Water Quality

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Flushing Systems for Dairies

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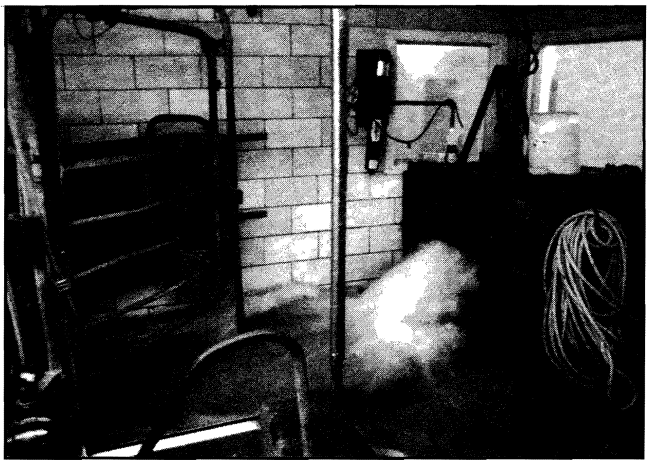
Flushing dairy facilities, such as milking parlors, holding areas and free stall alleys, can replace mechanical scraping or scraping with a tractor and blade. For optimum performance, flushed surfaces are usually sloped at 2 percent to 5 percent to provide adequate flow velocity for good cleaning and transport.

The Missouri State Milk Board requires the milking parlor to be flushed with fresh water but effluent may be recycled from a lagoon for flushing other areas, such as the holding pen, loafing and feeding areas.



Fresh water must be used for flushing inside milk parlors in Missouri.

Advantages

Some advantages of flushing dairy facilities, compared to scraping with a tractor and blade, include:

1. Labor may be reduced.
2. Flushing systems may be easily automated.
3. Frequent flushing may result in cleaner facilities and less odor.
4. Operating costs are lower.
5. Flushing is suited to a low-labor system incorporating a lagoon and irrigation for storage/treatment and distribution of waste.
6. Better accomodates large facilities and cow numbers.
7. Floors dry out better because wet, residual manure is removed.

