AEROBIC TREATMENT UNITS

NOWRA
National Onsite Wastewater Recycling Association

Presented at NOWRA 2025 Mega-Conference, October 19-22, 2025.

RCAP

THIS PROJECT HAS BEEN FUNDED WHOLLY OR IN PART BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY UNDER EPA TREATMENT WORKS AREA 2

NOWRA
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RCAP

Original Materials Development

These materials were originally developed through a CIDWT project. The project was a collaborative effort with stakeholder support to develop materials specifically focused on operation and maintenance of onsite wastewater treatment systems.

Learning Objectives

Upon completion of this module, participant should be able to:

1. Describe the components of an aerobic treatment unit (ATU)
2. Differentiate among suspended growth, submerged fixed film and integrated fixed film activated sludge (IFAS) configurations.
3. Identify the different methods to introduce air into an aeration chamber.

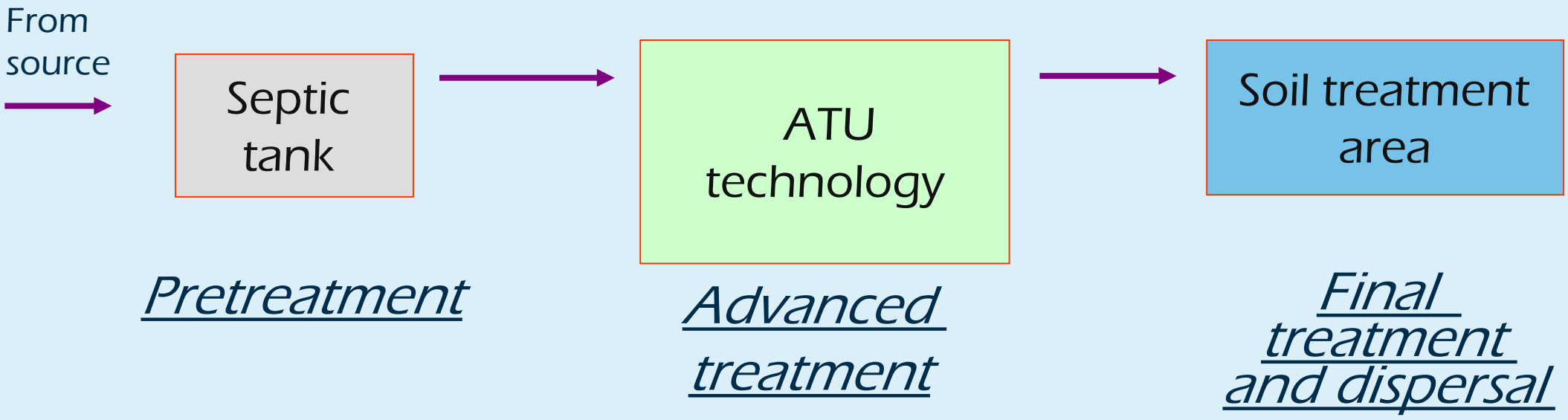
Learning Objectives (cont.)

4. Identify the specific periodic activities for media management.
5. Describe the effect of hydraulic loading on the clarifier and organic loading on the aeration chamber.
6. Accurately complete the Operational checklist 7-2. Aerobic treatment unit (ATU).

Overview

- Five targets for operational evaluation of ATUs
  - Trash removal / anaerobic treatment
  - Aeration chamber (and media, if present)
  - Air supply
  - Clarification
  - Sludge return
- Routine maintenance activities

How to use this ATU section



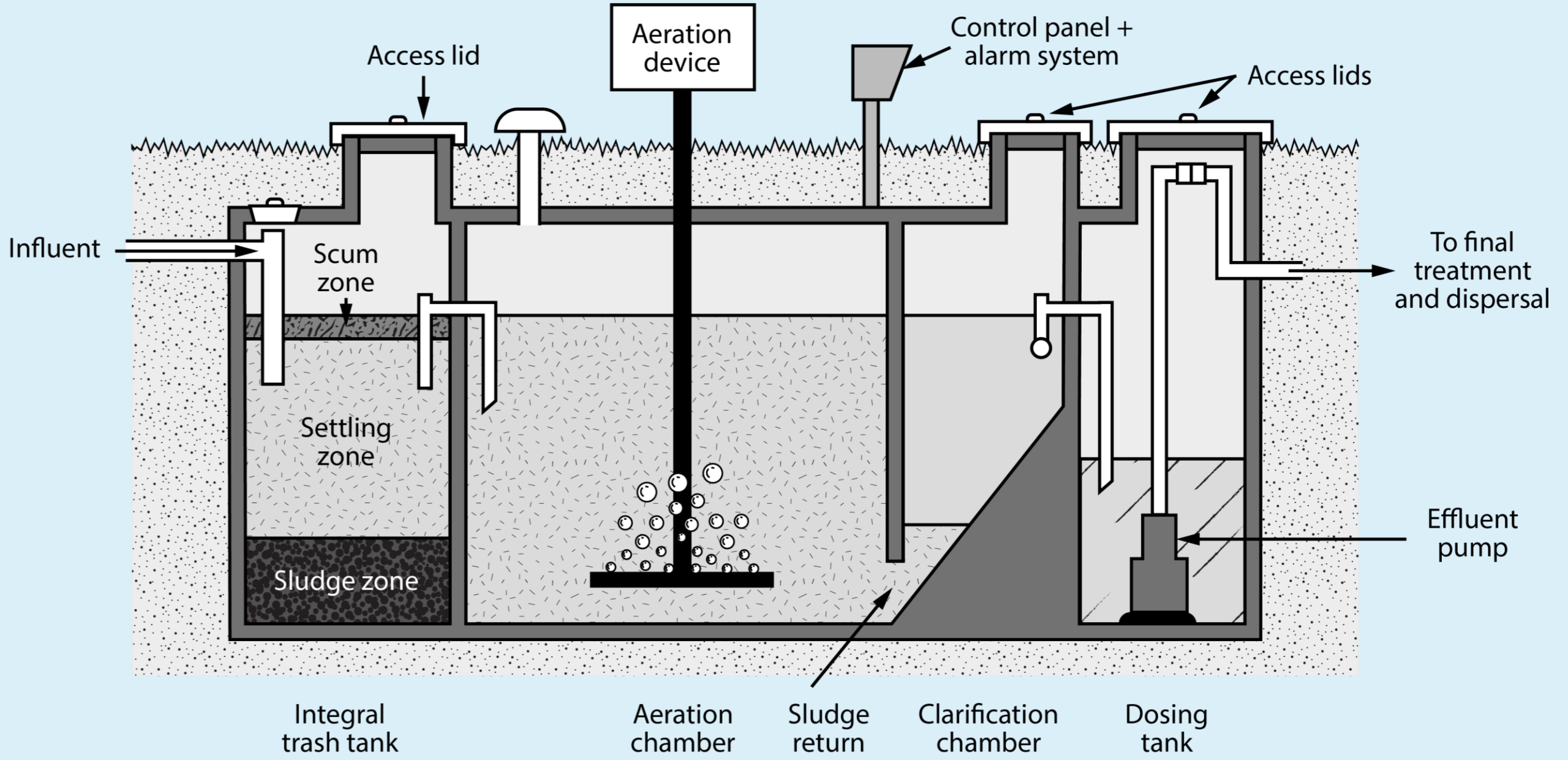
Chapter 6: addresses pumps and controls

ATU Treatment

- Substantial reduction of BOD and TSS
- Nitrification
  - Alkalinity is critical
- Pathogen reduction
- May incorporate denitrification

Devices and processes in ATUs

- Trash tank
  - Trash removal/anaerobic treatment
- Aerobic treatment
  - Mixing of the food & bacteria
  - F/M ratio
- Air supply
- Clarification
- Sludge return


Access lid
Aeration device
Control panel + alarm system
Access lids
Influent
Scum zone
To final treatment and dispersal
Settling zone
Sludge zone
Effluent pump
Integral trash tank
Aeration chamber
Sludge return
Clarification chamber
Dosing tank

Trash Removal and Anaerobic Treatment

- Generally referred to as the “trash tank” or septic tank
  - Removes non-degradable materials from the waste stream.
  - Manufacturer-specific capacity
  - Provides anaerobic treatment.
  - Can be used as a component of a denitrification process.

  - Covered under the Septic, Trash, And Processing Tank (STPT) Operational Checklist (Form 5.2)

Microbes

- Microbes
  - Provide treatment
  - Must keep them healthy
    - *Food*
    - *pH*
    - *Oxygen - DO*
    - *Temperature*
- Dead Microbes
  - Don’t move

Loading rates

- Water use: Hydraulic loading
  - Flow volume
  - Flow rate
- Food: Organic loading (BOD)
  - Concentration, mg/L
  - Mass, Pounds per day
- Food to Microorganism (F:M) ratio

Operation and Maintenance

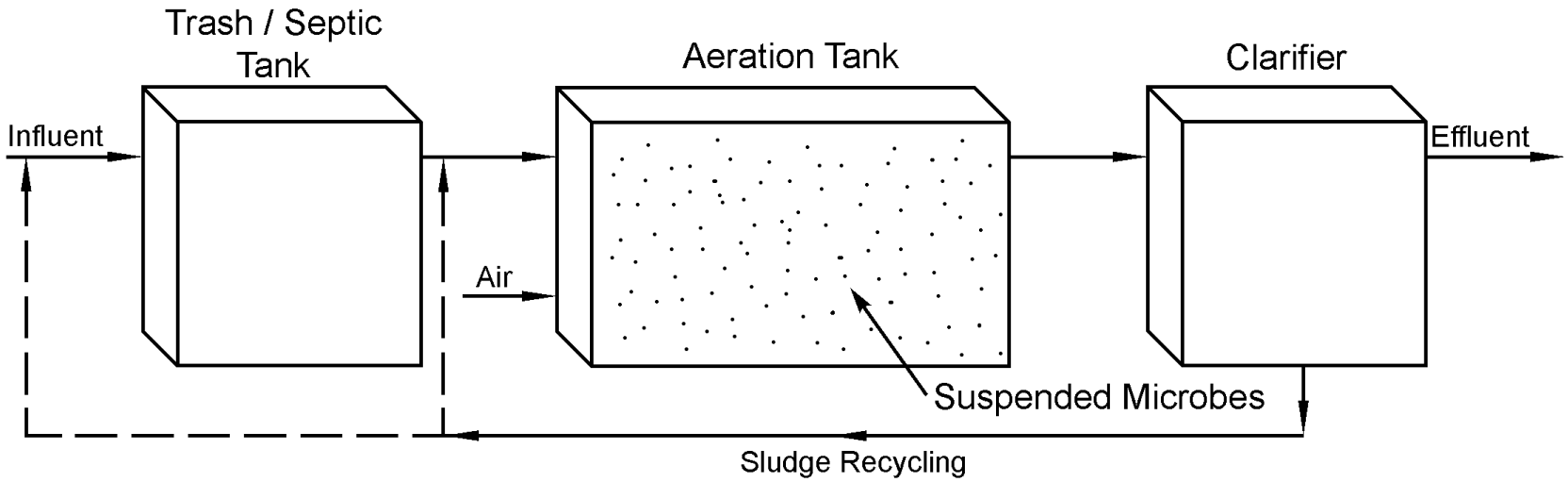
Form 7-2 Operational Checklist: Aerobic Treatment Unit (ATU)

