Milk House Wastewater
Bark Bed Design

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Introduction
- Photos of sites
- Operation principles/goals
- Most of this covered already in introduction

Design Steps
- Daily Flow and Septic Tanks
- Infiltration Area Sizing
- Pipe Layout
- Bark requirements
- Pump flow rate
- Pipe sizing and pressure loss
- Pump selection

Daily Flow
- Five gallons per cow per day
- Monitor water usage
- Flow meter photo

Septic Tanks
- 6-day HRT minimum
- Sized equal or greater than the bulk tank volume to hold waste milk
- Typically more than one tank

Effluent Filter
- Between 2nd tank and pump tank
- Filters larger particles that get through tanks.
Bulk Tank Failure
- Forgot to plug bulk tank
- Treated milk entered tank
- Must “dump” the milk
- Pump the tanks
- Drain the bulk tank
- Pump the tanks

Pump Tank
- Bark beds require pressure distribution
- Pump tank volume is not included in the overall 6-day HRT
- Pump tank volume is maximum of 1-day HRT or 500 gallons

Schematic of Systems

Case Farm #1 Flow Rate
- 60 Cow dairy
- Flow rate of 5 gallon/cow/day
- 60 cows x 5 gpc/d = 300 gpd

Case Farm #1 Tank Sizes
- Use maximum of 1000 gallons, bulk tank size, or 6-day HRT
- Bulk tank is 800 gallons
- 6-day HRT is 1800 gallons
- Multiple tanks
  - 2 - 900 gallon tanks = 1800
  - But since most common tank is 1000 gallon use 2 - 1000 gallon tanks

Case Farm #1 Pump Tank
- Pump tank is 500 gallon minimum or 1-day HRT
- For case farm #1 use 500 gallon tank

Most likely design
Infiltration Area

- Noncompacted area
- Natural soils
- Constructed with zero slope
- Scarify Surface
- 2’ to water table

Infiltration Area Sizing

- Loading Rate (gallons per square foot or g/ft²) is a function of
  - soil type
  - Organic Loading
- For our systems we use an organic load of 750 mg/L and assume this concentration after 2nd septic tank.
- See Table 2 in Design Guide

Case Farm #1 Area

- 300 gpd flow
- Loam soil Loading rate is 0.12 g/ft²

\[
\text{Area} = \frac{300 \text{ gpd}}{0.12 \text{ g/ft}^2} = 2500 \text{ ft}^2
\]

Layout and Piping

- Effective width of distribution pipe is 10 ft
- Maximum bed width is 3 distribution pipes or 30 feet

Definitions

- Main Pipe: Pipe from pump tank to manifold or distribution lines
- Manifold: Pipe between main line and distribution pipe when multiple distribution pipes are used
- Distribution Pipe: Pipe with holes for distributing effluent
- Distribution Section: Section of distribution pipe with single flow direction

Standard Distribution Pipe

- Laid on gravel spreader or
- Hung in chambers
Standard Distribution Pipe

- ¼ inch holes with 4 or 5 ft spacing (max 5 ft)
- Begin and end spacing with ends of pipe
- Calculate number of holes
  - Bed length divided by hole spacing then subtract one ...
  - Pipe length divided by hole spacing then add one

Question

- Available site is 16 feet wide.
- Question? Can you have one distribution pipe and count the infiltration area as 16 feet wide?

Hole Spacing (OSTP)

<table>
<thead>
<tr>
<th>Perforation Spacing ft</th>
<th>Pipe Diameter</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 inch</td>
</tr>
<tr>
<td>2.5</td>
<td>8</td>
</tr>
<tr>
<td>3.0</td>
<td>8</td>
</tr>
<tr>
<td>3.3</td>
<td>7</td>
</tr>
<tr>
<td>4.0</td>
<td>7</td>
</tr>
<tr>
<td>5.0</td>
<td>6</td>
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</tbody>
</table>

Distribution Pipe

- Maximum number of holes from manifold to end of pipe is 22 (think flow distance from manifold or main line)
- Center manifold allows for longer bark beds
- Keep lateral sections the same length and same elevation

Case Farm #1 (End)

- Bark bed is 125 ft x 20 ft
- Distribution pipe is 115 ft
- Use hole spacing of 5 feet
- # holes is 24 for end manifold

Case Farm #1 (Center)

- Bark bed is 125 ft x 20 ft
- Distribution pipe is 115 ft
- Use hole spacing of 5 feet
- # holes is 12 per distribution section
- Total per distribution pipe is 24
Bark or Wood Chip Media
- 24 inch minimum cover over top of infiltration area to
  - Protect soil surface
  - Insulate infiltration area
  - Allow good oxygen transfer to soil

