SEWAGE TREATMENT PROCESSES

I. Basic Objectives
   - A. Stabilize the Organic Matter
   - B. Coagulate & Remove Settleable Solids
   - C. Store Settled Solids for Future Removal

II. Three Steps
   - A. Primary Treatment
     1. Conditions sewage for further treatment
     2. May be
        - a. Anaerobic
        - b. Aerobic
        - c. Both Aerobic & Anaerobic
   - B. Secondary Treatment
     1. Solids Removal
     2. May be
        - a. Filtration
        - b. Settling
        - c. A Combination
   - C. Tertiary Treatment
     1. Disinfection
     2. May be
        - a. Chlorination (most common)
        - b. Ultraviolet (UV) light
        - c. Ozone

III. Purpose of Primary Treatment
   - A. Condition sewage for secondary treatment
     1. Floats light solids
        - a. Oils
        - b. Fats
        - c. Paper
        - d. Plastic articles
     2. Settles heavier solids
     3. Store solids for future removal
   - B. Reduces BOD and TSS

IV. Types of Primary Treatment
   - A. Septic tank
     1. Anaerobic bacteria (no oxygen)
     2. Good settling properties
     3. Slow process (2-4 days)
     4. Standard size except for RPF
     5. Effluent filter recommended / not required

B. Aerobic treatment unit
    1. Activated Sludge Process
        a. Aerobic & Facultative organisms
            - Eubacteria
            - Filamentous bacteria
            - Rotifers
            - Protozoa
            - Algae
        b. Forms floc (settles) readily
        c. Fast process (hours)
    2. Construction varies with manufacturer
    3. Approved by Product Review Committee

V. Maintenance Requirements
A. Septic Tank
    1. Pump solids out
        a. Every 5-7 years
        b. Or as needed
        c. Check sludge depth with
            - dip stick / toweling
            - Sludge Judge (proprietary)
    2. Clean effluent filter
    3. Check integrity of baffles, filters, etc.
B. Aerobic treatment unit
    1. Maintenance requirements set by manufacturer
    2. Maintenance training provided by manufacturer

VI. Common Problems
A. Poor Settling
    1. Dispersed Growth
        a. Organisms suspended in liquid portion of liquor
        b. Mostly bacteria
        c. Few ciliated protozoa
        d. Common during start up period
        e. Usually fixes itself
    2. Bulking
        a. What's Bulking?
            1. Over abundance of filamentous bacteria
                - Floc formation inhibited
                - Solids bulky / loosely packed
                - Live & dead cells in liquor
            2. High BOD
            3. Difficult to fix
        b. Indications
            1. Poor settling of mixed liquor

        2. Thick brown foam in chamber
    c. Possible fixes
        1. Reduce aeration
        2. Pump out & restart unit
        3. Commercial additives
        4. Pump out & add a balanced liquor
3. Toxicity
    a. Toxic substance killed organisms
    b. Dispersed biomass
    c. High BOD
    d. Filamentous bacteria take over on recovery
    e. Possible causes / fixes
        1. Big laundry day
        2. Chemicals added to system

B. Mechanical

1. Loss of power
    a. Breaker
    b. Corroded connections
    c. Owner related issues
2. Worn out equipment / parts

PRETREATEMENT

I. Purpose of Pre-treatment
   - A. Condition sewage for secondary treatment
     1. Floats light solids
        a. Oils
        b. Fats
        c. Paper
        d. Plastic articles
     2. Settles heavier solids
     3. Store solids for future removal
   - B. Reduces BOD and TSS

II. Types of Pre-treatment
   - A. Septic tank
     1. Standard size except for RPF
     2. Effluent filter recommended / not required
     3. May be used with approved pump vault
   - B. Aerobic treatment unit
     1. Construction varies with manufacturer
     2. Approved by Product Review Committee

III. Maintenance Requirements
   - A. Septic Tank
     1. Pump out
        a. Every 5-7 years ◁ depends on usage
        b. Or as needed
        c. Check sludge depth with
           1. dip stick / toweling
           2. Sludge Judge (proprietary)
     2. Clean effluent filter
     3. Check integrity of baffles, filters, etc.
   - B. Aerobic treatment unit
     1. Maintenance requirements set by manufacturer
     2. Maintenance training provided by manufacturer