1. Type of ATU

- Suspended growth
  - Includes membrane bioreactor (MBR) and sequencing batch reactor (SBR)
- Submerged attached growth/fixed film media
  - Includes rotating biological contactor (RBC)
- Integrated fixed activated sludge (IFAS)
  - Includes moving bed biofilm reactor (MBBR)

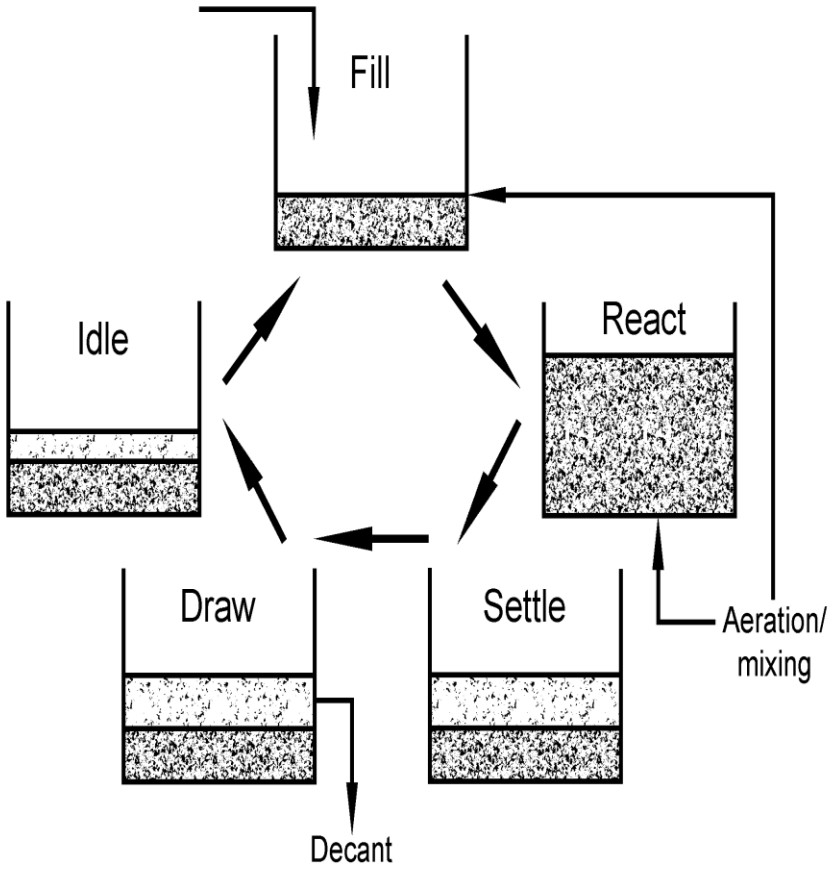
- Manufacturer: _____

Suspended Growth



- Aerobic microbes free swimming in the aeration chamber
- Microbes and wastewater mixed in the chamber
- Extended aeration to limit biomass wasting

Sequencing Batch Reactor

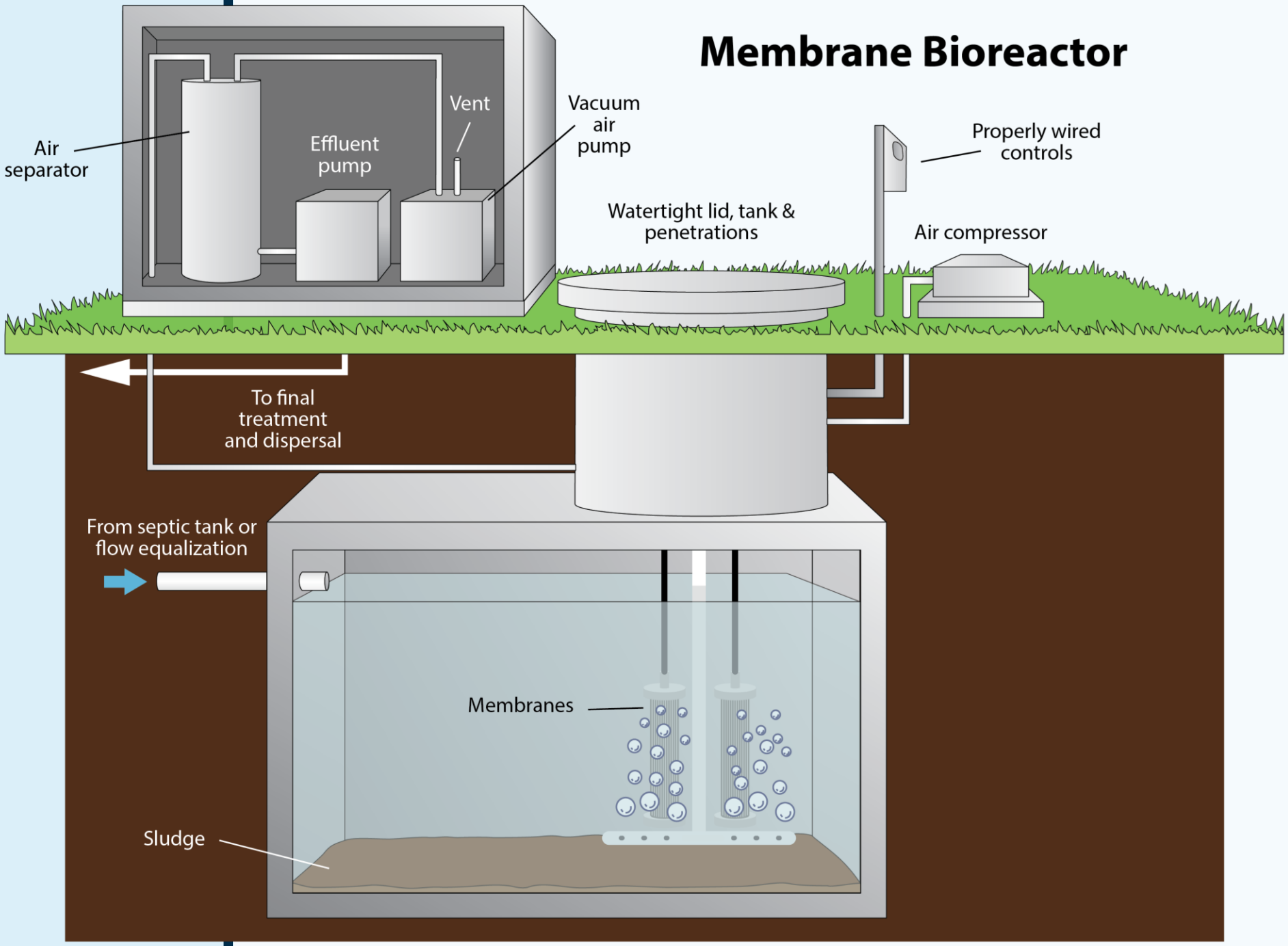


- Suspended growth treatment process
- Utilize a single chamber for achieving aeration, clarification and anoxic conditions
- Flow equalization chamber for dosing effluent into the treatment chamber

Membrane Bioreactor (MBR)

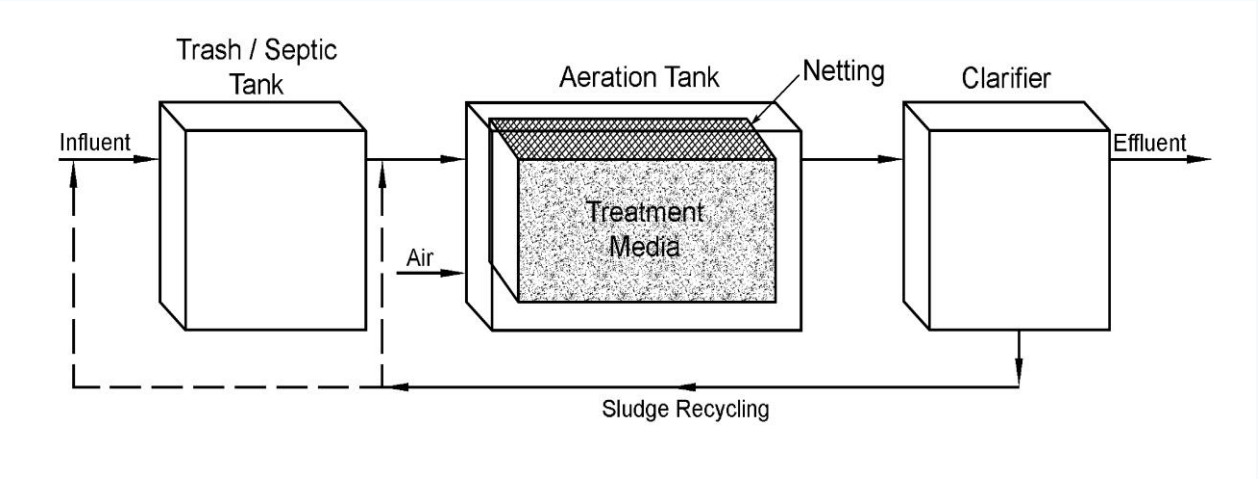
- Ceramic or hollow tube membrane submerged in aeration chamber
- Membrane provides filtration of liquid – suspended microorganism remain in the aeration chamber
- Air diffuser
  - Provides aeration for treatment
  - Continuously scours membrane surface to remove microbes and suspended solids
- Centrifugal or vacuum pump draws liquid through a plate or hollow tube configuration to clarify effluent
- Greater mixed liquor concentration than typical suspended growth systems

