A3611

Milking center wastewater management

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Treating and disposing of milking center wastewater

This fact sheet is part of a series for dairy farmers and others in the dairy industry concerned about managing wastewater generated from milking activities. The series introduces practices and devices that help conserve water, energy and cleaning chemicals. Ways to treat and dispose of milking center wastewater are also discussed. The goal is to help dairy farmers operate in a more profitable and environmentally-sound manner.

The information presented here reflects state-of-the-art concepts in milking center resource conservation and wastewater disposal. As research into new technologies goes forward, advances in milking center wastewater management will continue.

Titles in this series include:

Controlling Milking Center Wastewater: An Overview (A3608)

Estimating the Volume of Wastewater (A3609)

Managing Waste Milk (A3610)

Treating and Disposing of Wastewater (A3611)

Reducing Phosphorus Levels in Wastewater (A3612)

Conserving Water in the Milking Center (A3613)

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Selecting and designing the wastewater treatment option best suited to your particular dairy farm is a complex process. It involves considering treatment objectives, wastewater characteristics, geologic factors and costs (see table 1).

This fact sheet discusses options for handling milking center wastewater and provides background information for planning treatment and disposal system renovations or new installations. A guide to estimating the amount of daily wastewater generated is available in *Estimating the Volume of Wastewater* (A3609), another publication in this series. You can obtain additional information from wastewater analyses, soil surveys and on-site inspections. Consulting with professional agricultural engineers, Cooperative Extension agents and Soil Conservation Service personnel will aid in the decision-making process. You may need to secure approval from various regulatory authorities (for example, state milk inspectors, Department of Natural Resources personnel, milk plant sanitarians and local zoning officials) prior to installing a new wastewater treatment system.

Sources and components of wastewater

Milking center wastewater is generated when you clean animals, milking systems, buildings and equipment. It may also be a byproduct of cooling milk, softening water, and washing hands and boots.

Wastewater is often contaminated by a variety of substances, including milk, detergents, sanitizers, manure, dirt, feed and bedding. As a result, it typically contains high concentrations of biodegradable organic solids, nitrogen- and phosphorus-containing compounds, and even organisms that cause disease. These substances degrade water quality and create health hazards if they are allowed to enter surface or groundwater. Furthermore, it is illegal to discharge untreated milking center wastewater into waterways, lakes, streams or ditches without a permit.

Handling and disposal options for milking center wastewater

The disposal systems described in the remainder of this publication have been used successfully on Midwestern dairy farms. They vary widely in their applicability to milking center size and design, ability to remove contaminants, site requirements, costs and management needs (table 2).

Liquid manure systems with land application

From an environmental standpoint, the best way to dispose of milking center wastewater is to combine it with manure and apply the mixture to cropland by injecting, irrigating or spreading it. This is also the cheapest method, provided that the farm is equipped to handle liquid manure. A properly constructed and adequately sized liquid manure storage facility provides the flexibility to temporarily store wastewater until land application is appropriate.

Table 1. Criteria for selecting a milking center wastewater treatment system.

Category	Specific criteria
Treatment objectives	Discharge to surface water or groundwater after treatment; application to fields, etc.
	Laws governing disposal
Geologic factors	Soil type, permeability and depth
	Minimum depth to groundwater and bedrock
	Slope
	Drainage
Wastewater characteristics	Volume produced
	Biochemical oxygen demand
	Suspended solids
	Total nitrogen
	Total phosphorus
Costs	Labor and materials for installation, operation, maintenence

Table 2. Comparison of common milking center wastewater disposal systems.

