NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
WASTE TREATMENT
CODE 629
(No.)

DEFINITION

The use of unique or innovative mechanical, chemical or biological technologies that change the characteristics of manure and agricultural waste.

PURPOSE

To use manure and waste treatment facilities to improve water quality and air quality by:

- Reducing the nutrient content, organic strength, and/or pathogen levels of manure and agricultural waste.
- Reducing odors and gaseous emissions
- Facilitating desirable waste handling and storage
- Producing value added byproducts that facilitate manure and waste utilization.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where there is a need to implement waste treatment technologies that are not within the scope of other NRCS Conservation Practice Standards and that are sufficiently developed for incorporation into a manure or agricultural waste management system. This includes new or unique components or processes.

General Criteria Applicable to All Waste Treatment Purposes.

This practice does not apply to the treatment of waste milk, manure, or human waste.

All tanks shall meet the structural requirements for waste storage structures found in Practice Standard 313, Waste Storage Facility. Tanks shall be installed with a minimum of 2 feet of soil cover over the top to protect from freezing.

Pipelines shall be designed to avoid freezing.

The treatment system shall be located a minimum of 25 feet from drainage tile.

A sanitary trap is required to prevent gasses from flowing into the milking center from the treatment system.

All riser joints, access openings, and pipe connections shall be installed watertight.

Laws and Regulations. Ensure that the manure and waste treatment facilities and processes are planned, designed, and constructed to meet all federal, state, and local laws and regulations. State and national laws, rules, and regulations shall be as interpreted by the Minnesota Pollution Control Agency (MPCA). This standard does not contain the text of the federal, state, or local laws, rules or regulations.

Utilities. Locate all buried utilities in the project area including drainage tile and other structural measures.

Design. The waste treatment technology provider shall complete and supply to the land owner/operator a detailed design of the facility/process clearly identifying the objectives and anticipated outcomes of implementation.

When the planned technology involves a system or process include in the design documentation a process diagram containing, at a minimum, the following information:

1. Volumetric flow rates including influent, effluent, and recycle streams.

2. Waste load projections including volume, mass, and characteristics of the waste important to the waste treatment facility or process.

3. Unit process volumes and hydraulic retention times where appropriate.

4. Air emissions projections from the system.

5. Nutrient fate projections within the system.

6. Process monitoring and control system requirements as described below in the Monitoring section of the criteria.

It is the responsibility of the technology provider to furnish information from a university or other independent research entity to document the effectiveness of the technology to achieve its intended purpose. Provide independent, verifiable data demonstrating results of the use of the facility or process in other similar situations and locations. If available document the effectiveness of the technology under different climatic factors. Documentation from peer reviewed journals is preferable. Where use of a waste treatment facility or process to improve one resource concern negatively impacts another, impacts and mitigation measures, if required by state or local agencies, are to be documented.

Components. Waste treatment facilities and processes may consist of multiple components. Where criteria for individual components are described in existing NRCS practice standards, use those practice standards and their specific criteria for planning, designing, and installation of that component.

Where components of a facility or process are not described in a current NRCS practice standard, the system provider shall furnish a minimum one year warranty on all construction, equipment, and applied processes.

Expected System Performance. Clearly document the expected system performance prior to system installation. At a minimum, document all expected system volumetric flow rates, macro-nutrient reductions or changes in form, expected pathogen reductions, gaseous ammonia and hydrogen sulfide emissions reductions (or increases).

Operating Costs. The system provider shall furnish an annual estimate of operating costs and the time, labor, energy, and equipment requirements for each waste treatment component of the waste management system and on the operation cost or savings the waste treatment component will have on the waste management system as a whole. Identify as estimates the operating costs not based on actual data. Adequately document the anticipated operation cost or savings of the waste treatment component on the entire system.

Monitoring. Install as a part of the system equipment needed to properly monitor and control the waste treatment facility or process. Identify the process control parameters to be monitored in the design documentation. Identify parameters considered critical to proper system operation in the Operation and Maintenance (O&M) Plan. Monitor critical equipment status and unit processes.

Byproducts. Implementation of a waste treatment process or operation of a waste treatment facility shall not result in discharge of byproducts harmful to the environment.

Handle and store all byproducts in such a manner as to prevent nuisances to neighbors or to the public at large.

The land application of byproducts to supply plant nutrients must meet the criteria in NRCS Conservation Practice Standard 590, Nutrient Management.

Handle and dispose of any unmarketable or unused byproducts in accordance with all applicable federal, state, and local laws and regulations. A plan for dealing with such byproducts shall be prepared and approved prior to utilization of the process or installation of the waste treatment facility, and shall include a listing of any permits or permissions required for the execution of the plan.