Membrane Bioreactor (MBR)

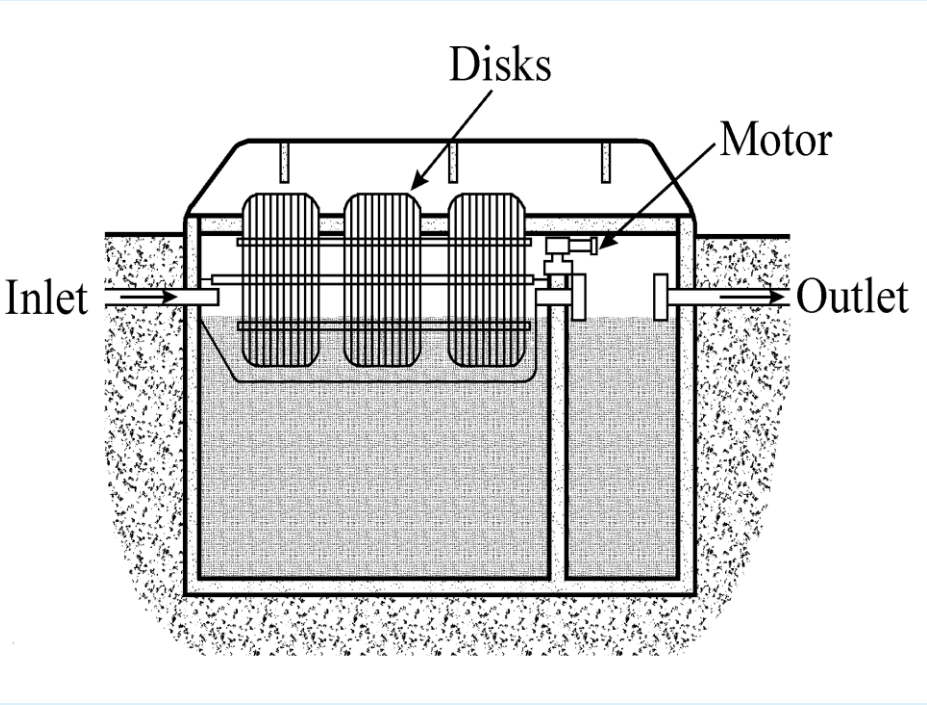


Submerged Attached Growth/Fixed Film Media

- Media submerged in the aeration chamber
- Microbes are attached to the media
- Effluent circulates through the media bringing contaminants to the microbes
- Extended aeration to limit biomass wasting



Rotating Biological Contactor

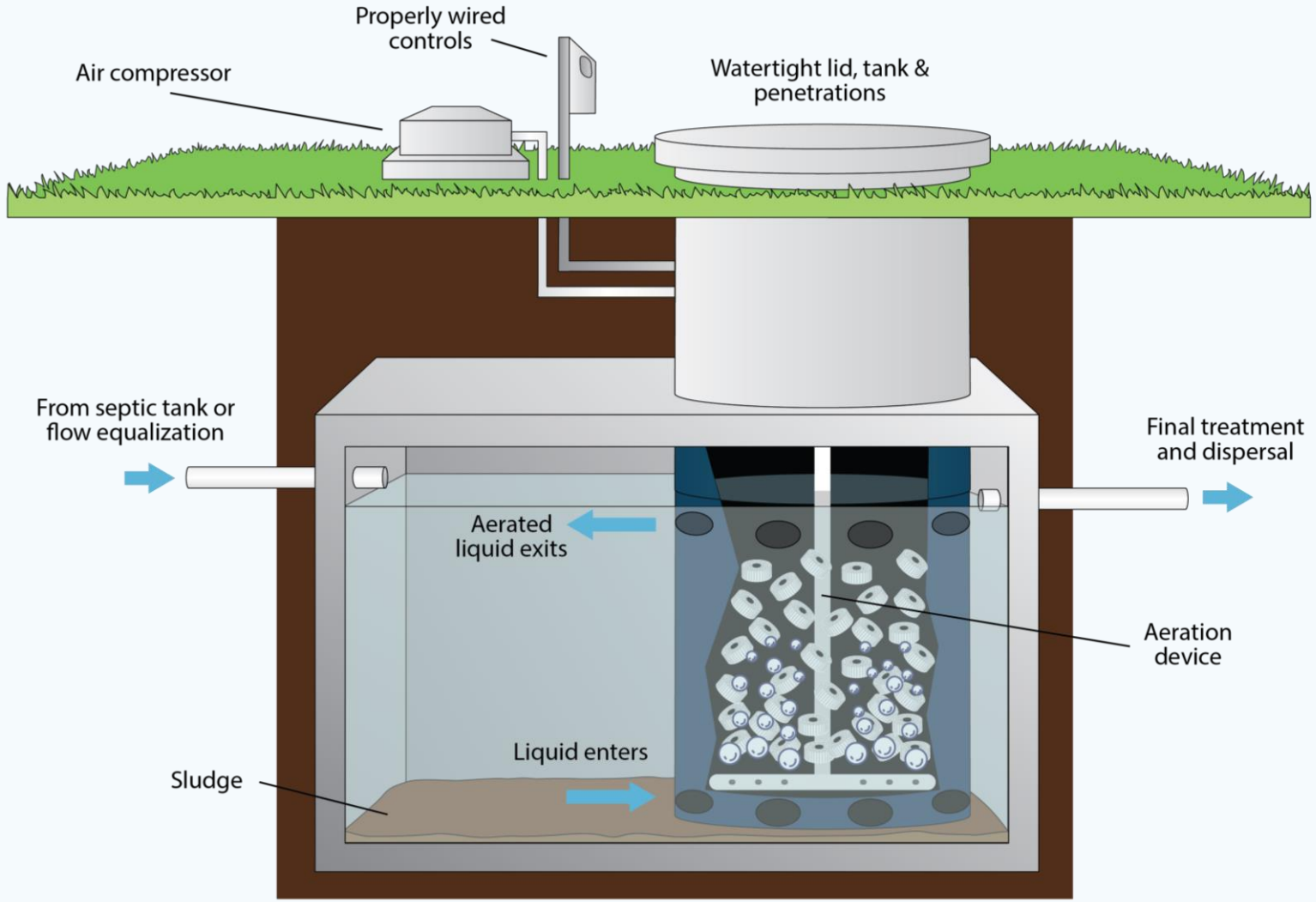


- Fixed film media
- Media is a disk
- Motor slowly rotates disks through the effluent
- Aeration is achieved by passing the media through the air space in the chamber

Integrated fixed activated sludge (IFAS)

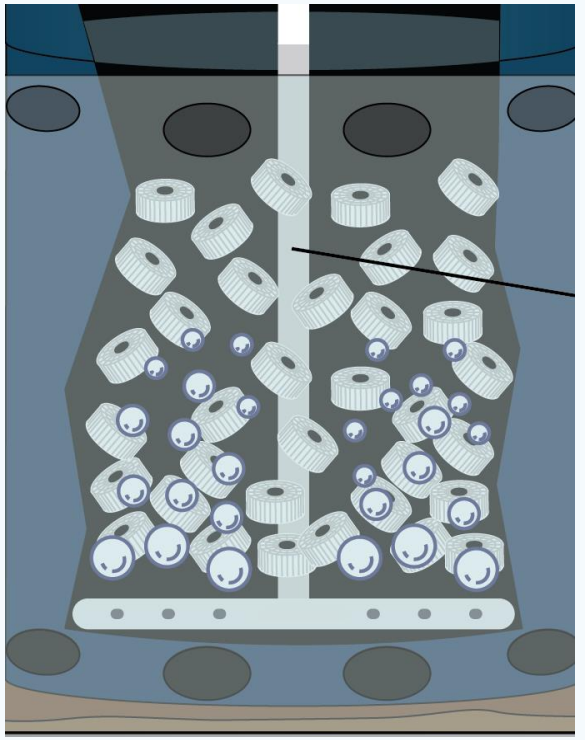
- Both attached and suspended growth configurations are included in the treatment train
- Containerized media for biofilm development
  - Open structured media for biofilm development
  - Aeration in containerized media
- Suspended growth microbial growth in tank

Integrated fixed activated sludge (IFAS)



Moving bed biofilm reactor (MBBR)

- Containerized plastic media
  - Container located inside a tank
  - Open structured media for biofilm development
  - Aggressive aeration rolls the media to slough the excess biomass from the media