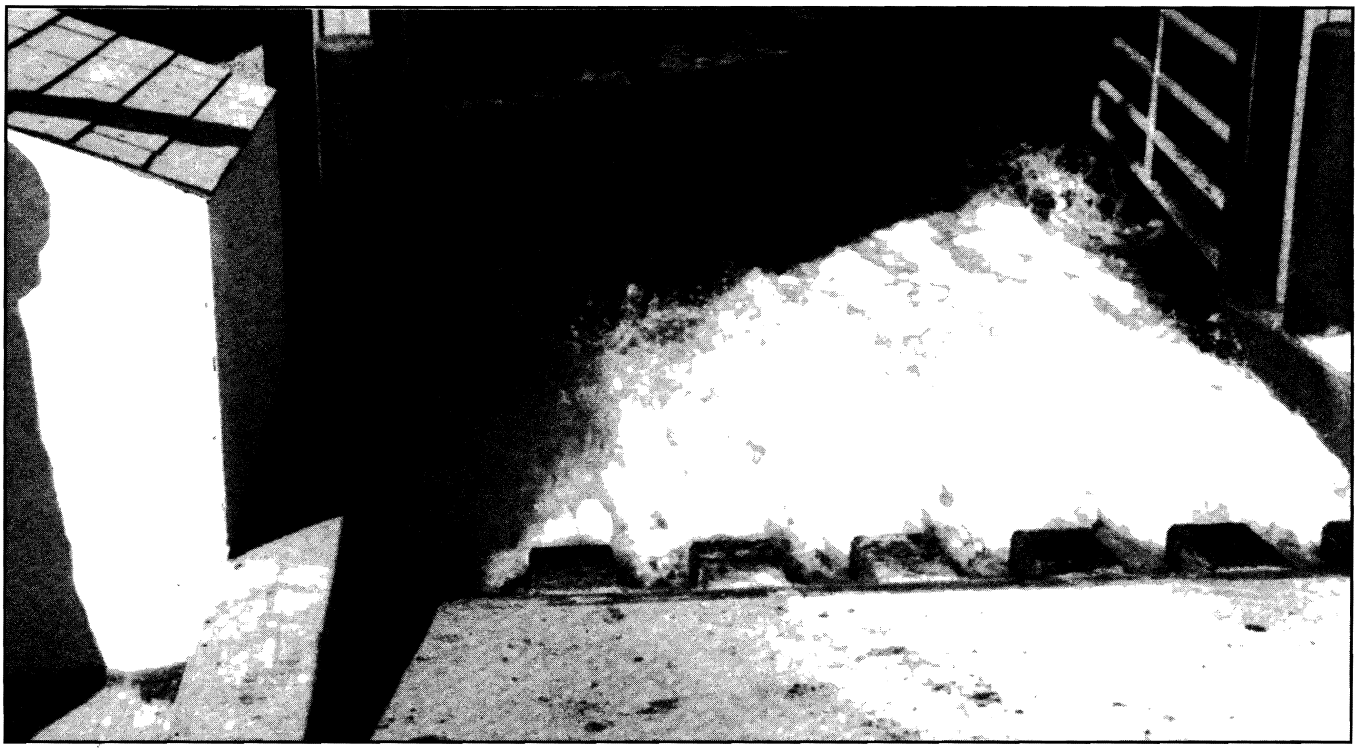
Disadvantages

Disadvantages of flushing include:

1. For optimum system, facilities should be designed with proper slopes and other features.
2. Large amounts of "water" are required and must be stored (up to 125 gallons/cow-day or more).
3. Flushing systems may not be feasible to operate when temperatures remain below 20 to 25 degrees F.
4. Optional system (scraping) required for cold weather operation, thus increasing total investment.
5. Installation of flush systems with associated recycle pump, piping, and flush devices may be relatively complicated and expensive.
6. Solids separation may be desirable to reduce system problems.
7. A lagoon is required to receive, store, and provide a source of flush water.

Components required

Major components required for a typical flush system include a "water" supply, recycle system,



Properly designed flush systems provide better cleaning and sanitation than scrape systems.

flush tanks, sloped/curbed alleys/areas to flush and a receiving gutter at the lower end of the flushed areas (See Figure 1 on page 3).

Water supply

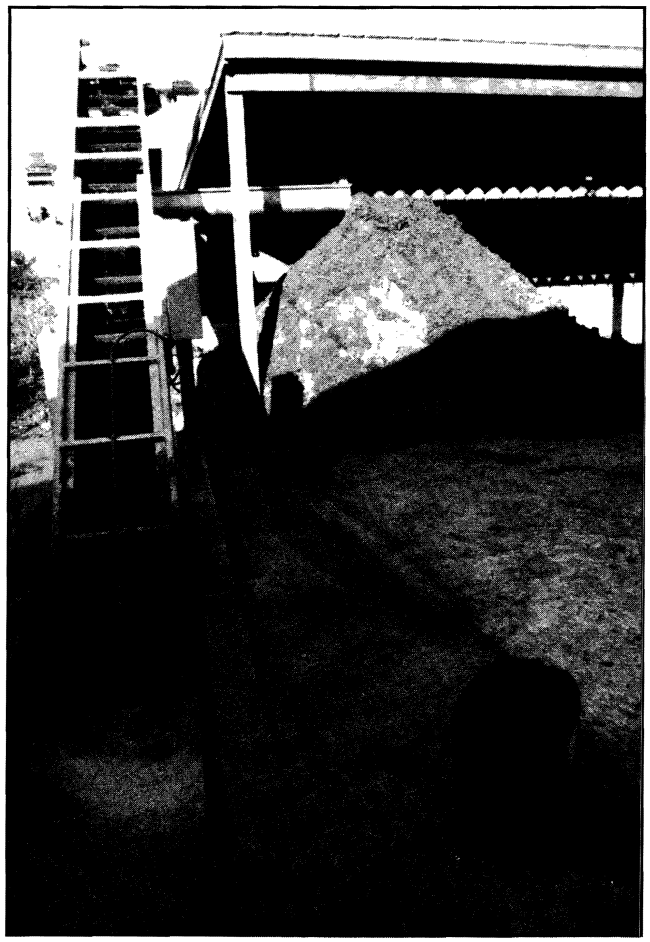
The usual "water" supply/storage is an anaerobic lagoon. The farm water system may provide for "fresh-water" flushing in the parlor.

Recycle system

Pumps

The recycle pumps are usually centrifugal pumps floated on the surface of the lagoon or placed in a wet well at the lagoon. Pumps are usually sized relatively small to reduce first cost as well as wire sizes and electrical demand. The Missouri approach has been to size the recycle pumps and pipes to fill the flush tanks in about two to four hours . Pumps in the 1 to 5 horsepower range will generally provide the 20 to 100 gallons/minute flow rates typical for dairies. Some systems in the West use extremely large pumps that can supply the instantaneous flow rates required to flush channels/alleys without the use of flush tanks. Systems of this type may require a pump capacity of several thousand gallons per minute.

Pumps for dairy lagoons should have an open or semi-open impeller to reduce clogging with solids. If stringy, fibrous material is present in the lagoon, a chopper pump should be used (for details, see MU Publication G 1158, *Recycling Lagoon Wate for Manure*



Solids separators keep fibrous, stringy material out of the lagoon and reduce pumping problems.