Case Farm #1
- Bed area of 20 x 125 or 2500 ft²
- Bed depth is 24 inches
- 10% additional for wastage

\[ Volume = 2500 \text{ ft}^2 \times \frac{24 \text{ in}}{12 \text{ in/ft} \times 1.1} = 5500 \text{ ft}^3 \]

About 200 cubic yards

Pump Sizing
- Function of pressure and flow requirements of system
- Flow is in units of gallons per minute (gpm)
- Pressure is in units of pounds per square inch (psi) or more commonly feet of water column (ft H₂O or ft)

System Flow Rate
- System flow is the sum of flow from each hole at the design pressure
- For \( \frac{3}{4} \) inch holes at 2 feet of pressure the flow is 1.04 gpm
- Therefore, multiply the number of holes by 1.04 gpm to get the total system flow rate
Case Farm #1 Flow Rate

- 2 lateral lines
- 24 holes per line (12 per section)

\[ \text{Flow Rate} = 48 \text{ holes} \times 1.04 \text{ gpm} = 50 \text{ gpm} \]

System Pressure Requirements

- Pressure required to pump to a higher elevation (ft)
- Pressure lost due to pipe friction
  - Flow rate
  - Pipe diameter
  - Flow distance
  - Pipe connections
- Required system pressure is 5 ft H₂O

Diagram

1) Elevation loss
2) Friction loss: pipe diameter, flow rate, and distance
3) Effluent distribution = 5 ft

Pipe Friction Loss

- Supply line is 2 or 3 inch with selection based on friction loss
- Friction loss per unit length is function of pipe diameter and flow rate (see Table 1)

Table 1. Pipe Friction Loss

<table>
<thead>
<tr>
<th>Nominal Pipe Diameter</th>
<th>Flow (gpm)</th>
<th>2 inch</th>
<th>3 inch</th>
</tr>
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<tbody>
<tr>
<td>14</td>
<td>0.20</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>0.45</td>
<td>0.18</td>
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</tr>
<tr>
<td>16</td>
<td>1.13</td>
<td>0.55</td>
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</tr>
<tr>
<td>17</td>
<td>2.00</td>
<td>0.75</td>
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</tr>
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<td>18</td>
<td>3.00</td>
<td>1.00</td>
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<td>2.00</td>
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<td>2.25</td>
<td></td>
</tr>
<tr>
<td>24</td>
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<td></td>
</tr>
<tr>
<td>25</td>
<td>10.00</td>
<td>2.75</td>
<td></td>
</tr>
</tbody>
</table>

Manifold and Distribution

- If manifold pipe is larger than main line then negligible friction loss
- No additional friction losses in distribution pipe due to loss in flow along pipe
Case Farm #1 Pressure
- Elevation = 8 feet
- Pipe Friction = ???

Case Farm #1 Pressure
- Elevation = 8 ft H2O
- Pipe Friction = 6 + 1.5 = 7.5 ft H2O
- Distribution = 5 ft H2O
- Total = 20.5 ft H2O

Case Farm #1 Pressure
- 150 feet of main line
  - 2 inch pipe requires 3.99 ft/100 ft or 6 ft H2O
  - 3-inch pipe requires 0.58 ft/100 ft or 0.75 ft H2O
- Additional friction for pipe connections is 25% or 1.5 ft minimum
  - 6 x 0.25 = 1.5
  - 0.75 x 0.25 = 0.2

Pump Selection
- System pressure requirements (total head)
- System flow rate (gpm)
- Also, install pump a minimum of 6 inches off the bottom of the tank to reduce solids being pumped to infiltration area.

Pump Curve
- Case Farm #1 Pump Curve
  - 50 gpm and 18 ft head
Completed Bark Beds

Design Information
- Number of Cows?
- Water use
  - # washings and water use per washing
    - Milk system
    - Bulk tank
  - Other water
    - Laundry
    - Feeding
    - Cleaning

Note: Asking about water usage stresses the importance of paying attention to what goes into the system.

Design Information
- Parlor wash?
- Sand bedding?
- Where does waste milk go?
- What happens when bulk tanks need dumping?
- Expansion planned?
- System changes planned?

Design Information
- Soils Map
- Elevations at tank location and infiltration area
- Location and Elevation of existing drain lines
- Quality of existing lines?
- Distances between milk house and tank, tank and infiltration area
- Underground water lines, electric lines, etc

Excavation
- Safety
- Accurate Elevations
  - Drainback is critical

Excavation
- Trenches dug at 1.5% - 2% slope
- All finished pipe slopes at 1%
- Infiltration area is FLAT
Plumbing
- Connections and soil settling

Installation
- Electrical

Questions??