2. Conditions at the ATU

a. Evaluate the presence of odor within 10 feet of perimeter of system:
   - *None*
   - *Mild*
   - *Strong*
   - *Chemical*
   - *Sour*

b. Source of odor, if present

2. Conditions at the ATU (cont.)

c. Was foam or residue observed outside of the unit

a. Located at grade

b. If no, how deep is lid buried

Swing tie measurements

Too deep

3. ATU access

Lid slightly buried

3. ATU access (cont.)

c. Risers on tanks

d. Evidence of infiltration in risers

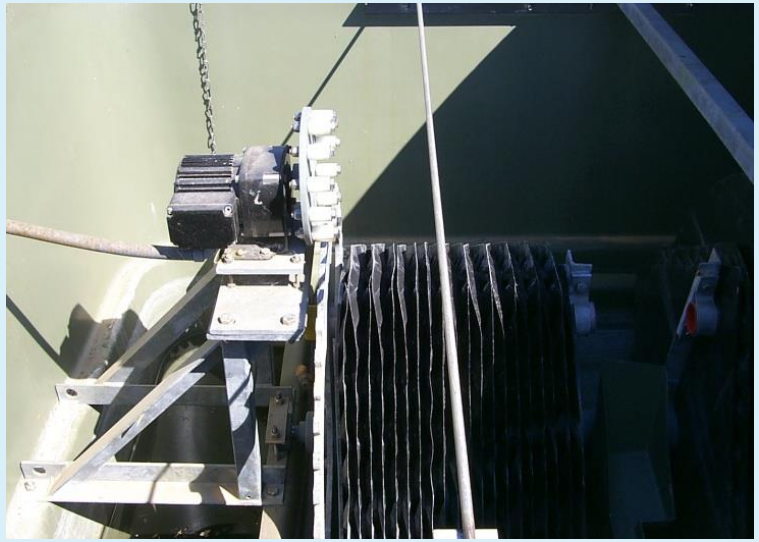
e. Lid/secondary restraint secured

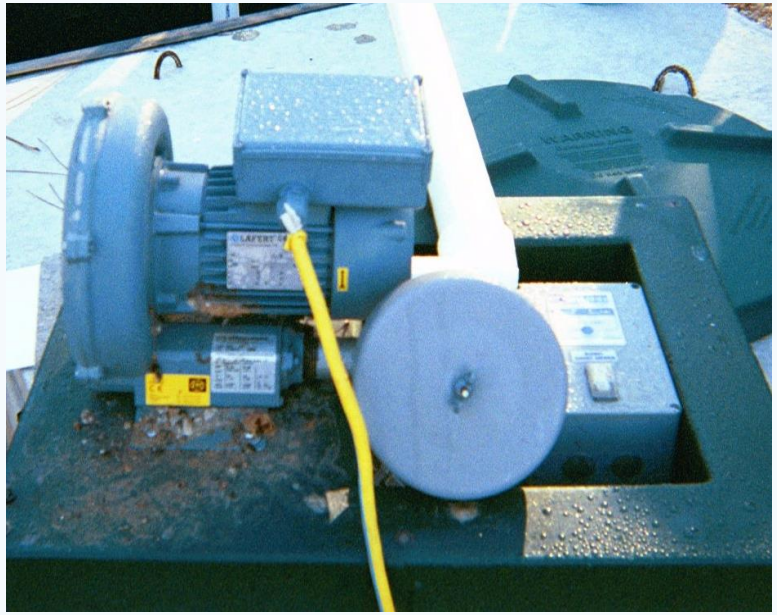
f. Lids in operable condition

4. Venting/Air supply

a. Air supply method:

- ☐ Aspirator
- ☐ Aerator
- ☐ Compressor
- ☐ Blower
- ☐ Free Air



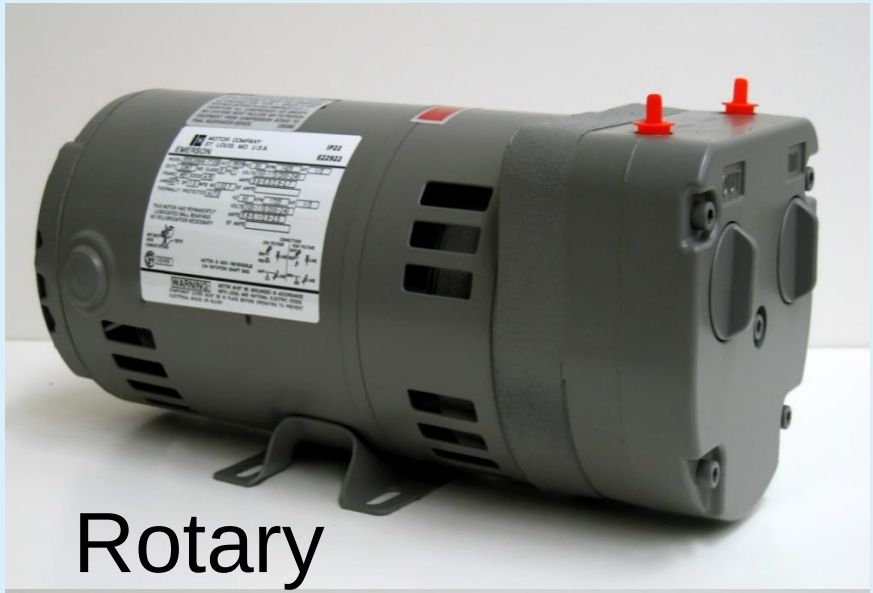


Unacceptable

Aspirator/Aerator

- Vacuum pulls air into the water
- Spinning shaft or impeller causes the vacuum
- Check air flow
- Remove aerator
- Clean shaft

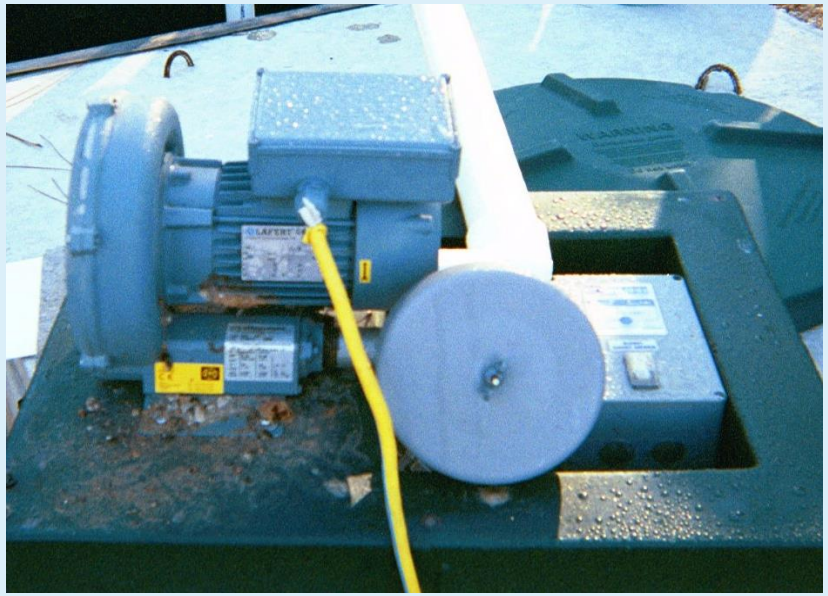
Compressors



Rotary

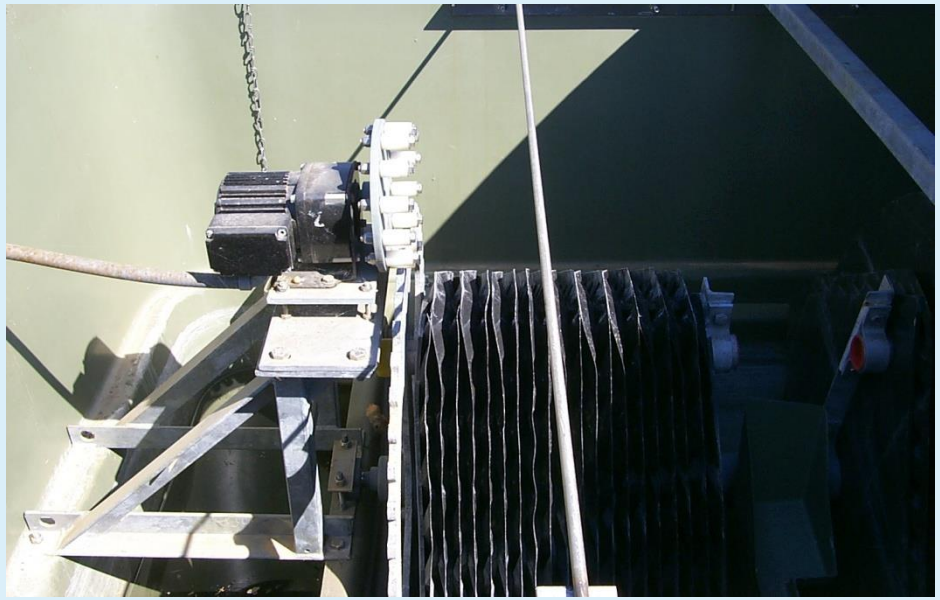
Linear

- Greater pressure
- Lower air flow
- Two distinct types of compressors
  - Rotary
  - Linear
- Listen for operation
- Check operating pressure
- Clean filters
- Rebuild or replace as necessary



Blowers

- Lower pressure
- Greater air flow
- Check inlet screens/filters
- Air flow discharge from unit



Free Air

- Media sequentially rotates through air space in top of unit and the effluent in the tank.
- Atmospheric oxygen diffuses into the effluent
- Check air vent for proper air exchange
- Roof vent provides “chimney effect” for air draw

4. Venting/Air supply (cont.)

b. Operation:

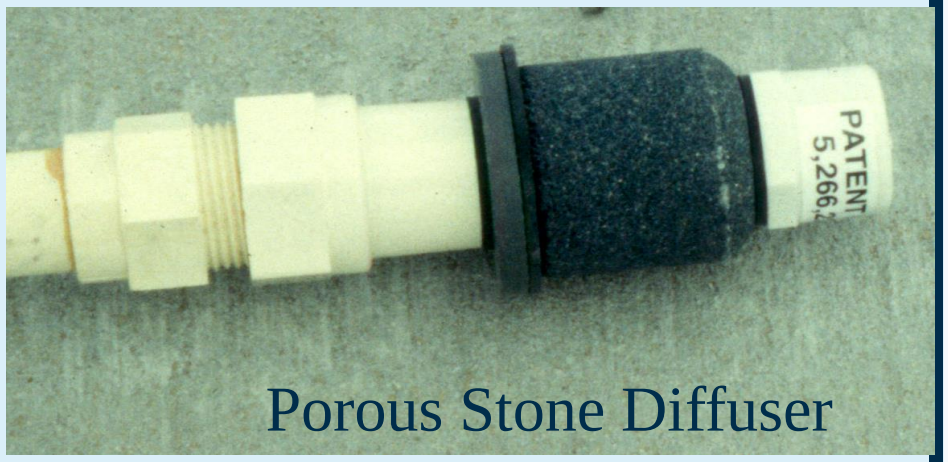
☐ Continuous

☐ Timed

ETM reading: _____

c. Air supply unit operating properly?