Recycle the waste treatment byproducts to the extent possible without causing a hazard to the environment.

Safety. Include the design of the process or facility safety features to minimize hazards. Provide guards and shields for moving parts of the equipment used in the treatment process. Fence waste treatment facilities and post warning signs where needed to prevent children and others from entering a hazardous area.

Carry out all treatment processes in accordance with all safety regulations. Wear protective clothing when handling potentially harmful chemicals that may be used in the process. Provide proper ventilation.

General Criteria Applicable to Milking Center Wastewater.

This practice applies to the treatment of milking center wastewater generated from the cleaning of empty milking lines and tanks and to the liquid portion of milk parlor wash water. It applies for facilities not permitted under current MN NPDES permit.

CRITERIA

The following criteria establishes minimum allowable limits for design parameters, acceptable installation processes, or performance requirements.

Treatment Systems. Treatment systems covered under this standard are:

1. Chemical Batch Reactor. Milking center wastewater only.
2. Bark bed. Milking center wastewater only.
3. Aeration and Media Filtration. Milking center wastewater only.
4. Irrigation. Milking center wastewater and liquid portion of milk parlor wash water.
5. Vegetated Treatment Dosing System. Milking center wastewater and liquid portion of milk parlor wash water.

1. Chemical Batch Reactor.

   Milk Parlor Wastewater may be treated using a chemical batch reactor system utilizing coagulation and flocculation. Independent, verifiable data demonstrating results of the use of the facility or process in other similar situations and locations shall be provided. This data shall show that the effluent BOD_5 from the reactor shall be 200 mg/l or less.

   Discharge from the reactor system shall be to an in ground infiltration/filtration system. This in ground infiltration/filtration system shall meet the requirements of the reactor supplier and follow Minnesota Rules Chapter 7080.

2. Bark Bed.

   Bark bed is a flat soil infiltration area covered with 18 – 24 inches of bark or wood shreds. Effluent is distributed to the soil infiltration area through a pressure distribution system

   Bark beds shall be designed and constructed as recommended by the most recent “Milk House Wastewater Design Guide” published by the University of Minnesota. Additional specific criteria is as follows.

   Soils Investigation. A soils investigation shall be made at the proposed infiltration area. The USDA Soil Texture designation shall be recorded for all soil horizons to a minimum depth of 3 feet or bedrock, whichever comes first. A suitable number of investigations shall be made to describe the soils at the proposed site.

   Primary Treatment. Wastewater shall be pretreated in two septic tanks. The septic tanks shall meet the requirements of Minnesota Rules Chapter 7080. Each tank shall be sized for a minimum of 3-day Hydraulic Retention Time (HRT) or the volume of the bulk tank, whichever is greater. The HRT is computed based on the gallons per day of wastewater to be treated.

   HRT (days) = Tank Volume (gal)/Flow Rate (gpd)

   Infiltration Area.

   Infiltration area shall be level.

   All surface water shall be excluded from the infiltration area.

Distribution System. A pump pressurized distribution system shall be used to uniformly distribute the wastewater to the infiltration area. Transfer pipe shall have a minimum diameter of 2 inches and be free draining with a minimum slope of 1%. Pump sizing shall result in a minimum velocity of 2 feet per second through the pipe. The pump tank/sump shall be sized for a 1 day HRT or 500 gallons, which ever is greater.

Distribution of the effluent in the infiltration area can be done in two ways.

a. Gravel Bed (Spreader). Pressure distribution pipes can be laid on top of gravel beds placed on the undisturbed or tilled infiltration area. Gravel should be 1 ½ - 2 ½ inch washed stone with <5% passing the No. 200 sieve. Gravel beds should be 8 – 10 inches high and a minimum of 5 ft. wide. Bed and pipe shall be covered with a geotextile fabric to slow the plugging of the gravel by the bark.

b. Chamber System. Pressure distribution pipes suspended from the top of manufactured septic chambers. Chambers are placed directly on top of the undisturbed or tilled infiltration area surface.

Spacing between pressure distribution pipes shall be 10 feet and bark should extend a minimum of 5 feet on either side of the distribution lines. Hole sizing and spacing of these distribution pipes is a function of pressure and flow in the pipe and should be designed according standard methods found in septic system design manuals and Minnesota Rule 7080.

Bark Bedding. The infiltration area shall be covered with bark or wood chips to a minimum height of 2 feet above the top of the distribution piping. The bark bed shall extend a minimum of 5 feet laterally from the distribution piping.