Disposal system	Milking system and manure management considerations	Setup cost†	Mgmt. needs††	Wastewater management priorities	Remarks
Liquid manure storage with land application	Suited to large pipeline and parlor systems. Wastewater mixed with manure. Wastewater increases manure pumpability.	H	L	Wastewater minimization if design capacity is approached.	Most environmentally-sound disposal option. Odors possible. Low cost option if liquid manure facilities with sufficient capacity available.
Holding tank or pond with land application	Suited to small to medium pipeines or small parlors. Liquid manure could be included, but separate handling advised.	M	M/H	Wastewater minimization if design capacity is routinely met. Reducing solids desirable.	Frequent emptying required. Wastes can be land spread,§ irrigated or pumped to intensive land application. Tank or pond sizing critical. Complete tank or pond pumpout advised.
Aerobic lagoon with land application	Suited to medium to large parlors and large pipeline systems. Can handle feedlot runoff if properly sized. Separate manure handling required.	H	M/L	Solids and waste milk reduction.	Can produce high quality effluent. Effluent can be irrigated or land spread.§ Periodic sludge removal required. Pretreatment advised for solids reduction.
Intensive land application	Suited to small to medium pipelines and small parlors. Separate manure handling required.	L	M/L	Solids and waste milk reduction. Nitrogen reduction advisable on sandy soils.	Low cost option for pipeline systems. Settling/flotation (S/F) tank‡ required for pretreatment. Dosing to single or multiple infiltration areas advised. Dense grass stand required.
Subsurface disposal	Best suited to small to medium pipeline systems. Separate manure handling required.	M	M/H	Solids and waste milk reduction.	Not advised for areas that are wet or have shallow soils. S/F tank‡ required for pre-treatment. High maintenence requirements and failure-prone. Absorption fields must be properly sized and built. On-site soil investigations required.
Municipal sewage system disposal	Can be used with any milking system. Separate manure handling required.	L	L	Reduce wastewater volume and contaminants to limit fees.	Only available near cities and villages. Many treatment plants don't permit direct hookups, require hauling. Provides a good emergency backup.

† Estimated cost range to install major system components.
H = High (> $10,000), M = Moderate ($2,500 - $10,000), L = Low (< $2,500).

†† Relative time and effort required to operate and maintain system.
H = High, M = Moderate and L = Low.

‡ Settling/flotation tanks must be periodically cleaned out.

§ Land application includes field spreading with plow down or injection.

Holding tank or pond with land application

You can temporarily store wastewater in a large holding tank or pond with a storage capacity of at least 15 days. Adequately-sized units can handle seepage from solid manure storages and barnyard runoff in addition to milking center wastewater.

In holding units, wastewater separates into a top layer of liquid and a bottom layer of solids. When the units are emptied, you should remove both solids and liquids. The waste can be applied to fields with liquid manure handling equipment or with specially adapted sprinkler irrigation equipment. Some farmers use an irrigation system to handle the liquid and a liquid manure pump and tank spreader for the solids.

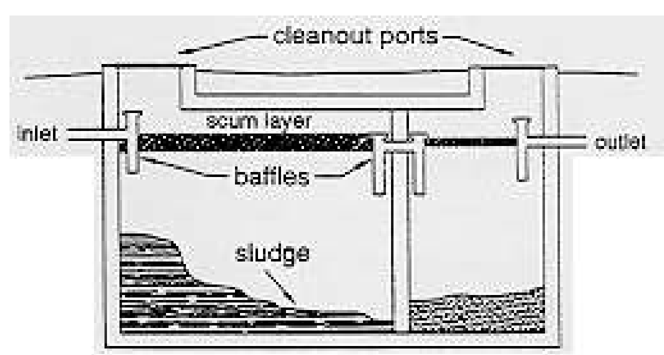
Aerobic lagoon with land application

Another option for disposing of liquids is intensive land application. Aerobic (oxygenated) lagoons are shallow basins that serve as both treatment and storage units for milking center wastewater and barnyard runoff. Wastewater remains in aerobic lagoons considerably longer than it does in holding units—usually about 6 months. During storage, microorganisms break down organic materials to simpler compounds such as carbon dioxide and water. As long as breakdown occurs in the presence of oxygen, objectionable odors are not produced. To maintain sufficient oxygen levels, lagoons must be shallow (3 to 5 feet deep) and the surface free of scum and other floating debris.