Perforated Pipe



Porous Stone Diffuser

Air Supply

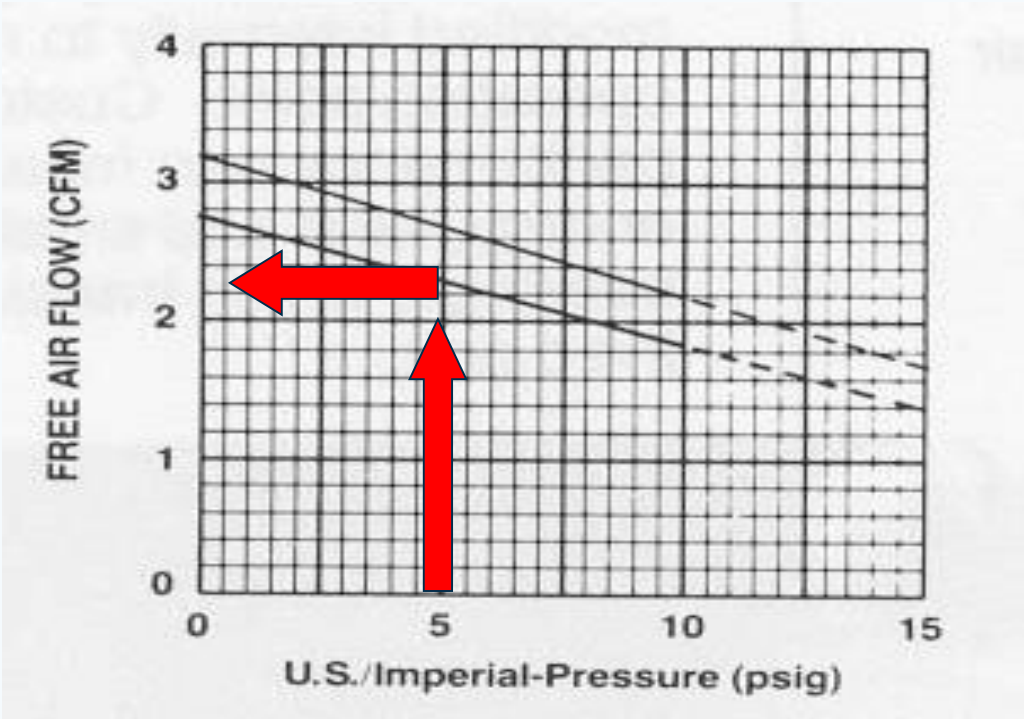
- Supply lines
- Dispersion methods
  - Holes
  - Slots
  - Porous material
- Potential for plugging in the orifices that could reduce air flow

4. Venting/Air supply (cont.)

d. Pressure at air supply unit:

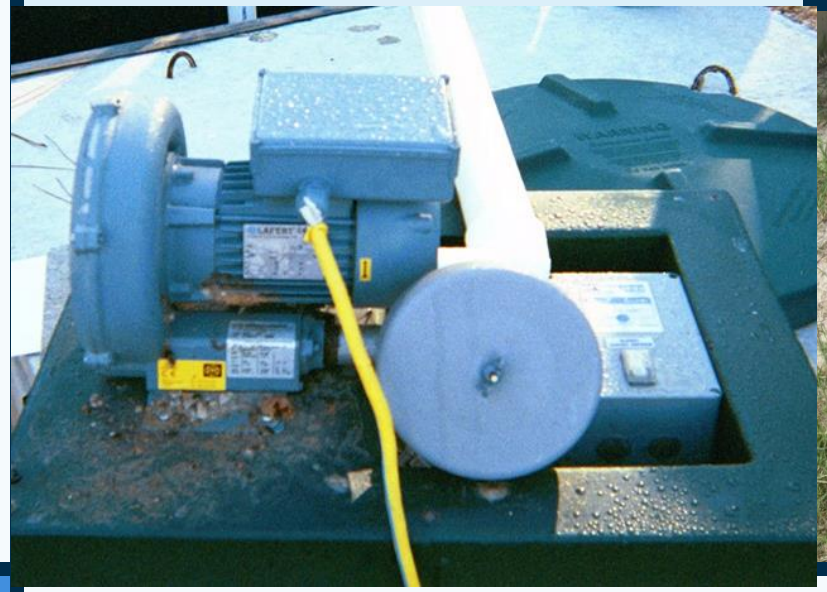
- Where measured
  - Pressure gauge
  - Schrader valve
- What should it be?
  - Flow pressure curve
- How to read it

Schrader valve



4. Venting/Air supply (cont.)

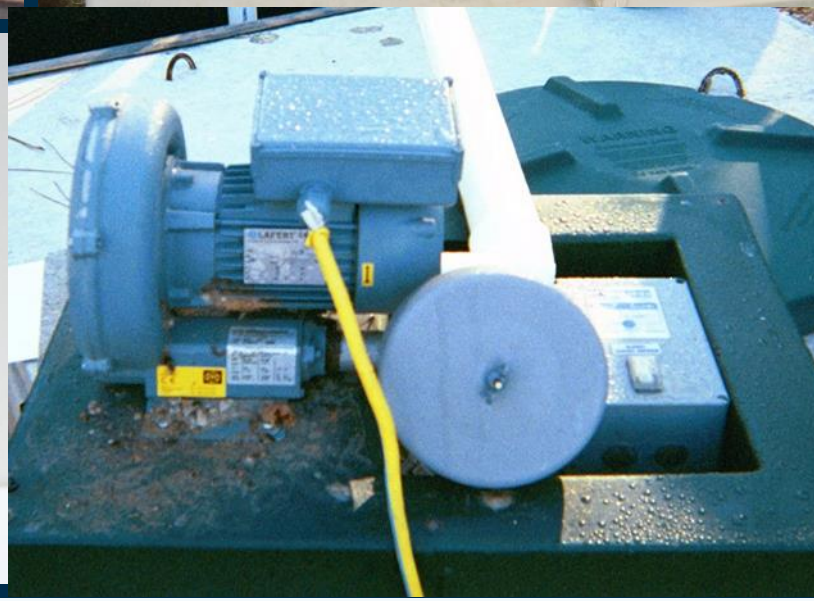
e. Air flow at air supply unit:
   - Measured at the air supply unit
   - Positive pressure
     - *Compressor*
     - *Blower*
   - Vacuum
     - *Aspirator*



4. Venting/Air supply (cont.)

f. Air filter/screen:

- Cleaned
  - *Washed/Dried*
- Replaced
  - *Every Time*
  - *Yearly*
- Filter Locations
- Internal



4. Venting/Air supply (cont.)

g. Venting appears operable

- Air entering system
- Air must exit somewhere
  - Unit
  - House vent
  - Biofilter

5. Aeration chamber

a. Mixing in aeration chamber
   - *Rolling motion*

b. DO in aeration chamber
   - *>2 mg/L*

c. pH in aeration chamber
   - *7.0*

d. Aeration chamber temperature
   - *68 to 75^{o} F*

Collect sample from aeration chamber and measure parameters

5. Aeration chamber (cont.)

e. Settleability test

30 Minute Test

- Beaker with 10 even gradations
- Sample from aeration chamber.
- Let stand for 30 minutes
- Read level of clear zone.

• 20% to 60% is ok.