Bark Bed Considerations. Consideration should be given to the expected BOD5 loading rate as compared to the assumed rate that the table in the design guide is based on.

Depending on the existing condition of the infiltration area and how much grading is needed for construction, consideration should be made to loosening the area after final grading with a chisel plow or harrow to remove compaction.

A commercial sized effluent filter installed after the primary treatment tank will extend the time before plugging of the infiltration area.

Bark material should have large pore spaces (high porosity) to allow good oxygen transfer to the soil. Hardwood bark or chips are preferred over softwood due to expected lifespan.

3. Aeration and Media Filtration.

System shall consist of a primary septic tank, the treatment unit (Aerobic Treatment Unit (ATU) or Recirculating Media Filter (RMF)) and a subsoil infiltration area. Both the ATUs and RMFs are designed to reduce the organic loading of the milkhouse waste down to levels similar to household septic waste (200 mg/L BOD_5). This reduction in wastewater strength allows the effluent to be distributed into a standard sized septic soil infiltration system.

Aeration and Media Filtration systems shall be designed and constructed as recommended by the most recent “Milk House Wastewater Design Guide” published by the University of Minnesota. Additional specific criteria is as follows.

Soils Investigation. A soils investigation shall be made at the proposed subsurface absorption site. The USDA Soil Texture designation shall be recorded for all soil horizons to either the seasonal groundwater elevation, bedrock or a depth of 8 feet, whichever comes first. A suitable number of investigations shall be made to describe the soils at the proposed site.

Primary Treatment. Wastewater shall be pretreated in a septic tank. The septic tank shall meet the requirements of Minnesota Rules Chapter 7080. The tank shall be sized for a minimum of 3-day Hydraulic Retention Time (HRT) or the volume of the bulk tank, whichever is greater. The HRT is computed based on the gallons per day of wastewater to be treated.

HRT (days) = Tank Volume (gal)/Flow Rate (gpd)

Aerobic Treatment. Aerobic treatment shall be designed and managed in such a way that the effluent BOD5 entering the soil adsorption system is 200 mg/l or less. Independent, verifiable data demonstrating results of the use of the aerobic treatment facility or process in other similar situations and locations shall be provided.

Infiltration/filtration System. Discharge from the aerobic treatment system shall be to an in ground infiltration/filtration system. In ground infiltration/filtration system shall meet Minnesota Rules 7080.

4. Irrigation.

Irrigation system shall consist of a primary treatment tank from which wastewater is delivered to pasture or cropland area (irrigation area) by a pressurized irrigation system operating daily throughout the calendar year.

Irrigation systems shall be designed and constructed as recommended by the most recent "Milk House Wastewater Design Guide" published by the University of Minnesota. Additional specific criteria is as follows.

Siting Parameters. The irrigation area shall be situated or constructed in soils with 20% or greater passing the #200 sieve size a minimum of two feet below the buffer surface. The minimum separation to the seasonal water table and bedrock shall be two feet. The down gradient end of the irrigation area shall be a minimum of 50 feet from any private water well, channelized flow, surface water feature, or karst feature. The slope on the irrigation area shall be less than 3% or designed to prevent surface runoff during irrigation.

Primary Treatment and Transfer Wastewater shall be pretreated in a septic tank. The septic tank shall meet the requirements of Minnesota Rules Chapter 7080. The tank shall be sized for a minimum of 3-day Hydraulic Retention Time (HRT) or the volume of the bulk tank, whichever is greater. The HRT is computed based on the gallons per day of wastewater to be treated.

HRT (days) = Tank Volume (gal)/Flow Rate (gpd)

The outlet from the primary treatment tank shall be gravity flow to a dosing tank or chamber. This dosing tank shall have a minimum capacity to hold 3 days of effluent in addition to the normal daily pumping volume. A pump for pressure distribution of wastewater shall be located in the dosing tank. Distribution piping to the irrigation area shall be protected from freezing. Self draining pipes shall drain back to the dosing tank at a minimum 1% slope.

Irrigation Area and Delivery System. Sufficient irrigation areas and suitable sprinkler heads shall be used to ensure year round operation, including during freezing conditions.

5. Vegetated Treatment Dosing System.

The vegetated treatment dosing system consists of primary treatment in two septic tanks from which wastewater is spread across a sloped vegetated treatment area via an elevated, gated pipe on the upslope end.

Siting Parameters. The vegetated treatment area shall be situated or constructed in soils with 20% or greater passing the #200 sieve size a minimum of two feet below the buffer surface. The minimum separation to the seasonal water table and bedrock shall be two feet.

The down gradient end of the vegetated treatment area shall be a minimum of 50 feet from any private water well, channelized flow, surface water feature, or karst feature.