Aerobic lagoons function most effectively if the wastewater is pretreated to remove solids. A common pretreatment system consists of two settling/flotation tanks connected in series or a single tank separated into two compartments (figure 1). In the first compartment of a dual compartment tank, heavy solids form a sludge layer on the bottom, and fats and by-products of bacterial action form a floating layer of scum. A baffled outlet drains the liquid between these layers to the second compartment, where solids carried over from the first compartment settle and liquid is stored. Pretreated wastewater is transferred to the lagoon by gravity flow or pumping. Sludge and scum must be removed periodically from settling/flotation tanks to prevent their overflow into the lagoon.

When an aerobic lagoon is emptied, the solid and liquid waste can be handled in a manner similar to holding tank waste. Options for disposal include irrigation and field spreading.

Figure 1. A dual compartment settling/flotation tank for pretreating milking center wastewater.



Intensive land application

Liquid waste can also be intensively land applied. Intensive application of *pretreated* milking center wastewater to grassy areas (filter strips) can be an effective means of treatment. Filter strips should be gently sloped (2% to 6%) to encourage slow wastewater flow; they should also be flat across their width to prevent channels forming (figure 2). Filter strips with insufficient slope allow wastewater to pond and steep strips cause rapid runoff with inadequate treatment time. Long, narrow strips may be used on sites with steeper slopes (up to 10%) or greater topographic relief. Serpentine or switchback strips provide a greater length of flow (figure 3).

You can use a concrete or gravel spreader to disperse wastewater across the width of a filter strip (figures 2 and 3). Wastewater can also be dispersed by pumping it through an ejector with a movable discharge nozzle. Rotate the nozzle a quarter turn every three to four days.

Wastewater flowing down a filter strip evaporates or seeps into the soil. Fine particles are filtered out, organic compounds are degraded by microorganisms in the presence of oxygen (creating little odor), and phosphorus and nitrogen are consumed by plants. Tall fescue and reed canary grass are recommended cover crops in filter strips because they tolerate moisture and develop thick ground cover, preventing erosion. Vegetation should be harvested periodically to remove trapped nitrogen and phosphorus. Do not graze the filter strip because hoof traffic damages the surface. You can feed harvested vegetation to livestock or use it as bedding for non-lactating animals.

Filter strips should be constructed so that surface water flow is diverted around them. They should also be fenced to exclude livestock.

Figure 2. Grass filter strip for disposing of milking center wastewater.

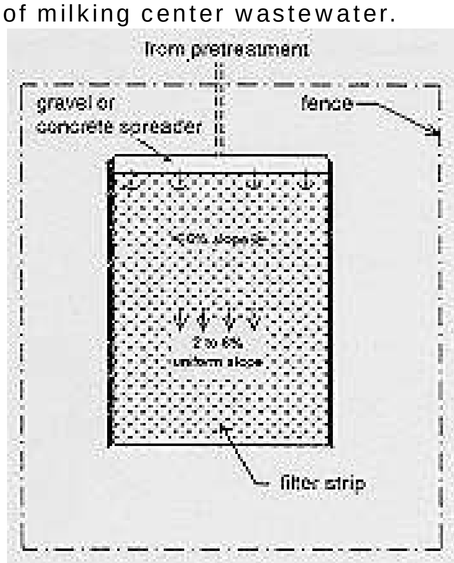
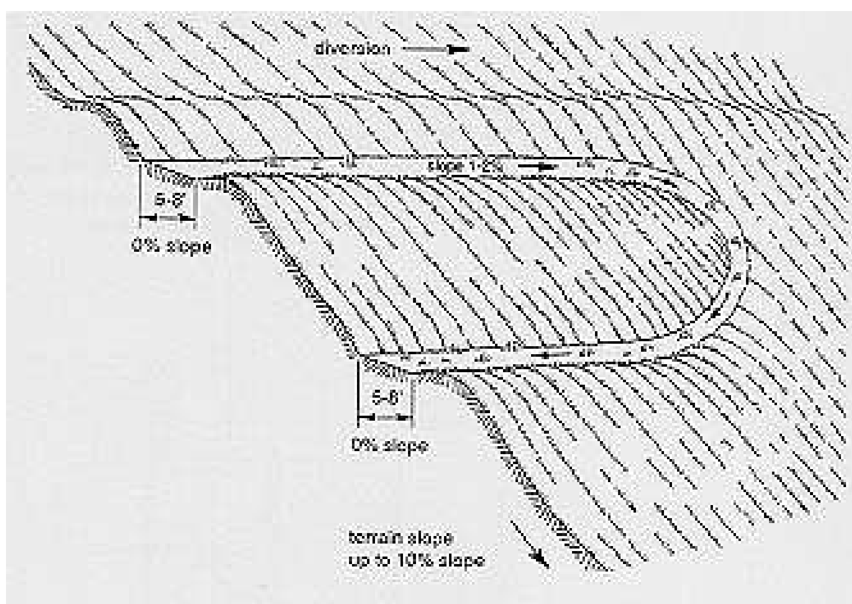