5. Aeration chamber (cont.)

f. Biomass color in aeration chamber

- Clear
- Brown
- Black

g. Sludge pumping recommended

6. Additional tasks for submerged attached/fixed film media evaluation

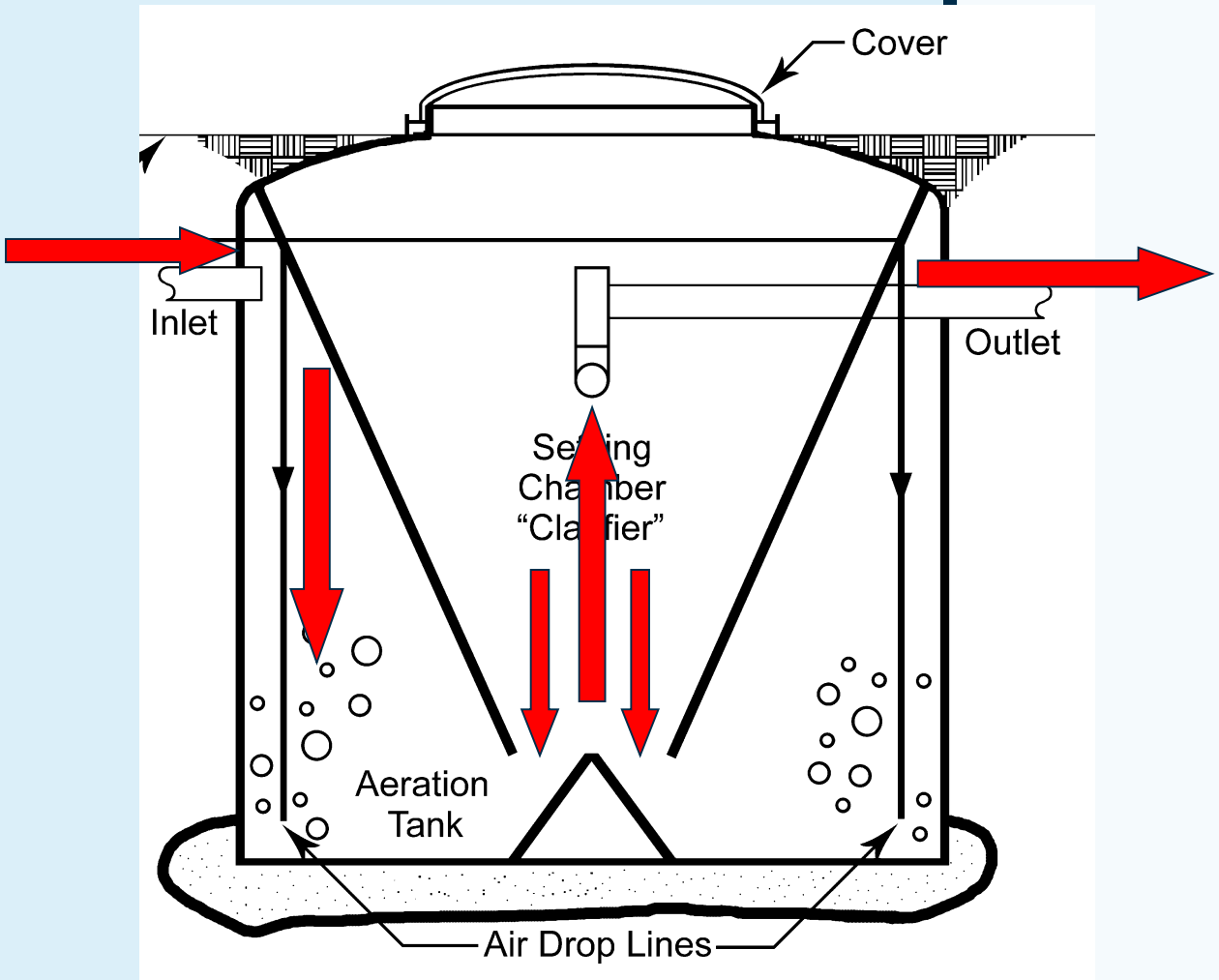
a. Media plugging

b. Media floating

c. Media washed
   - Air
   - Water

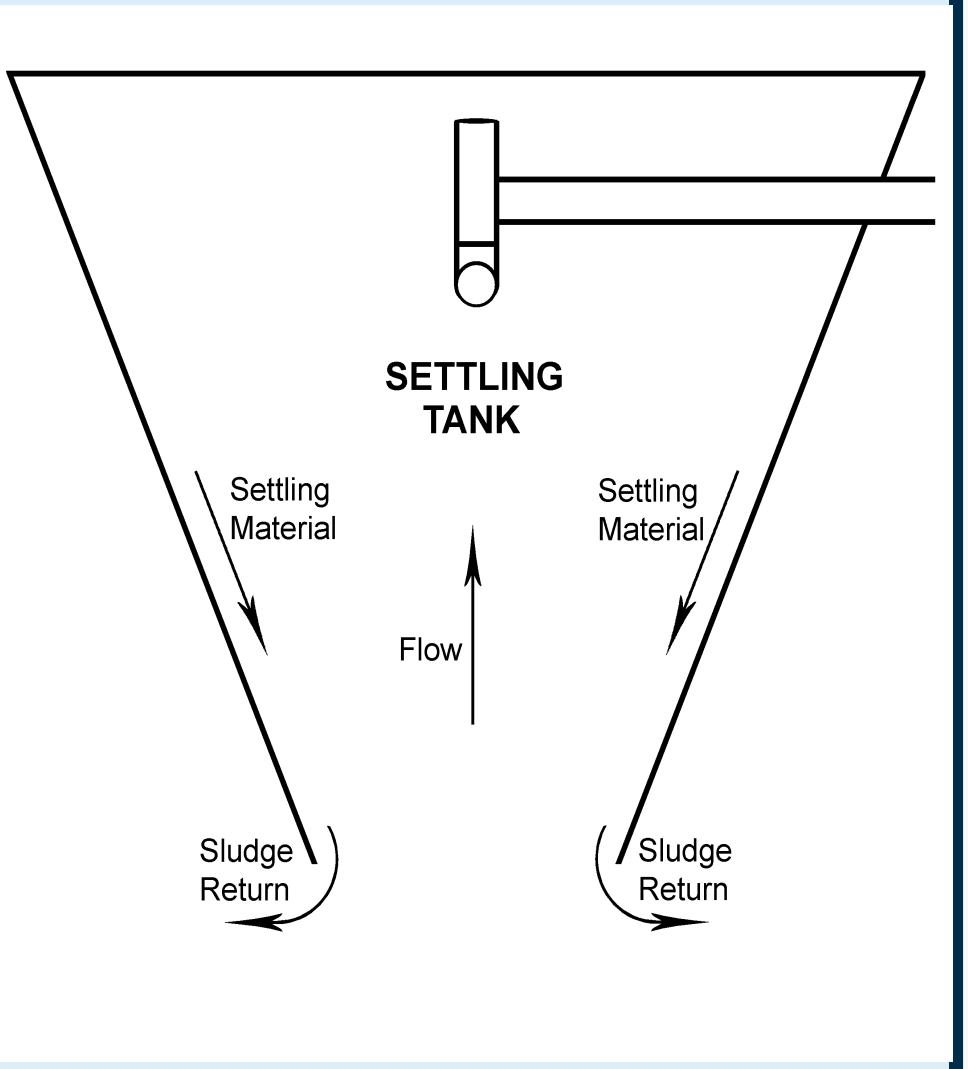
d. Media replaced

7. Clarification chamber



- Clarification is the process where the microbes, cell waste and biomass settle out of the water.
- “Normal” condition: Solids blanket in the bottom and a clear zone below the discharge point

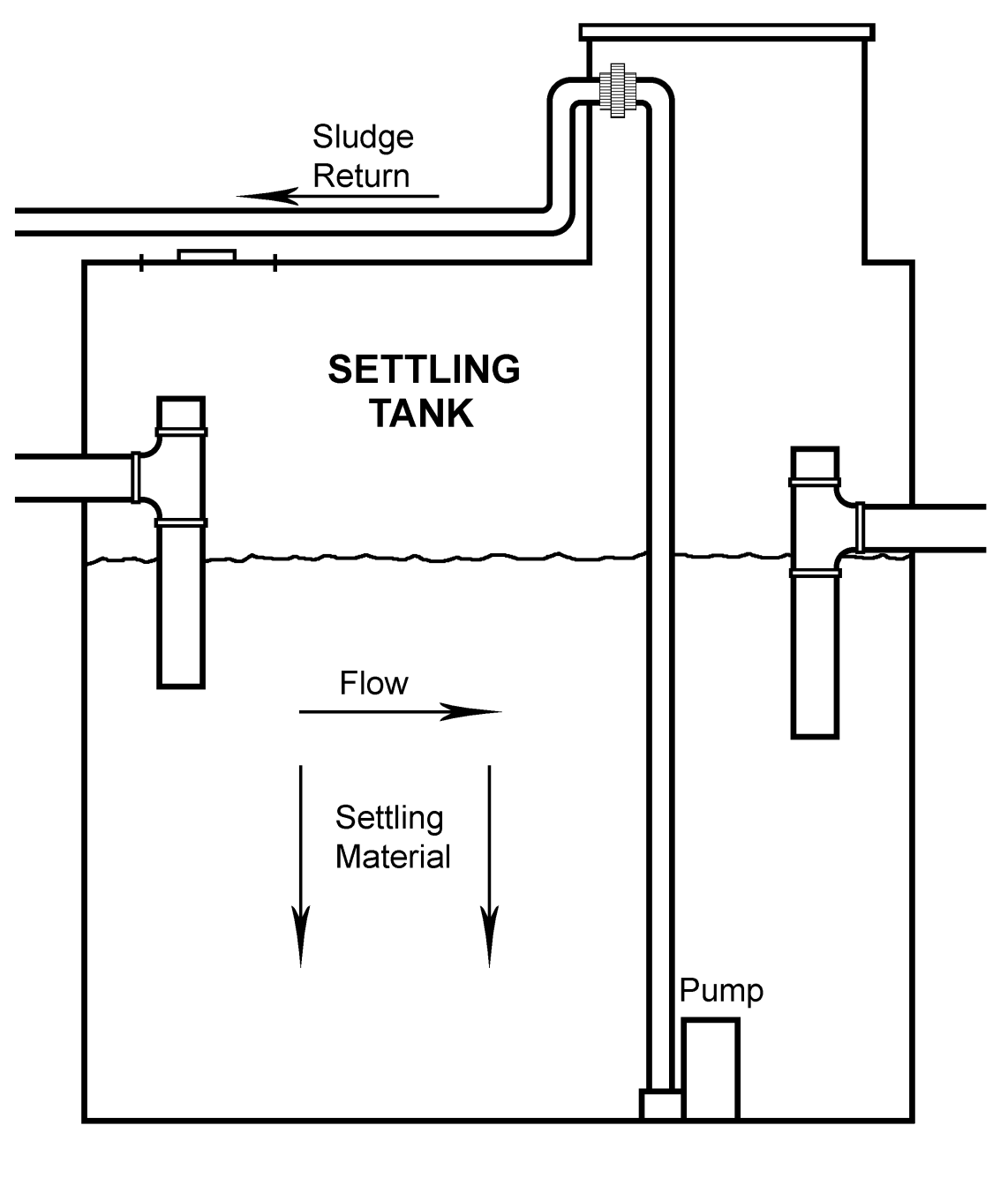
Vertical Clarifier



- Vertical upward flow through the chamber
- Upward flow rate must be less than the settling rate for good solids separation.

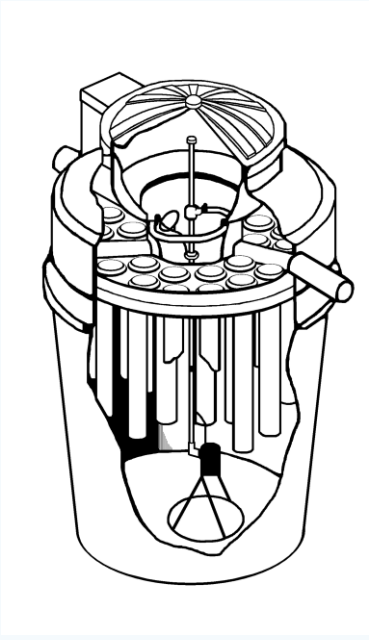
Horizontal Clarifier

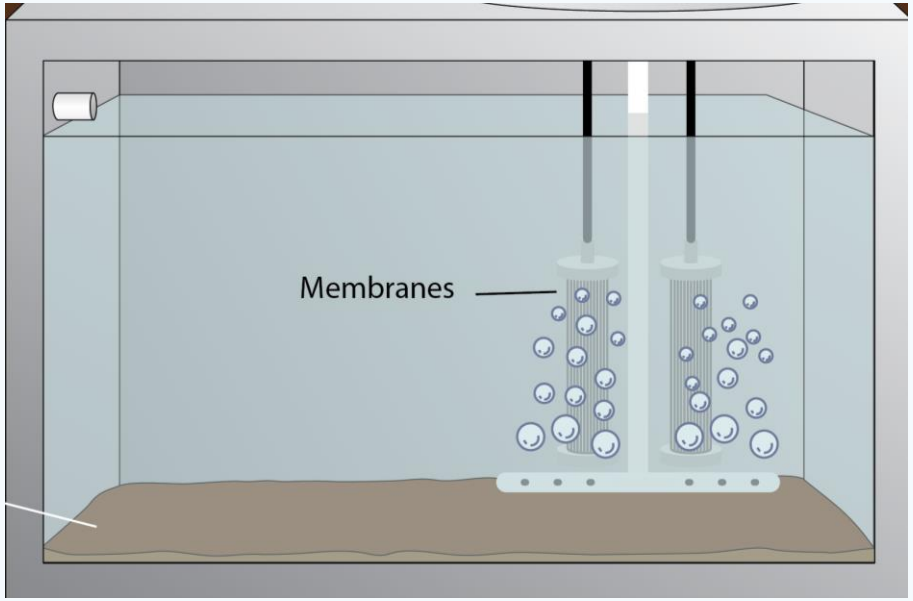
- Horizontal flow through the chamber
- Particles must settle below flow line