The slope of the vegetated treatment area shall be between 1% and 15%.

Primary Treatment. Wastewater shall be pretreated in two septic tanks. The septic tanks shall meet the requirements of Minnesota Rules Chapter 7080. Each tank shall be sized for a minimum of 3-day Hydraulic Retention Time (HRT) or the volume of the bulk tank, whichever is greater. The HRT is computed based on the gallons per day of wastewater to be treated.

HRT (days) = Tank Volume (gal)/Flow Rate (gpd)

Distribution System. Outlet from the second primary treatment tank shall be gravity flow to a dosing tank or chamber which shall be separate from the primary treatment tank. A pump, automatic siphon, or functionally similar device, shall be located in the dosing tank or chamber.

Wastewater shall be distributed to the buffer through a level perforated plastic pipe suspended between one and 1.5 feet above the ground. Perforations shall be between a half inch and one inch in diameter, placed in

the bottom of the pipe, and spaced at two foot to six foot intervals. The ground directly below the perforated pipe shall be armored to prevent erosion.

Vegetated Treatment Area. The minimum vegetated treatment area shall be the greater of either:

a. A minimum area to provide a flow through time of 15 minutes at a maximum flow depth of 0.5 inch using a Manning's n=0.24.

b. A minimum area to accommodate the design loading rate, up to a maximum of 0.9 inch per week.

Dosing. The soil infiltration rate and slope shall be considered in designing the application rate to enable effluent to flow down the slope and not to percolate below the root zone at the top of the slope.

Wastewater shall be dosed to the upper end of the buffer at a frequency of no more than once every three days.

The allowable maximum soil dosing rate is shown in Table 1:

TABLE 1
Maximum Soil Dosing Rates
(gal/ft^2/day)

Soil Drainage Class	Soil Depth	
	>40"	24" – 40" Note 1
Well Drained	0.300	0.250
Moderately Well Drained	0.250	0.200
Somewhat Poorly Drained	0.125	0.075

Note 1 A minimum soil depth of 24" to the seasonal water table, bedrock or hardpan is required

The actual flow depth and hydraulic loading rate produced by the selected pump and designed distribution system shall be calculated and shown to be in accordance with criteria in this standard.

CONSIDERATIONS

Location. Locate the waste treatment facility as near the source of manure or other waste as practicable and as far from neighboring dwellings or public areas as possible. For proper location also consider slope, distance of manure and other waste transmission, vehicle access, wind direction, proximity of streams and flood plains, and visibility.

In determining the location of the facility, consider elevation and distance from various components to take advantage of gravity flow where possible.

Manure Characteristics. Waste treatment may require specific total solids and nutrient contents of the waste stream. Pretreatment options such as dilution or settling could be used to adjust the solids content before entering the waste treatment facility or process.

Visual Screening. Evaluate the visual impact of the waste treatment facility or process within the overall landscape context. Look at implementing screening with vegetative plantings, landforms, or other measures to alleviate a negative impact or enhance the view.

Milking Center Wastewater Treatment. Dairy animals should not be in contact with the milking center wastewater to avoid disease transfer. Exclude dairy animals from the application site while liquid is present.

Utilize water, organic matter and chemical conservation methods in the milking center.

In some cases, a combination of systems may be appropriate. Combinations might include a bark bed for winter land application and cropland irrigation for the summer. This combined system would make some of the wastewater nutrients available for crop production and enhance the bark bed's useful life. Combination systems can be more complex because of the different piping and pumping requirements for the different systems.

Measures should be taken to control vectors (mosquitoes, flies etc.) if they pose a problem.

Safety. Install a fence around the milking center treatment system where needed to exclude people, equipment and/or animals. Open storage containers or access openings shall be fenced, covered, or secured to prevent entry by people or animals. Warning signs shall be posted to alert of the dangers of entering the storage container or primary treatment tanks.

OPERATION AND MAINTENANCE

Develop and review an O&M plan with the owner/operator prior to construction of an innovative waste treatment facility or implementation of an innovative waste treatment process. Ensure the O&M plan is consistent with the proper operation of all system components and contains requirements including but not limited to:

- Recommended loading rates of the waste treatment facility or process for hydraulic and critical pollutant parameters.
- Proper operating procedures for the waste treatment facility or process, including the amount and timing of any chemicals added.
- Operation and maintenance manuals for pumps, blowers, instrumentation and control devices, and other equipment used as components of the waste treatment facility or process.
- Description of the planned startup procedures, normal operation, safety issues, and normal maintenance items. This includes procedures for the planned replacement of components with less than a ten year service life.
- Alternative operation procedures in the event of equipment failure.
- Troubleshooting guide
- Monitoring and reporting plan designed to demonstrate system performance on an ongoing basis
- The service life of each component as identified by the manufacture of service provider. The minimum service life for the waste treatment facility or process is ten years. Where components have less than a ten year service life, clearly identify their planned replacement schedule.

