Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

WASTEWATER TREATMENT, MILK HOUSE

CODE 627

(no)

DEFINITION

The physical, mechanical, and biological treatment of dairy milk house wastewater.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Improve water quality by reducing nutrients in surface and ground water
- Improve air quality by reducing odors

CONDITIONS WHERE PRACTICE APPLIES

This practice presents a conservation alternative that applies to milking operations where milk house wastewater is generated. Milk house wastewater is the greywater from the cleaning of milking equipment.

This practice does not apply to treatment of large quantities of waste whole milk, which should be pumped directly to a liquid waste storage structure.

This practice does not apply to human waste or backwash from a water softener.

CRITERIA

General Criteria Applicable to All Purposes

Treatment system performance and capacity

Design the capacity of the milk house wastewater treatment system to treat the milk house greywater collected at the maximum daily volume of wastewater produced. Ensure the wastewater treatment system design can handle the specific total solids and nutrient content of the waste stream.

Laws and regulations

Plan, design, and construct the milk house wastewater treatment system to meet all Federal, State, Tribal, and local laws and regulations that can affect the installation, placement, and use of the milk house wastewater treatment system.

Location

Locate and design the waste treatment system such that it is outside the 100-year floodplain unless site restrictions require locating it within the floodplain. If located in the floodplain, protect the facility from inundation or damage from a 25-year flood event. Additionally, follow the policy found in the NRCS General Manual (GM) (Title 190), Subpart B, Section 410.25, “Flood Plain Management,” which may require providing additional protection for milk house wastewater treatment components located within the floodplain.

Collection of milk house wastewater
Design sump traps, grates, and screens in the milk house to remove solids from collected wastewater. Minimize milk solids and fat content of the wastewater by diverting waste milk and emergency spills of the milk supply away from the collected wastewater.

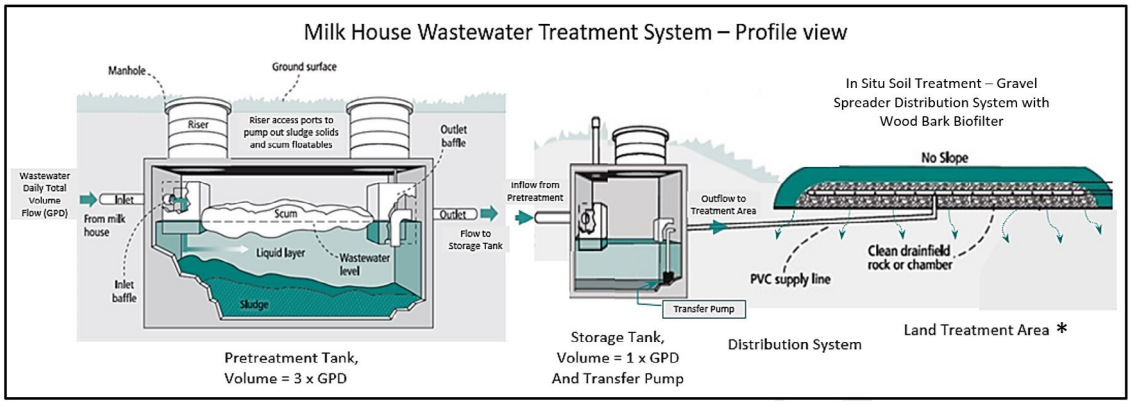
Wastewater characteristics
Ensure the wastewater treatment system design can handle the specific total solids and nutrient content of the waste stream.

Design components
The milk house wastewater treatment system consists of five components. Components 1 through 4 listed below are required on all systems. Component 5, the final treatment, has options for implementation based on the site conditions and management alternatives. Example shown in figure 1.

