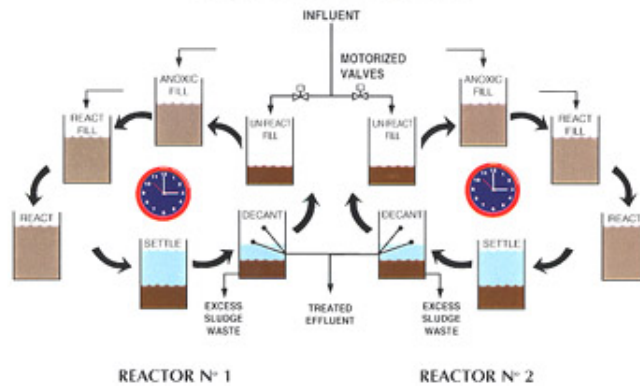
-Anaerobic processes:

Suspended- and attached- growth

Aerobic processes: suspended-growth

SBR A CONTINUOUS PROCESS "IN BATCH"

Treatment sequence



Aerobic processes: suspended-growth (cont.)

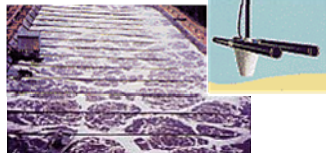
Aerated lagoon



Aeration Tank



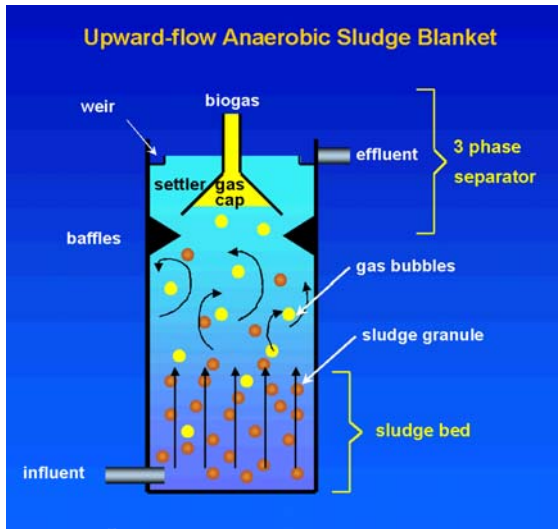
Aerobic processes: suspended-growth (cont.)



Aerobic processes: attached-growth

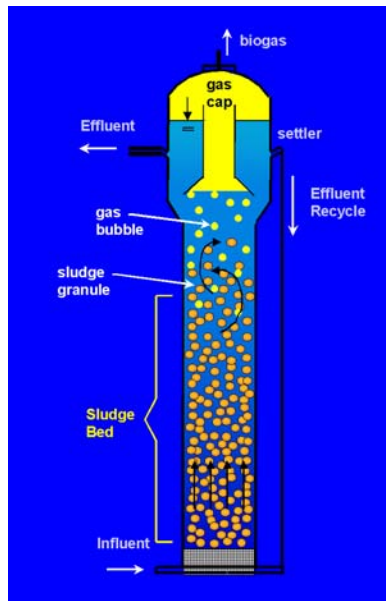


Anaerobic processes: suspended-growth



UASB

Anaerobic processes: suspended-growth (cont.)



The expanded granular sludge bed (EGSB) reactor concept

Anaerobic processes: attached-growth