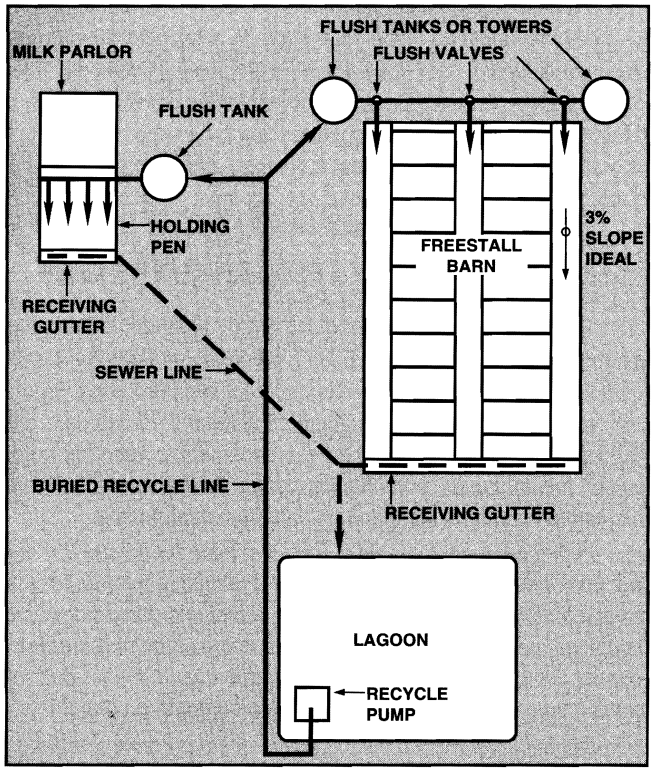


Figure 1. Schematic of typical components in a dairy flush system.

Flushing Systems). Solids-separation equipment ahead of the lagoon reduces clogging and pumping problems.

Pumps commonly used include submersible, centrifugal sewage pumps (also called sewage ejector pumps) and self-priming centrifugal pumps, that can be placed above the lagoon level in a wet well or in a hut to prevent freezing.

Submersible sewage pumps are usually suspended about 2 feet below the water surface to minimize pumping surface debris or bottom sludge. The recycle pump should be located on the side opposite the discharge from the flushed facility for recycling the best quality water.

In deciding what type of pump and pumping structure will be used, the ability to do maintenance on the pump must be considered. For floating, submersible pumps, a system of cables to anchor the pump, or floating dock, is needed. For wet-well type pumps, a hoist of some type is needed to lift the pump out of the wet-well for servicing.

Pipes

Polyethylene or PVC pipe is recommended for recycling lagoon water. Fewer crystallization problems seem to occur with plastic than with metal components. Curves with flexible plastic pipe for turning corners is preferable to using 90-degree elbows. Typical pipe diameters range from 2 to 4 inches.

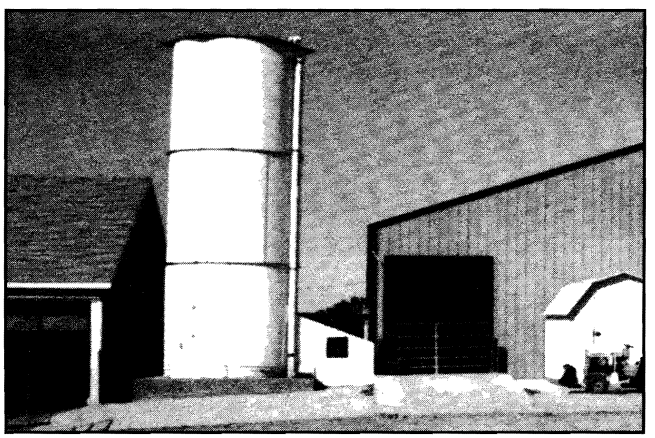
Flush gutters/alleys

Flush gutters/alleys with 2 percent to 5 percent slopes and 10-inch high curbs are typical. Experience has shown that providing a 5 feet/second flow velocity at a 3-inch depth for at least 10 seconds will provide acceptable cleaning in most cases. A 3 percent slope on the flushed area will provide these conditions with the least water volume and discharge rate requirements. Slopes flatter, or steeper, may require more water volume and higher discharge rates. For the optimum 3 percent slope, flush volumes are about 100 gallons per foot of width of the area being flushed. This volume should be increased for gutters longer than 150 feet. Equal in importance to flush volume is the rate at which the flush tank or valve discharges the flush water into the flush gutter. Adequate flush volume will not provide cleaning if that volume is not discharged fast enough.

