Aerobic Systems and Flocculation

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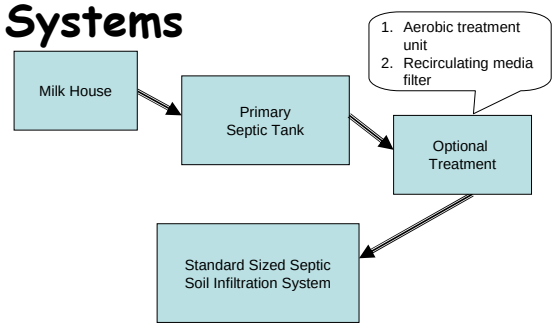
Minnesota's only research university

Learner Outcomes

- Understand basic concepts behind aerobic treatment units (ATUs), recirculating media filters (RMFs) and flocculation systems
- Able to communicate design information to vendors
- Able to size soil infiltration areas

Schematic of Aerobic Systems



Septic Tank Sizing for Primary Treatment

Largest of

- 3 days hydraulic retention time (HRT)
- Bulk tank volume
- 1000 gallons

Aerobic Treatment Units (ATUs)

- Aerobic (oxygen loving) bacteria break down organic matter
- Less organic loading of soil infiltration area
- Pumps, blowers or venturi systems add oxygen (air) to wastewater in a tank
- Support media provides location for aerobic bacteria to attach

ATUs continued

- Used before for domestic waste and restaurant applications
- Wastewater with more organic loading (BOD_5)
  - Requires more oxygen to break down organic matter
  - Produces more new cells
- Goal is BOD_5 less than 200 mg/L

Effective oxygen transfer is critical

Little bubbles **Big bubbles**

Small bubbles have more surface area per unit volume of air for oxygen transfer than big bubbles.

Nibbler Unit

- 3600 gallons of ATU capacity
- 1.5 HP blower
- Designed to remove ≈ 3.0 kg of BOD_5/day

FAST® Units

- 2700 gallon of ATU capacity
- 1.5 HP blower
- Designed to remove ≈ 2.7 kg of BOD_5/day

SludgeHammer®
(formerly Pirana)

Stall Barns
- 1000 gallons of ATU capacity
- Two 0.1 HP blowers
- Designed to remove 1.4 to 2.7 kg BOD_5/day

Parlors
- 3000 gallons of ATU capacity
- Three 0.1 HP blowers

Recirculating Media Filter (RMF)

- Wastewater recirculates through media 5 to 10 times
- Bacteria on fixed film growth media break down organic matter
- Pump and timer control recirculating rate

DYNO2 Installations

ATU Outcomes

- Milk house wastewater is high strength
- Average BOD_5 at output varied from 90 to 1370 mg/L with inputs from 500 to 2650 mg/L
- Temperature was not an issue
- pH was not an issue
- Power use was an issue

ATU and RMF Design Information for Vendors

- Wastewater strength - BOD_5 organic loading rate (mg/L)
- Daily wastewater flow rate (gal/day)

Infiltration Area

- More than 2 ft separation from trench bottom to bed rock or water table*
- 100 ft setback from wells
- 50 ft setback from water bodies

* No toilet wastes

Infiltration Area

- Level trench base
- Can be terraced
- Gravel trench or chamber distribution system

Infiltration Area Loading Rates

Soil Texture	Loading Rates (gpd/ft^2)
Coarse sand medium or loamy sand	1.20
Loamy sand, fine sand, sandy loam or loam	0.59
Silt loam, silt, clay loam, sandy clay or silty clay	0.45
Clay, sandy or silty clay	0.24

Case 1 – Find septic tank size

Given

- 60 cow herd
- 1,500 gallon bulk tank
- Infiltration area soil is sandy loam

1) Find daily flow rate
2) 60 cows * 5 gpd/cow = 300 gpd
3) Find 3 d HRT
4) 300 gpd * 3 d = 900 gal
5) Select bulk tank = 1,500 gallon, size of bulk tank

Case 1 – Find infiltration area

Given
- 60 cow herd
- 1,500 gallon bulk tank
- Infiltration area soil is sandy loam

1) Find daily flow rate
2) 60 cows * 5 gpd/cow
   = 300 gpd
3) Select loading rate from table
   = 0.59 gpd/ft^2
4) Infiltration area
   = $\frac{300 \text{ gpd}}{0.59 \text{ gpd/ft}^2}$
   = 508 ft^2

Case 2 – Find septic tank size

Given
- 100 cow herd
- 1,500 gallon bulk tank
- Infiltration area soil is loamy sand

1) Find daily flow rate
2) 100 cows * 5 gpd/cow
   = 500 gpd
3) Find 3 d HRT
4) 500 gpd * 3 d
   = 1,500 gal
5) Select bulk tank = 1,500 gallon

Case 2 – Find infiltration area

Given
- 100 cow herd
- 1,500 gallon bulk tank
- Infiltration area soil is sandy loam

1) Find daily flow rate
2) 100 cows * 5 gpd/cow
   = 500 gpd
3) Select loading rate from table
   = 1.20 gpd/ft^2
4) Infiltration area
   = $\frac{500 \text{ gpd}}{1.20 \text{ gpd/ft}^2}$
   = 417 ft^2

Infiltration area with multiple terraced distribution trenches

Installation

- Trained professionals
- Follow manufacturers recommendations
- Avoid smearing or compacting infiltration area

Management & Maintenance

- Manage wastewater volume and strength – no waste milk!
- Consider maintenance agreement
- Pumps run 24/7, monitor & maintain
- Pump tanks at least annually

Flocculation

- Chemical treatment unit
- Sludge (settled solids) handled with solid manure
- Effluent
  - sent to soil infiltration area
  - BOD_5 goal < 200 mg/L

Hydrated Lime Flocculator

- Accumulate wastewater in 175 gallon fiberglass tank
- Add hydrated lime (3 cups), ferric sulfate and polymer and mix
- Suspended solids and dissolved materials precipitate and settle to bottom in a sludge layer

Flocculation Continued

- Sludge discharged to barn cleaner
- Effluent discharged to a 10 ft x 60 ft drain field
- Housed in building
- Requires rerouting of plumbing
- Chemical use and storage

Questions?

Visit www.manure.umn.edu and click on Milk House Waste

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