Clarification via liquid filtration

- Particulate filtration in suspended growth configurations using
  - Socks
  - Membranes





7. Clarification chamber (cont.)

a. Scum Layer

b. Clear zone depth below outlet

c. Effluent screen/tertiary filter cleaned

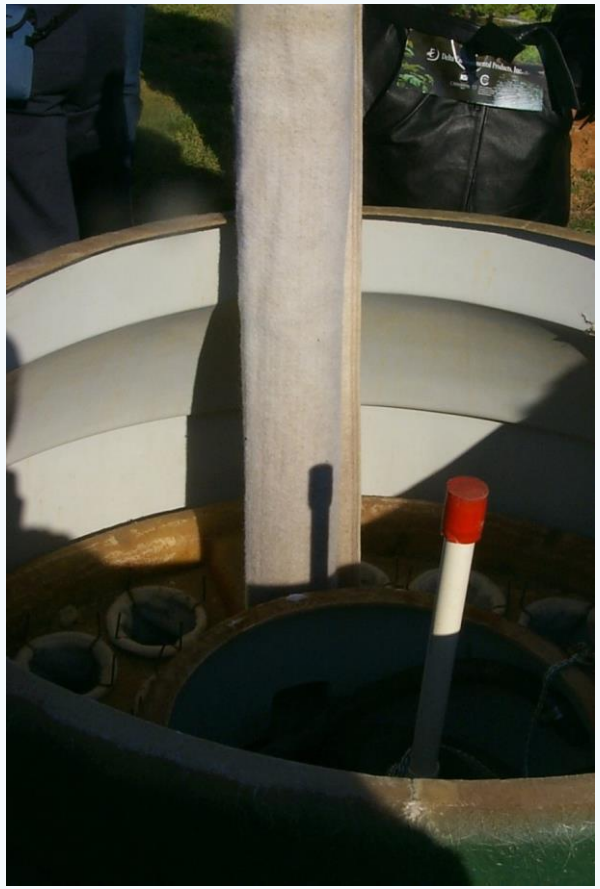
d. DO in clarifier
   - > 2.0 mg/L

e. pH in clarifier
   - 6.8 to 7.5

7. Clarification chamber (cont.)

f. Temperature in clarifier
g. Effluent odor after passing through unit:
   - None
   - Mild
   - Strong
h. Effluent color after passing through unit:
   - Clear
   - Brown
   - Black
i. Effluent turbidity

j. Tasks for liquid filtration units



- Socks
  - Clean-in-place: air or liquid washing
  - Remove, wash, possible chlorine treatment, air dry and replace

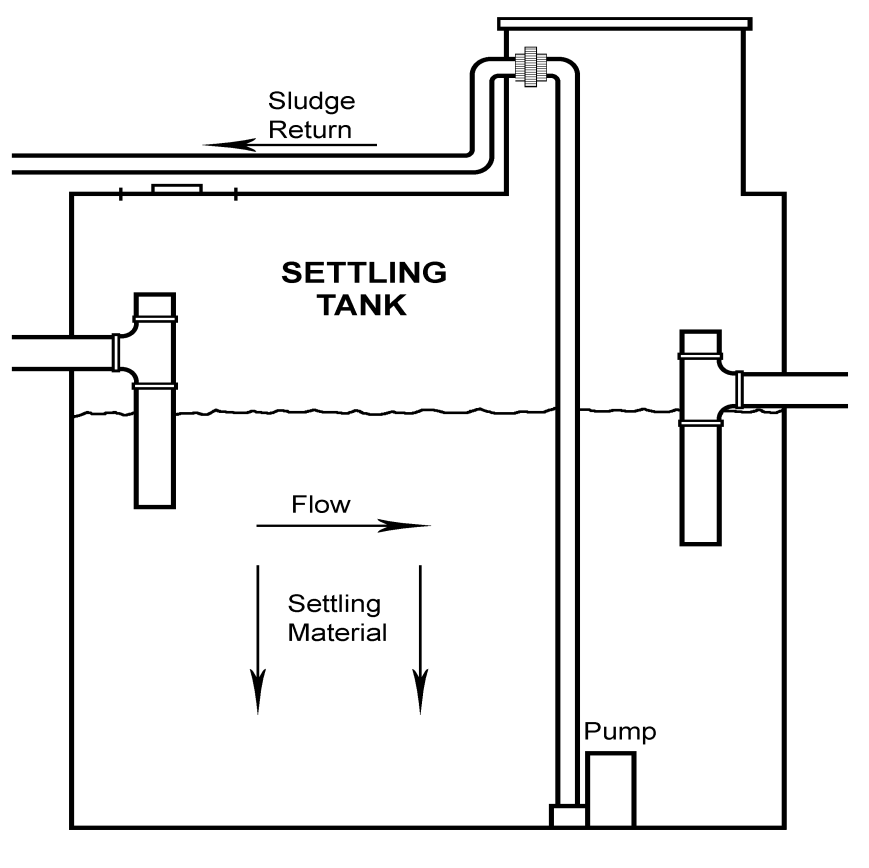
j. Tasks for liquid filtration units

- Membranes
  - Clean in place: backwash, chemical oxidation of organics
  - Remove, wash, chemical treatment for accumulated solids or inorganic scale

8. Sludge return operating

- Settled solids sent back to a previous treatment chamber
- Passive system
  - Settled solids pass through the bottom opening and back to the aeration chamber
- Active system
  - Settled solids blanket below the outlet baffle