Flush tanks and valves should be designed to discharge the required flush volume in about 10 seconds. Gutters longer than 150 feet may require a longer discharge time to maintain an adequate flush wave in the gutter.

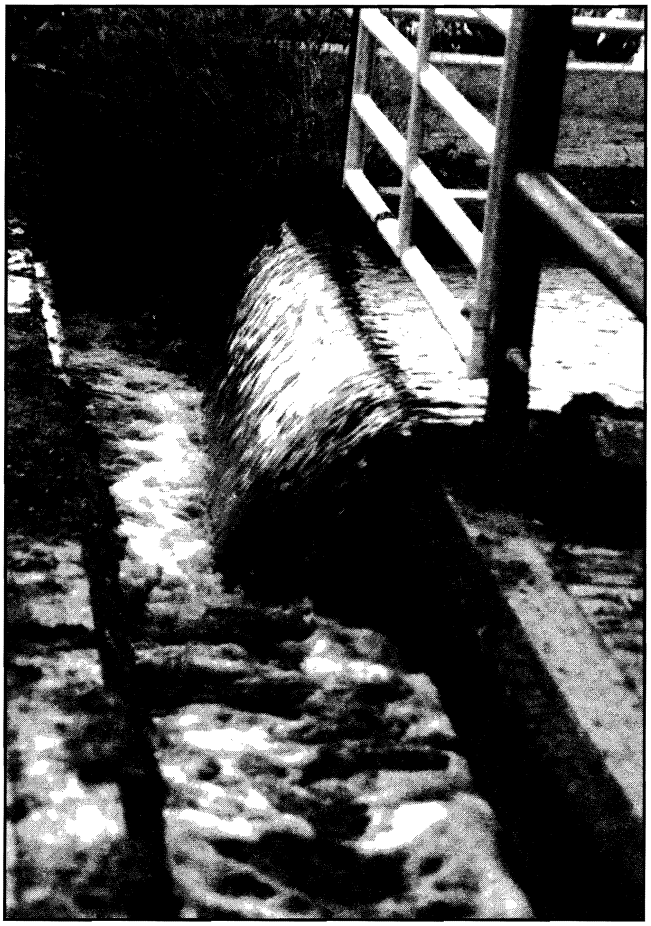
Flush tanks and valves

Flush tank types include tip/rollover tanks,



Water towers provide high pressure to pipeline/valve flush systems.

A slope of 3 percent is best for flush alleys, and curbs must be constructed to carry water down the flush alley (grooves provide traction for cows).



Receiving gutters have the capacity to carry flush water to the lagoon.

siphon tanks, and cylindrical "water-tower" tanks (typically 20 to 25 feet tall to provide pressure and storage volume). Pipeline/valve systems typically utilize tall water towers with large pipes (12-inch diameter typical) and fast-opening valves (butterfly, pneumatic, etc.) to release water into the flush gutter.

Receiving gutters.

Receiving gutters (channels) collect the flush water/manure at the end of the flushed surface (alley, holding area, etc.). The open-channel receiving gutter may transport the flush water to the anaerobic lagoon in lieu of a pipe-type conduit. Gutters should be designed with capacity to receive and transport the design flow at sufficient velocity to prevent settling (deposition). Receiving gutters should have at least 2 percent bottom slope, 1-foot minimum depth and 1.5-foot minimum width.

Building site requirements

To achieve an economical flush system, a natural ground slope of 2 percent to 5 percent in the direction of flow (from the upper end of the flushed area (gutter/alley, etc.) to the lagoon is desired. This allows facilities to be built on the desired slope for flushing with a minimum of earth moving. Buildings can have a roof-line on the same slope as the foundation.

Adequate slope from the flushed facilities to the lagoon eliminates any need for pumping waste to the lagoon. The site must be suitable for construction of a lagoon according to the state regulator's requirements, and it must have sufficient clay in the soil to provide a water-tight seal for the lagoon.

References

1. MWPS-7, *Dairy Housing and Equipment Handbook.* 1985. Midwest Plan Service, Iowa State University, Ames, Iowa 50011.

2. MWPS-18, *Livestock Waste Facilities Handbook.* 1985. Midwest Plan Service, Iowa State University, Ames, Iowa 50011.

3. MU Publication G 1158, *Recycling Lagoon Water.* Extension Publications, University of Missouri, Columbia, MO 65211.

4. University of Missouri Extension Publication MP-666, *"Waste Management Systems for Dairy Herds".* 1991. University of Missouri Extension Publications, Columbia, MO 65211.

5. NRAES-31, *Proceedings from the Dairy Waste Management Symposium,* Syracuse, New York, February 22-24, 1989. Northeast Regional Agricultural Engineering Service, 152 Riley-Robb Hall, Cornell University, Ithaca, NY 14853. See pages 273-280.

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