Figure 3. Narrow, serpentine filter strip for disposing of milking center wastewater in areas with steep slopes or significant topographic relief.



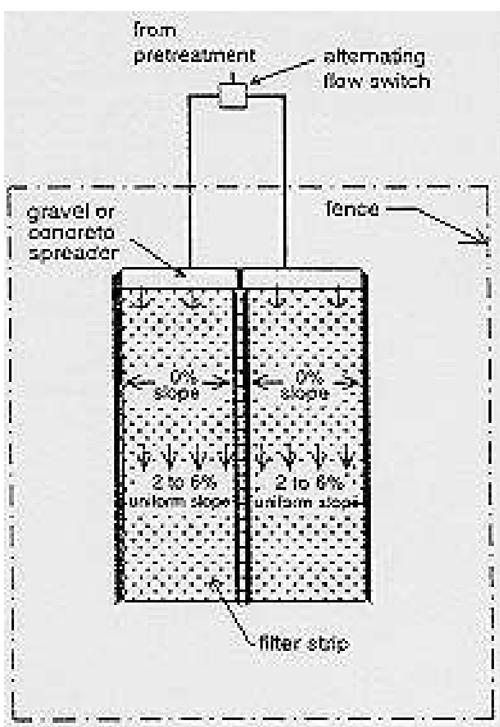
Filter strips work best if the soil remains aerated. You can promote aeration by periodically allowing the strip to dry out. Do this by constructing two filter strips and using them alternately (figure 4) or by dosing a single strip periodically with wastewater from a holding tank.

The effectiveness of filter strips decreases in winter when bacterial action slows, plant growth ceases and frozen soil prevents infiltration. If the pipes supplying a filter strip are self-draining, wastewater will not freeze in them. Filter strips have been used successfully year-round in the upper Midwest, but some runoff is likely during thaws.

A variety of intensive land application systems are available. The system best suited to your particular operation depends on the slope of the site, depth of the groundwater, and soil characteristics such as permeability, drainage and depth.

The two systems described in the following section require that wastewater be pretreated in a settling tank or lagoon to remove solids. This prevents plugging of soil pores and discourages anaerobic, odor-producing processes.

Figure 4. Parallel filter strips with alternate dosing.



OVERLAND FLOW. Wastewater runs slowly in a uniform layer down a vegetated strip over clay soil with low permeability. Vegetation removes nutrients from the wastewater, microorganisms break down organic materials, and plants take up water, or the water evaporates. You must harvest the vegetation and use it as a livestock feed or bedding to prevent the release of nutrients when vegetation dies. The risk of groundwater contamination is relatively low, but surface water may be contaminated when the water flow exceeds the system's capacity (for example, during wet weather or spring thaw).

SLOW SURFACE INFILTRATION. This method works well on moderately permeable, deep soils (well-drained loamy soils with at least 3 feet to bedrock and groundwater). As wastewater flows down the filter strip, it percolates slowly through the soil. There is a moderate risk of groundwater contamination from nitrate, but a low risk of contamination from organic materials, phosphorus, detergents and bacteria. The risk to surface water is mitigated if the area is designed to minimize runoff during rains and snowmelt.