8. Sludge return operating (cont.)



Note method for sludge return

- Passive
- Active

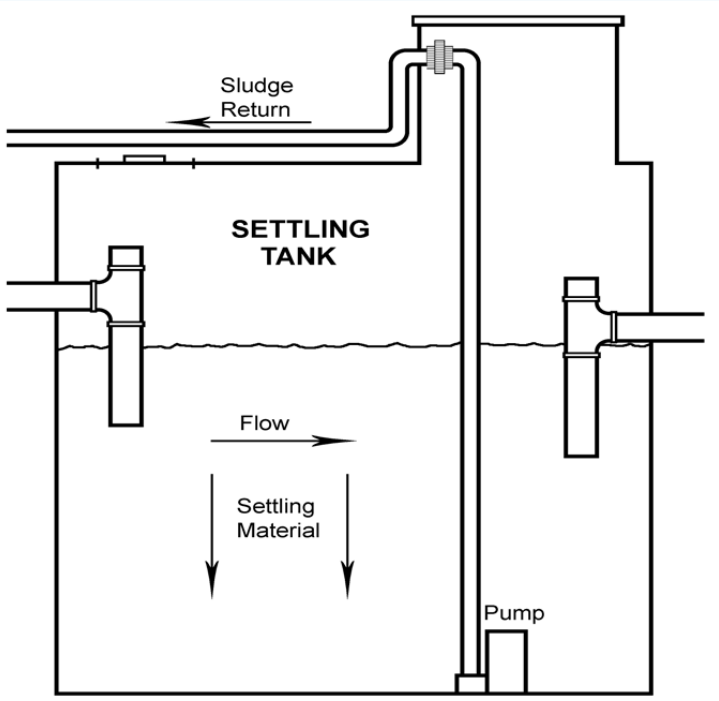
a. If active, pump was checked manually

b. Pump operating properly

9. Integral pumps

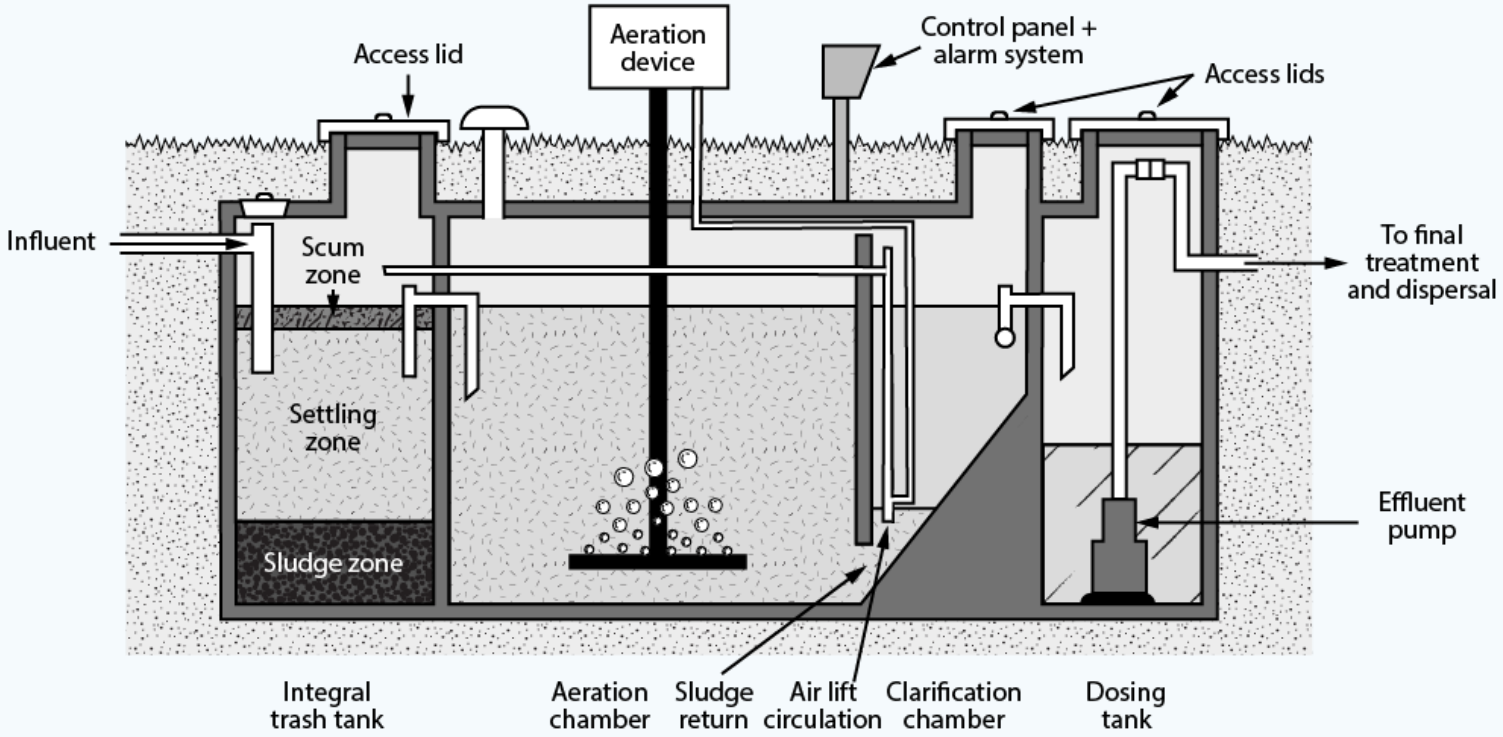
a. Type of integral pump and purpose

- ☐ Centrifugal
- ☐ Air lift



9. Integral pumps

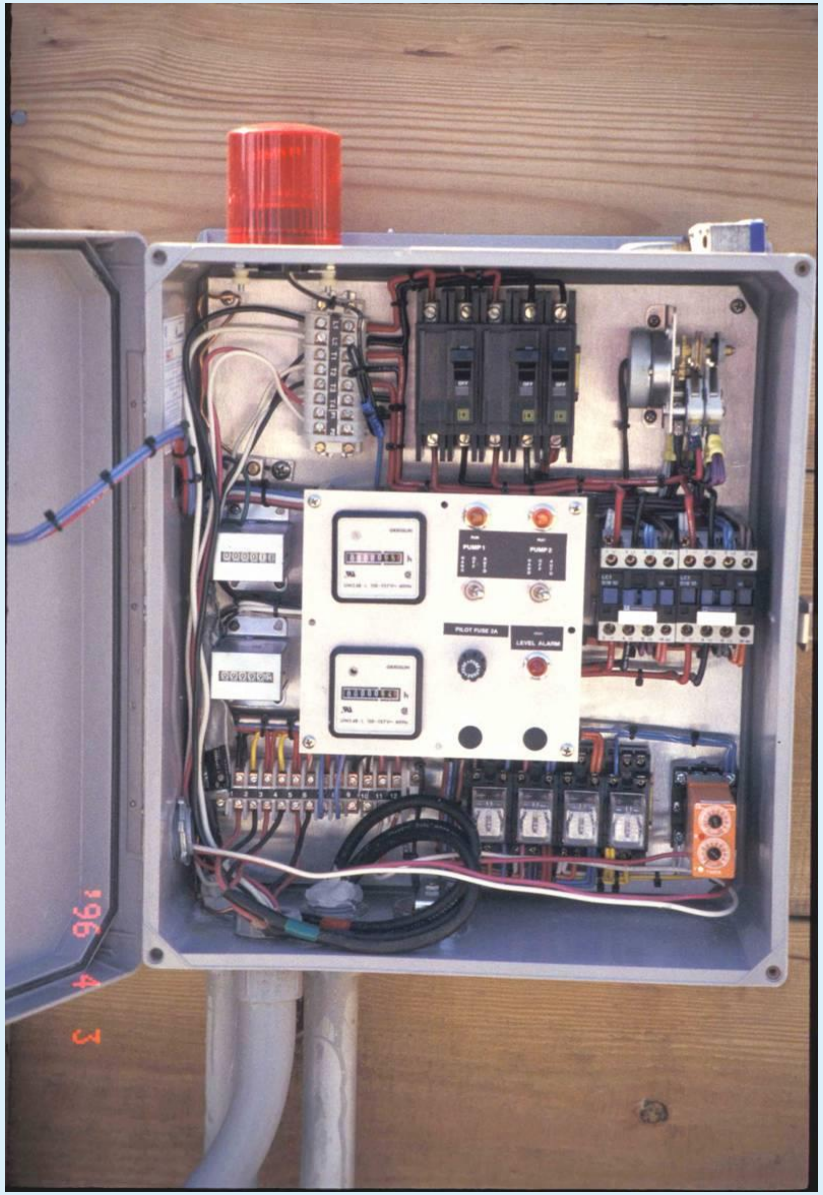
b. Pump operating properly



9. Integral pumps

c. Timer settings changed

d. Air flow rate changed (air lift pumps)



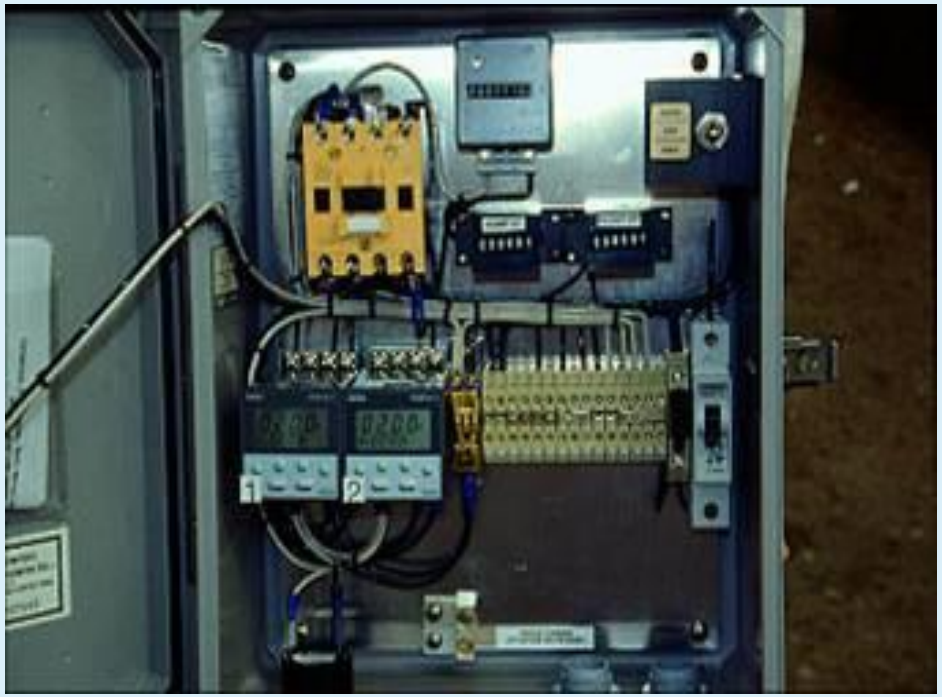
10. Control panel

N.A. Creative retrofit??

a. Controls operating properly

b. Enclosure water- and gas-tight

c. Alarm test switch operating properly



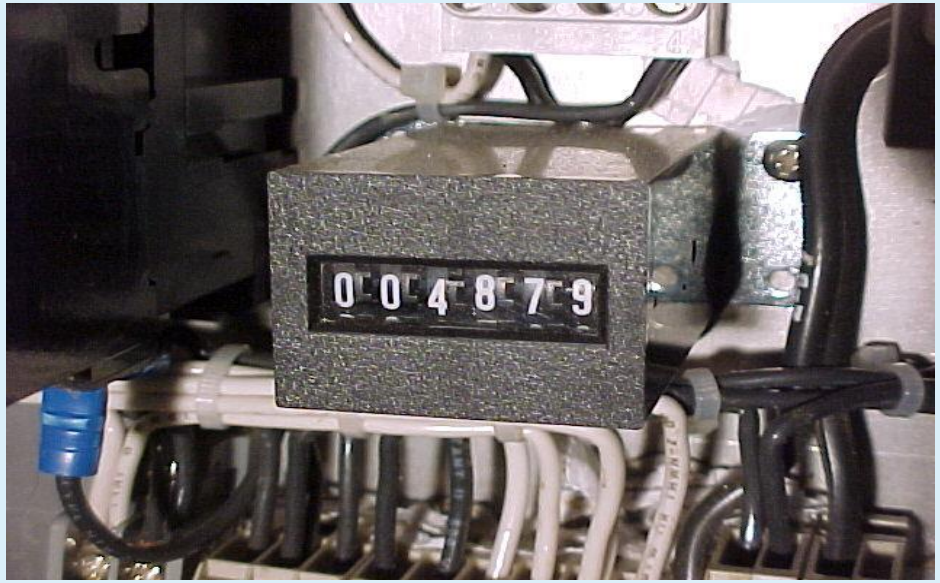
10. Control panel (cont.)

d. At time of inspection, control switch was set to:
   - N.A.
   - Hand/Manual
   - Auto

e. If auto, setting:
   - Time on (min)
   - Time off (min)

f. Telemetry operational

11. Alarm(s)



a. Alarm(s) present

Types:

- High water
- Air pressure
- Remote

b. Alarms operating

c. Alarm readings

- Cycle counter

d. Battery backup charged

e. Telemetry operational

12. Manufacturer's required maintenance performed

- Generally, manufacturers have specified maintenance for their proprietary products.
- Check with the manufacturer of the specific product for additional activities.
- Perform the additional specified operation and maintenance procedures.
- Document performance of the activities.
- *Be sure to utilize only approved replacement parts.*

13. Lab samples collected for monitoring

- Constituent monitoring
  - Regulatory requirements
  - Manufacturer requirements
  - Designer O&M requirements
- Collect, transport and store samples using standard procedures.
- Utilize approved laboratory for sample analysis
- Coordinate sample submission with lab schedule
- Report information to proper entities

Summary

- Five targets for operational evaluation of ATUs
  - Trash removal / Anaerobic treatment
  - Aeration chamber (and media, if present)
  - Air supply
  - Clarification
  - Sludge return
- Routine maintenance activities

QUESTIONS?

Instructor's Contact information here