Operation and Maintenance specific to Milkhouse Wastewater Treatment Systems.

- Information shall be provided on primary treatment processes including source control. Manure, waste milk, or human waste shall not be added to the waste stream. The milk parlor shall be operated and cleaned in such a way as to minimize solids from entering the treatment system for those systems that allow the liquid portion of milk parlor wash water. A contingency plan to address unexpected volumes of waste milk, wastewater, and runoff shall be developed.
- Primary treatment tanks shall be pumped at least annually. Tanks should be inspected every month for scum and sludge buildup to determine when the tanks should be pumped. Tanks should be pumped when solids are 18 inches or more deep on the bottom of the tank or the floating sum layer is 4 to 6 inches thick. Contents of the tank shall be land applied according to a spreading plan, stored in a waste storage facility meeting the criteria of NRCS Field Office Technical Guide (FOTG) Section IV, Standard 313-Waste Storage Facility, or removed by a licensed hauler.
- An effluent filter is commonly installed in the outlet of the primary septic tank to reduce the loading on the secondary treatment system. This filter should be inspected and cleaned monthly initially and less often if these monthly inspections show no signs of buildup.
- The Bark Bed, ATU or RMF systems are not designed to treat waste milk (milk from treated and fresh cows, bulk tank failures, or spills). The irrigation system can handle some wasted milk but excessive amounts may cause odors and will fill the septic tanks with scum. As such, all waste milk should be diverted from the wastewater treatment system. It is critical that all employees know that waste milk cannot enter the treatment system. Plumbing within the milk house will facilitate the diversion of this waste milk from the system. Check with the milk inspector for requirements regarding waste plumbing. Waste milk is often fed to other farm animals, or added to the manure handling system and land applied.
- Rodent control may also be needed in valve access pipes, bark beds, or drainfields.

- Continue to monitor water flow to the system. This monitoring will help determine if excessive water is getting to the treatment system (more than what the system was designed for).
- Bark Bed – Inspect for seepage around the perimeter of the bark bed every 3 months. If necessary add additional bark when bark depth is less than 12 in. Over time, the bark will decompose and additional bark will be needed to maintain adequate cover over the soil infiltration area both to protect and insulate the soil.
- Irrigation – Irrigation zones must be manually controlled for summer and winter operation or if soils become saturated. Monthly checks should be done to insure that irrigation heads are not plugged and no concentrated flow is occurring.
- ATU or RMF – The life of the soil infiltration area following an ATU or RMF is directly related to the treatment efficiency. Monthly visual observation of the effluent will help indicate the unit's performance. Semi-annual testing of the effluent will document system performance. BOD5 concentrations in this effluent should remain below 200 mg/L. Other maintenance requirements may be recommended by the specific vendor.
- On Vegetated Treatment Dosing systems, maintain the wastewater spreader to the initial design function. Also, inspect and repair the buffer area after storm events and fill in gullies, remove flow disrupting sediment accumulations, re-seed disturbed areas, and rake other measures to prevent concentrated flow.
- Irrigation and Vegetated Treatment Dosing area vegetation shall be harvested as appropriate to encourage dense growth, maintain upright growth, and remove nutrients and other contaminants that are contained in the plant tissue. Conduct harvesting and other maintenance activities only when the irrigation area is dry and moisture content in the surface soil layer will not allow compaction or rutting. Flow disrupting sediment deposits should be removed from Vegetated Treatment Dosing areas.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for waste treatment facilities in accordance with the criteria of this standard and good engineering practice.

As a minimum, provide the following in the plans and specifications:

1. Layout and installation details of livestock facilities, waste collection points, waste transfer components, waste treatment and storage facilities, including supporting documentation.
2. Location of all inflow and discharge pipelines, pipeline materials, diameter and slope.
3. Details of support systems for all components of the treatment facility.
4. Fencing and signage as appropriate for safety purposes.
5. Required tests to determine the effectiveness of the waste treatment as appropriate.
6. Other plans to manage the system including a nutrient management plan for proper land application of byproducts.

REFERENCES

1. Design Recommendations for Milkhouse Wastewater Treatment Systems, Schmidt, David; Christopherson, Sara; Fryer, Pete; Janni, Kevin, ASAE Paper 054103, 2005