Subsurface disposal

Subsurface disposal is typified by the familiar settling/flotation tank-leach field system (figure 5). Wastewater is first delivered to a settling/flotation tank (preferably dual-compartment; see figure 1), where solids settle out and bacteria begin to decompose organic matter. A scum layer composed of fats and by-products of bacterial digestion forms on top. Liquid between the scum and solids layers is delivered to the leach field by pumping or gravity flow. In the leach field, pretreated wastewater flows out of a perforated pipe into the surrounding aggregate. Some dissolved solids and other components bind to soil particles as wastewater percolates outward.

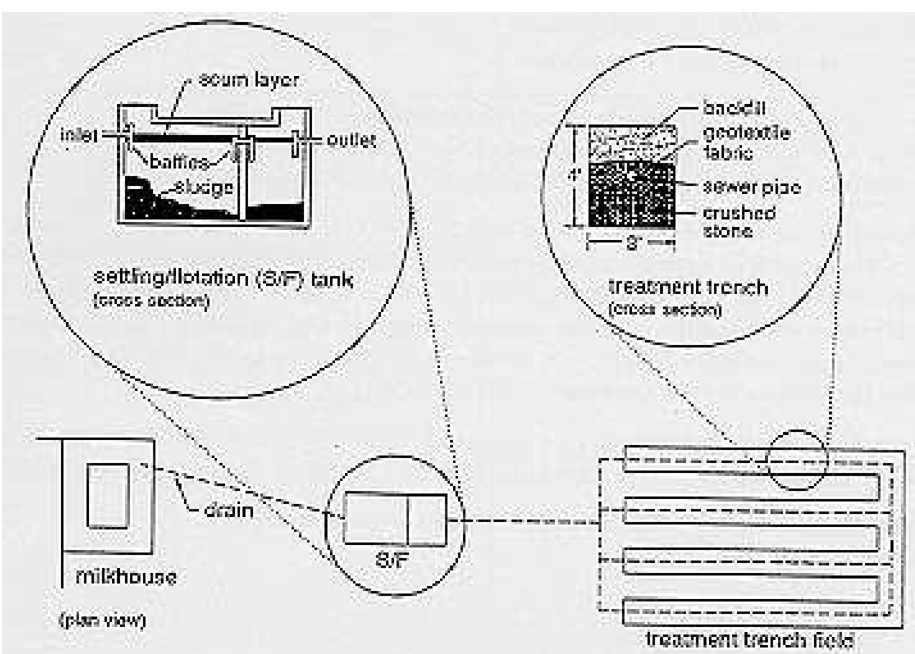
Settling/flotation tanks require periodic pumping to remove solids and scum. If these materials spill over into the leach field, the system may become plugged and wastewater backs up into drains and rises to the soil's surface. Leach field failure may also occur when the system must process excessive amounts of wastewater or organic solids, or when sanitizers destroy bacteria important for waste decomposition. Cleaning the settling/flotation tank regularly, reducing wastewater volume, and eliminating solids from the system will help keep subsurface disposal systems operational. Because they fail frequently and lack the ability to remove nitrogen, these systems are generally not recommended for milking center wastewater.

Municipal sewage system disposal

Farms near cities or villages may be permitted to discharge milking center wastewater to municipal sewage systems. Direct hook-up to municipal sewage lines is allowed in some areas, while other municipalities require that wastewater be hauled to treatment plants via tank truck.

Municipal sewage disposal can be expensive and is generally not feasible on a long-term basis. Fees are usually assessed on the basis of per-gallon-of-waste or per-pound-of-contaminant (for example, suspended solids, biochemical oxygen demand, nitrates, phosphorus). If they are available, municipal sewage facilities provide a good emergency backup for wastewater disposal during wet weather or when on-farm treatment systems are undergoing repair.

Figure 5. Settling/flotation tank and treatment trench (leach) field for treating and disposing of wastewater (not generally reccommended).



For more information

For a more detailed discussion of milking center wastewater management, see *Pollution Control Guide for Milking Center Wastewater Management* (A3592) by R. E. Springman, D. C. Payer and B. J. Holmes, available from your county Extension office or from Cooperative Extension Publications at the address listed below. You may also obtain more information from:

- University of Wisconsin-Extension county agents.
- your local county land conservation department.
- Soil Conservation Service field offices.
- dairy plant representatives.
- Department of Natural Resources district offices.

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