Milk House Wastewater Treatment System Design Workshop

David Schmidt and Kevin Janni
Bioproducts & Biosystems Engineering
University of Minnesota

Minnesota's only research university

Acknowledgements

- US Environmental Protection Agency (EPA) 319 grant funds
- Minnesota Pollution Control Agency (MPCA)
- University of Minnesota Extension
- Natural Resources Conservation Service (NRCS)
- Soil and Water Conservation Districts (SWCD) - Carver, Wright, Winona, Goodhue
- County Environmental Services Staff

- Watershed Districts
  - Bevens Creek
  - Crow Wing
- Private Companies
  - Bongoard's Creamery
  - Bio-microbics
  - NCS Wastewater Solutions
  - SludgeHammer Group, Ltd.
- Sixteen cooperating dairy producers

Learner Outcomes

- Be able to select and design a milk house wastewater treatment system
- Understand critical design, installation and management issues.
- Other?

Agenda

- 319 Project overview
- Milk house wastewater characteristics
- Introduction to select systems
- Bark bed systems
- Aerobic & flocculation treatment
- Irrigation systems
- Dosing systems
- System selection & economics

Questions? Comments?
In the beginning - Fall 2000

• Blue Earth County farm visits
• Carver County Joint Agency Task Force

Available information

• Treatment and Disposal of Milkhous and Milking Parlor Wastes (1985)
• Pollution Control Guide for Milking Center Wastewater Management (1995)
• Guideline for Milking Center Wastewater (1998)

319 Project Objectives

• Identify effective techniques and systems to reduce pollution potential
• Design and install 16 milk house wastewater treatment systems
• Monitor and evaluate
• Disseminate the results

There Is No Single Ideal Design

Every Design Involves Trade-offs

Milk House Wastewater Storage Options

• Storage
  - Daily haul
  - Short term
  - Long term

Milk House Wastewater Treatment Options

• Treatment
  - Septic tanks
    • Settling solids
    • Floating scum
  - Aerobic
    • Aerobic treatment units
    • Recirculating media filters
  - Flocculation
  - Constructed wetland
Milk House Wastewater Discharge Options

- Discharge clean water
- Subsurface infiltration
  - Drain fields
- Surface land application
  - Crop, pasture or wooded land
  - Grassy filter strip
  - Terraced ridge/furrow areas
  - Bark beds

Systems Evaluated

- Bark beds
- Aerobic treatment
  - Aerobic treatment units (ATU)
  - Recirculating media filter (RMF)
- Irrigation to pasture or cropland
- All systems had primary septic tanks

Schematic of Systems Evaluated

- Milk House
- Septic Tank
- Optional Treatment
- Soil Infiltration Area

Milk House Wastewater Flows and Characteristics

Research based design values.
Milk House Wastewater Flows and Characteristics

- Wastewater flow rate
  - gallons per day per cow
- Biochemical oxygen demand (BOD$_5$)
  - milligrams per liter (mg/L)
- Total Nitrogen & Phosphorus
  - mg/L or pounds per 1000 gallons (lbs/1000 gal)

Wastewater Flow Rates

- Install water meters
- Subtract water for
  - Feeding calves (ex. milk replacer)
  - Washing farm equipment
  - Filling sprayer tanks
- 9 to 22 months of data
- Two months data recommended for design

Water use

Milk house wastewater contains:

- Residual milk
- Wash water, cleaning chemicals, detergents and acid rinse
- Manure and organic matter
- Bacteria
- Nutrients - nitrogen and phosphorus
- Soil & solids

Milk House Wastewater Sampling

- Sampled first septic tank after milk house
- Sampled outlet end or middle
- Analysis
  - BOD$_5$ and COD
  - Total suspended solids
  - Fats, oil and grease (FOG)
  - Total phosphorus
  - Ammonia
  - Total Kjeldahl nitrogen (TKN)

BOD$_5$
**Wastewater Design Values**

**TABLE 1. Milk house wastewater characteristics**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Average Milkhouse Value* (mg/L)</th>
<th>Average Home Value (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD₅</td>
<td>1218</td>
<td>750</td>
</tr>
<tr>
<td>TSS</td>
<td>350</td>
<td>240</td>
</tr>
<tr>
<td>Fat, Oils, and Grease</td>
<td>230</td>
<td></td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>0.5 (0.16)</td>
<td>1 (0.4)</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td>1.5 (0.46)</td>
<td>2 (0.46)</td>
</tr>
</tbody>
</table>

*Average values based on 5 gpd/cow and not recommended for design purposes.

- 0.84 lb Phosphorus per cow per year
- 15 lbs BOD₅ per cow per year

**System Restrictions**

- Small amounts of residual milk
  - Milk has BOD₅ of 100,000 mg/L (Loehr, 1974)
- Systems cannot handle
  - Colostrum from fresh or treated cows
  - Bulk tank failures or waste milk
- No human toilet wastes

**Management**

- Producers can manage milk house wastewater volume and strength
- Systems are not designed to treat waste milk!
- Maintenance is critical for long term performance!
- Annual septic tank agitation and pumping expected

- 81
- 20
Observations

- Higher BOD₅ levels than grab samples
- Farm yard surprises
- Crud clogs filters
- Lots of hair
- Bulk tank failure & waste milk procedures

Questions?

Visit [www.manure.umn.edu](http://www.manure.umn.edu) and click on Milk House Waste

Bioproducts and Biosystems Engineering
University of Minnesota