LOW PRESSURE DISTRIBUTION SYSTEM (LPD)

I. What is it?
- A. Alternative method of effluent distribution
  - 1. Subsurface disposal
    - a. Conventional gravel & pipe system
    - b. Approved gravel substitutes
  - 2. Very efficient distribution
    - a. Capping fills
    - b. Marginal soils
- B. Distribution system for:
  - 1. Intermittent Sand Filters
  - 2. Re-circulating Sand Filters

II. LPD Design
- A. Pre-treatment
  - 1. Septic tank
  - 2. Aerobic treatment unit
- B. Pump chamber or vault
  - 1. Pump
    - a. Low head pump (usually)
    - b. Dose
      1. timed
      2. demand
  - 2. Pump chamber
    - a. Separate tank
    - b. Usually a small septic tank
  - 3. Pump vault
    - a. Requires one size larger tank
    - b. Installed in outlet end of tank
    - c. Three inch maximum draw-down
- C. Distribution system
  - 1. Small pipes
    - a. 1¼ - 2 inch diameter
    - b. Schedule 40 PVC
  - 2. Low pressure
    - a. 3 – 10 feet of head
    - b. orifices 1/8 - 3/16 inch
  - 3. Clean- outs
    - a. Ends of laterals
    - b. Manifold ends

III. How an LPD works
- A. Moves effluent to absorption field

B. Loads soil
    1. Evenly
    2. Low volume / square foot

IV. Common problems
A. Clogged orifices
    1. Increases run time
    2. Clean lines and manifold
        a. Remove end caps
        b. Blow out lines
        c. Use brush / snake device
B. Pump not working
    1. Power supply
    2. Control panel
    3. Clear pump intake
    4. Replace pump if necessary
C. Effluent surfacing
    1. Distribution lateral
        a. Broken or crushed
        b. Separated at joint

RE-CIRCULATING SAND FILTER (RSF)

I. What is it?
- A. Multiple pass sand filter
- B. Smaller than intermittent sand filter
  1. Uses less media
  2. Smaller "footprint"
- C. Uses very coarse sand
- D. Usually used on larger systems
  1. Commercial
  2. Subdivisions
  3. Trailer parks

II. Re-circulating sand filter design
- A. Pre-treatment
  1. Septic tank
  2. Aerobic treatment unit
- B. Pump Chamber
  1. Pump
     a. Low head pump (usually)
     b. Timed dose
  2. Re-circulation valve
     a. Re-circulates effluent
     b. Maintains constant level in chamber
     c. 75-80% re-circulated
     d. 20-25% is discharged each cycle
- C. Filter open to surface
  1. Liner
     a. 30 mil minimum
     b. Usually PVC
     c. Prevents
        1. groundwater infiltration
        2. sewage exfiltration
  2. Gravel bottom
     a. Allows sand to drain
     b. Beds collection pipes
  3. Sand specification
     a. 0.5-1.0 effective particle size
     b. Uniformity coefficient < 4
     c. 18-24 inches deep
  4. Pea gravel upper layer
     a. Protects infiltrative surface
     b. Beds distribution system
  5. Distribution system
     a. Small pipes

b. Low pressure

6. Effluent fate
   a. Subsurface drainfield
   b. Surface discharge
      1. appropriate site
      2. disinfection required

III. How a RSF works
   A. Re-filters sewage
      1. 4-5 trips through filter
      2. Improved renovation
   B. Coarse sand
      1. Resists clogging
      2. Media for micro-organisms
   C. Discharges only with additional load

IV. Common problems / solutions
   A. Ponded filter
      1. Pretreatment unit not functioning properly
         a. Septic tank
            1. check outlet baffle / effluent filter
            2. continuous flow?
            3. tank need pumping?
         b. ATU
            1. continuous flow?
            2. operating properly?
      2. Excessive bio-mat
         a. Compare actual flow with design flow
         b. Repair
            1. chemically oxidize bio-mat
            2. replace sand layer
   B. Distribution system
      1. Clogged orifices
         a. Increases run time
         b. Clean lines and manifold
            1. remove end caps
            2. blow out lines
            3. use brush / snake device