1. Pretreatment tank component, reduces the total solids and nutrient content of the inflow up to 50 percent by clarifying the wastewater. The pretreatment tank design requires a specific hydraulic retention time to reduce the solids content by settling separation, and the detergents, fat, oil, and grease (FOG) content by flotation separation.
2. Storage tank for the clarified wastewater after pretreatment.
3. Transfer component, typically a pump system to distribute the stored pretreated wastewater.
4. A distribution system to uniformly apply the wastewater to the final wastewater treatment component.
5. A final wastewater treatment component that processes the nutrient content and utilizes the wastewater. Based on the site conditions, different strategies can be used for the final wastewater treatment component.
    - Onsite Soil Wastewater Treatment Component.—Used where the natural surface soil microbial population treats the wastewater and is referred to as the “land treatment area.” Sites must have a sufficient depth of unsaturated soil, appropriate ground slope, adequate treatment area, and no ground water quality risks.
    - Soilless Media Wastewater Treatment.—Where a treatment system is designed and constructed to process the wastewater with soilless media. The wastewater is then utilized after the wastewater final treatment component. This strategy is for sites that have resource concerns of soil quality, ground water quality, or both. Example sites can be where the—
        - Ground water table is within 2 feet of the soil surface.
        - Site has less than 2 feet of soil over bedrock.
        - Site has soils that mobilize metal elements into soil water.
        - Site has high-risk karst topography and potential sink holes.
    - Associated conservation practice standards for vegetative treatment can be used as the final treatment component. The milk house wastewater treatment design includes the criteria for components 1 through 4, so in this case, the associated conservation practice is installed as component 5 for the final treatment component. Vegetative treatment practices are applied according to NRCS Conservation Practice Standard (CPS) Nutrient Management (Code 590), Vegetated Treatment Area (Code 635), or Constructed Wetland (Code 656).

Figure 1. Example of storage tank with submersible pump configuration. Pump is located a minimum of 6 inches off the bottom of the tank to avoid moving solids to the final wastewater treatment component. *In-situ soil land treatment area with biofilter.

(Figure from the University of Minnesota Extension publication M1207, with permission to use and modifiy as shown.)



Wastewater design volume

Wastewater treatment systems must be designed to meet the maximum daily volume of wastewater produced. When the maximum daily volume of wastewater produced is not known, flow meters can be used in gathering real-time data to determine the design volume. Use existing records of wastewater volume, a minimum of 2 months of collected flow meter data, or a minimum of 5 gallons per wet cow based on annual maximum, plus wash water required for all tanks and equipment.

Tank components

Evaluate the pretreatment and storage tank sites for the depth to seasonal high ground water or perched ground water conditions that would require special design considerations for tank buoyancy.

Locate pretreatment tank and storage tank at least 10 feet from any structure.

Use a State-approved prefabricated concrete, steel, or plastic septic tank, or a tank design that meets the materials and structural design requirements for ASTM C1227, “Standard Specification for Precast Concrete Septic Tanks.” Tanks must be designed to be watertight and buried below grade. Steel or plastic tanks must meet acceptable septic industry standards.

The following attributes are required on the milk house wastewater tank components:

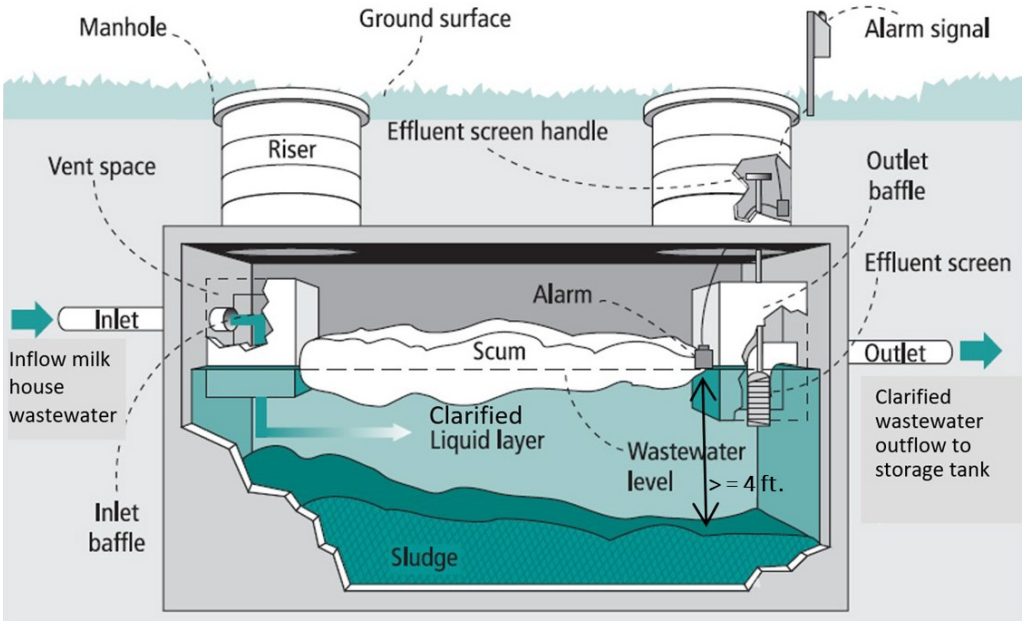
- Tank must be suitable for the site conditions. Site conditions include vehicular traffic loads, soil backfill loads, corrosion of wastewater, ground water floatation, and frost action.
- All riser joints, access openings, and pipe connections must be watertight.
- Install a sanitary trap or air gap ahead of the inlet of the pretreatment tank to prevent gases from flowing into the milk house from the pretreatment system.
- Specify baffles at both the inlet and outlet location on the pretreatment tank.
- Do not use a pretreatment tank with multiple compartments separated by a mid-tank baffle wall. Mid-tank walls cause turbulence flow preventing the clarification processes.
- Include a commercial size effluent screen or filter at the outflow of the pretreatment tank, prior to the storage tank and distribution pump, if required by pump manufacturer or distribution treatment system. Use a filter rated at two times the daily wastewater flow capacity (2 X volume wastewater, gpd). Commercial effluent filters with 1/16-inch wide slit type filter or 1/16-inch circular filter holes, or their equivalent have been found to work.
- Include a warning system in tanks to detect overfull conditions from solids and FOG buildup, clogged filter, or failed pump.
- Select tank manhole covers that aid safety and maintenance.

- In cold climates, install pretreatment and storage tanks with a minimum of 2 feet of soil cover over the top to protect from freezing, or insulate the top.
- Bury tanks with no more than 4 feet of soil cover at riser for tank cleanout equipment accessibility.

Pretreatment tank (Component 1)
The minimum hydraulic retention (storage) time for the wastewater pretreatment component to settle out the solids and float FOG out of suspension is 3 days. Design the minimum pretreatment tank volume for three times the daily volume of wastewater produced.

The clarified liquid design depth within the tank must be a minimum of 4 feet.

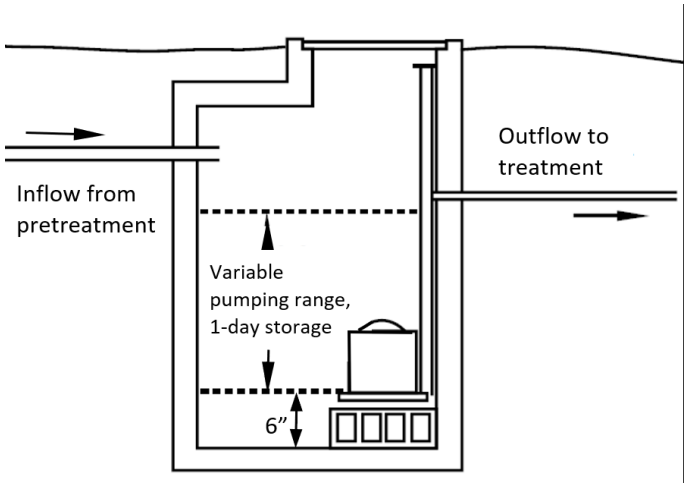
Figure 2. Example of pretreatment tank component configuration. (Figure from the University of Minnesota Extension publication M1207, with permission to use and modify as shown.)