      2. Pump not working
         a. Power supply
         b. Control panel
         c. Clear pump intake
         d. Replace pump if necessary

      3. Filamentous algae (the green slime)
         a. Too much re-circulation
         b. Must be physically removed

DISINFECTION OF SEWAGE EFFLUENT

I. All sewage discharges must be disinfected
   - A. This is current policy
   - B. Some RPF's approved without disinfection
     1. Older systems
     2. Onsite retention of effluent

II. Approved disinfection methods
   - A. Hypochlorinators
     1. Liquid feed
     2. Requires a pre-mixed solution of hypochlorite
     3. Timer pumps solution into contact chamber
     4. Advantages
        - hypochlorite solution is cheap
        - usually used on larger systems
     5. Disadvantages
        - hypochlorite solution is very corrosive
        - solution lines tend to plug
        - pumps expensive to replace
        - require frequent maintenance
     6. Rarely seen on residential systems
   - B. Positive contact, dry feed chloinators
     1. Most common disinfection unit
     2. Uses 2 5/8 inch calcium hypochlorite tablets
     3. Advantages
        - most common disinfection method
        - relatively low cost
        - easy to use and service
        - many good products on market
        - tablets available
     4. Disadvantages
        - tablets are expensive
        - tablets can absorb moisture
        - owners try to substitute swimming pool tablets
        - tablets hazardous around petroleum products
   - C. Ultraviolet light units
     1. Ultraviolet light kills micro-organisms
     2. Advantages
        - simple, no moving parts
        - no residual left in wastewater

3. Disadvantages
    - expensive to buy
    - uses electricity to operate
    - tubes must be cleaned regularly
    - must be protected from the elements
    - no residual left in wastewater
4. Rarely seen

D. Ozone units

1. Ozone kills micro-organisms
2. Produced by passing air over electric spark
3. Advantages
    - simple, few moving parts
    - no residual left in wastewater
4. Disadvantages
    - very expensive to buy
    - uses electricity to operate
    - generator expensive to replace
    - must be protected from the elements
    - no residual left in wastewater
5. Rarely seen

III. Requirements for using chlorinators

A. Both:

1. Hypochlorinators
2. Positive contact, dry feed chloinators

B. !0 ppm during peak flow

C. Contact chamber required

1. Baffled
2. 30 minutes minimum contact time
3. 25 gallons adequate for most residences
4. Protected from flooding

SAMPLING SEWAGE TREATMENT SYSTEMS

I. Sampling Frequency
- A. BOD & TSS
  1. Not required by Health Department
  2. DEQ may require 2 / year
- B. Chlorine residual two / year
- C. Fecal coliform
  1. Only required if no chlorine residual
  2. One consecutive sample
  3. < 400 colonies / 100 ml
- D. pH two times / year

II. Sampling ports
- A. Required on all new discharging systems
- B. May need to retrofit on old systems
- C. Locate for best results
  1. Outlet of chlorine contact chamber
  2. Discharge line

III. Sampling methods
- A. Technique
  1. Turkey baster or similar device
  2. Be careful!
     a. don't agitate effluent
     b. clear liquid only
  3. A turbid sample will be a bad sample
- B. BOD & TSS
  1. 1 liter container supplied by lab
  2. Ice immediately
- C. Fecal coliorm
  1. 100 ml container supplied by lab
  2. Use sterile technique
     a. Sanitize equipment before collection
     b. Handle container & lid carefully
     c. Ice immediately
- D. Chlorine
  1. Test at site
     a. Liquid test kit
     b. Test strip
  2. Chlorine residual >0.1ppm
- E. pH
  1. Test at site
     c. Liquid test kit
     d. Test strip
  2. pH 6-9

IV. Laboratories
    A. EPA / DEQ certified
    B. Find in yellow pages
V. Transportation
    A. Follow labs instructions
    B. Four hour time limit is normal
    C. Always ice samples
    D. Documentation
        1. Lab's chain of custody
        2. Health Department's reporting form