Storage tank (Component 2)
Clarified wastewater from the pretreatment tank must be stored in the storage tank until final treatment. The storage tank volume supplies the wastewater for distribution to the final treatment component.

Size the storage tank for a minimum capacity of 1 day of the design volume of wastewater produced or 500 gallons, whichever is greater. Size the storage tank larger when the final treatment (component 5) needs a larger dosing capacity or multiday rest periods between wastewater application treatments.

Figure 3. Example of storage tank with submersible pump configuration. Pump is located a minimum of 6 inches off the bottom of the tank to avoid moving solids to the final wastewater treatment component.



Transfer component (Component 3)
The wastewater treatment transfer component design must include the slope and length of wastewater transfer pipeline. Use gravity flow where feasible only from the milking center to the pretreatment tank and pretreatment outflow to the storage tank. Uncontrolled gravity flow from the storage tank to the final wastewater treatment is not allowed.

For pressure systems, size pumps to transfer the wastewater to the distribution system for the final treatment component at the required pressure head and flow rate. The pressure requirements must include elevation change, transfer pipe pressure losses, and the required distribution pressure at the pipe holes plus a minimum of 2 feet of (water head) pressure at the end of the distribution pipeline.

Select a type of pump suitable for operating in the corrosive environmental conditions of milk house wastewater.

Locate pump intake a minimum of 6 inches off the bottom of the tank to avoid moving solids to the final wastewater treatment component.

Base the requirements for pump installation, anchoring, and connecting appurtenances on manufacturer's recommendations.

NRCS CPS Pumping Plant (Code 533) can be utilized.

For siphon-dosing systems, the system must transfer wastewater at the volume and rate as designed for the final treatment component.

Distribution system (Component 4)
Design the distribution pipe with pipe material intended for wastewater systems. Specify hole sizing and spacing as a function of pipe diameter, length, pumping pressure, and flow for uniform distribution to the final treatment. Specify valve and control equipment intended to be used in wastewater treatment.

Design the installation to be suitable for the weather conditions at the site. When an operation is planned for cold weather, install the piping system on a slope to drain back to the pump to prevent freezing (thus no check valve), settling of solids, or both in the pipelines. Systems using sprinkler heads in cold weather should drain back to the pump and have flexible nozzles.

Protect transfer and distribution pipes from freezing and damage by livestock or machinery.

NRCS CPS Waste Transfer (Code 634) can be utilized.

Final treatment (Component 5)
Locate the final wastewater treatment outside any established rights-of-way such as roads, legal drains, utilities, and pipelines. Table 1 lists setback distances required for identified landscape and physical features unless State, Tribal, or local rules and regulations require a larger separation distance.

Table 1. Minimum Setback Distance for Storage and Treatment Areas for Horizontal Isolation of Soil Water Flow.

Feature	Setback Distance (ft.)
Property line	10
Building foundation	20
Top of slope dropoff	20
Private well	50
Wetlands	50
Public water supply well	75
Surface water	100

Soils investigation for the final wastewater treatment component
Determine the size of the final wastewater treatment component of the selected wastewater treatment system. Perform the soil investigation outside the planned footprint area. Confirm the soil texture and depth to any seasonal high ground water or restrictive layers.

Vegetative treatment
If vegetative treatment is used for the final wastewater treatment component, require year-round plant growth. Vegetation must be dense to provide effective treatment. Use criteria from NRCS CPS Vegetated Treatment Area (Code 635) or Constructed Wetland (Code 656).

Additional Criteria for Onsite Soil (Component 5), Wastewater Treatment Process, Land Treatment Area
Locate treatment systems where favorable soil characteristics and geology exist for the dispersal, infiltration, and assimilation of wastewater. Select a site away from future grazing, manure spreading, animal traffic, or vehicle traffic.

A minimum separation distance of 2 feet is required between the wastewater application surface and any seasonal high ground water, perched ground water, impermeable soil, or bedrock.

The area required for the design of the final wastewater treatment component is based on the most restrictive organic loading rate for the site soil texture properties identified. See additional document for this practice: “Wastewater Treatment—Milk House, Worksheet: Sizing Land Treatment Area.”

Decommission or reroute existing drainage tile located within the land treatment area footprint, plus an offset of half the drainage tile spacing specified in the soil drainage guide, or follow the appropriate soil-specific State guidance for drainage tile separation beyond the land treatment area footprint. Drainage tile may be used in the land treatment area if it has been designed in a parallel system to the dispersal system so as to maximize the expected soil treatment process.

Exclude offsite surface water runoff from entering the land treatment area. Use NRCS CPS Diversion (Code 362) or Roof Runoff Structure (Code 558) to divert surface water away from the land treatment area.

Wastewater distribution systems for a land treatment area can include the following distribution component alternatives:

- Surface Application to a Land Treatment Area.—Distribution systems that include other design

features to meet the treatment application site criteria.

- Surface application on a land treatment area under a bark bed biofilter.
- Land treatment area dosing with wood chip biofilter.
- Gravel spreader surface infiltration area.
- Other designs that meet the treatment application criteria.

- Sprinkler Irrigation Area.—Match the application rate of sprinkler nozzles to the most restrictive soil infiltration rate to prevent wastewater discharging from the land treatment area. Ensure the wastewater is applied at agronomic rates for nutrient removal and meeting an approved comprehensive nutrient management plan.

Additional Criteria for Soilless Media (Component 5), Wastewater Treatment Process

The soilless media treatment processes can be used if site soils have inadequate unsaturated depth or are composed of chemicals containing arsenic or metals that become soluble with wastewater biological oxygen demand (BOD). Soilless media treatment systems incorporate an aerobic microbial treatment with imported media in a designed structure prior to final treated water infiltration or utilization. After the final treatment process, wastewater can be recycled for cleaning the holding area, transferred to storage, or infiltrated. The planning and design for a soilless media wastewater treatment system must include the final utilization steps for the treated wastewater.

Wastewater treatment systems may include any of the following alternatives:

- Aerobic Treatment Unit and Subsurface Absorption System.—Refer to “Milk House Waste, Aerobic Treatment Unit – A Milk House Wastewater Treatment Option” (Christopherson et al., 2007).
- Filter Mound.—Refer to “Design Guide: Michigan Filter Mound for Treating Milking Center Wastewater” (Michigan Livestock Wastewater Treatment Workgroup, 2012).
- Gravel Vertical Flow Contactor.—Refer to “Gravel Vertical Flow Contactor, Michigan (Pea) Gravel Contactor for Treating Milking Center Wastewater” (Michigan Livestock Wastewater Treatment Workgroup, 2018).

Other waste treatment systems must follow the criteria in NRCS CPS Waste Treatment (Code 629).

Additional Criteria for Reducing Odors

The wastewater pretreatment (component 1) decreases odor-related concerns. Use the criteria from NRCS CPS Air Filtration and Scrubbing (Code 371) where additional reduction of ammonia and volatile organic compounds (VOC) compounds evaporating from the wastewater are needed. Biofilters are typically a mixture of wood chips or wood shreds piled such that air moves passively through the filter. The natural microbial population on the carbon-sourced material will reduce odors of ammonia and VOC compounds evaporating from the wastewater.

CONSIDERATIONS

Consult with the landowner/operator for their consideration of the management and maintenance aspects of alternative treatment and distribution systems before selecting the system to be installed.

Consider the weather at the location where the wastewater distribution system will function to ensure year-round operations. Consider vehicle access, wind direction, proximity of streams and flood plains, and visibility.

For milk house wastewater facilities producing over 500 gallons per day of wastewater, consider a wastewater storage system better suited to economically treating large volumes of liquid waste.

Consider elevation and distance from various components to take advantage of gravity flow to tanks.

Consider the alternative types of tank manhole covers. Quick-release manhole covers accommodate easy access for maintenance. Lockable manhole covers prevent unwanted access.

If designing a land treatment area for component 5, consider a distribution system and treatment area layout that has a longer, narrower footprint. That layout can be more accessible for construction and maintenance.

Consider designing more than the minimum number of system treatment zones to add flexibility for maintenance and operational tasks. Vegetative treatment systems can require resting periods and management seasons for vegetation removal.

Consider including wastewater source production and management strategies to reduce solids and the organic loading rate on the wastewater treatment system.

Consider methods to separate sand and manure solids from parlor floor wash down, holding area, or influent drains collected. Scrape solids separated to main manure collection system.

Consider management alternatives for reducing waste milk collected in the milk house wastewater. Examples include—

- Diverting waste milk directly to the manure collection system.
- Collecting the first rinse water from milking equipment containing a higher quantity of milk and add it to the long-term manure storage.
- Feeding waste milk, the first rinse water, or both to farm animals that can utilize the residual milk nutrients.

Consider testing the milk house wastewater for organic strength (5-day biological oxygen demand (BOD_5)). Representative sampling of the wastewater BOD_5 can provide operating information to prevent pretreatment and treatment system overloading and wastewater treatment failure. Wastewater treatment system designs based on site-specific wastewater organic strength data will more likely meet the practice life.

Consider continued monitoring of a water supply flow meter to inform the dairy of potential management concerns about capacity. Milk house management adjustments may be needed, or adjustments in the wastewater treatment system operation and maintenance plan may be required to address capacity changes.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for waste treatment facilities according to the criteria of this standard and good engineering practices.

Prior to construction, instruct the contractor to locate all buried utilities applicable to the project area, including drainage tile and other structural measures. Plan the site construction to protect natural resources and accommodate existing utilities.

As a minimum, provide—

- Layout and installation details of livestock facilities, waste collection points, waste transfer components, and waste treatment and storage facilities, and with supporting documentation.
- Map showing the location of the final treatment areas if the treatment involves land spreading that is variable. The map should include the locations of any specified setback distances.
- Location of all inflow and discharge pipelines, pipeline materials, diameter, slope, and appurtenances.
- Required properties of any locally sourced materials such as sand or gravel used in the treatment processes.

- Details of structural support systems for all components of the treatment facility.
- Fencing and signage as appropriate for safety purposes.
- Required tests of the treated waste as appropriate for confirmation of treatment effectiveness.
- Other plans to manage the system, including a nutrient management plan for proper land application of byproducts if applicable.

OPERATION AND MAINTENANCE

Develop an operation and maintenance (O&M) plan for this practice. The O&M plan must meet the purpose of the practice, its intended life, safety requirements, and the treatment system criteria for the design. Maintenance of transfer equipment, pretreatment and storage tanks, pumps, distribution system, and treatment media will be required throughout the year and expected life of the practice.

Prepare operation guidelines as needed for the treatment system to prevent harsh chemicals, drain cleaners, pharmaceuticals, manure solids, or other inappropriate substances from entering the milk house wastewater drain. The guidelines can include, but are not limited to, management strategies for the milk house to reduce wastewater produced. Include a plan in the guidelines to manage emergency spills or unexpected waste milk disposal to ensure waste milk does not reach the wastewater treatment system.

Include instructions to monitor the pretreatment and storage tanks (weekly for the first 6 months) for separated solids and floating material. Check the space of clarified liquid of the pretreatment tank near the outlet for the required 4 feet of depth. Schedule cleanout of the sludge and scum if buildup is found to be more than 25 percent of the tank volume. Determine the schedule for regular tank clean-out, which could be monthly to annually. Determine a schedule for regular inspection and cleaning of filters or screens.

Limit vehicle and animal access on any wastewater land treatment area to avoid damage to the wastewater transfer and distribution system, equipment, and treatment area site soil surface. Vegetative treatment systems must plan for scheduled vegetation management and harvest.

REFERENCES

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