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Managing Silage Leachate

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Silage leachate, with a high biochemical oxygen demand (BOD), presents environmental headaches and a loss of food value from the silage. This fact sheet provides information on mitigating these problems.

What is silage leachate and why is it a concern?

Silage leachate is a liquid produced during the ensiling process – the process that converts perishable wet forage plants to a stable stored feed energy source – when the silage material contains an excess amount of moisture. This leachate not only contains high concentrations of nitrogen and phosphorus, nutrients that can have a negative environmental impact on receiving water bodies, but it also has a very high biochemical oxygen demand (BOD) (Table 1). This BOD, which is a measure of how much oxygen a substance will remove from surrounding water, is typically so high that only 1 gallon of leachate will lower the oxygen in 10,000 gallons of fresh water to a level in which fish cannot survive. This is roughly 200 times stronger than raw sewage. Not only does this leachate present an environmental liability, it also translates to losses of valuable dry matter and nutrients from the silage.

Table 1: Silage leachate characteristics compared to liquid dairy manure.*

Constituent	*Silage Leachate (Typical)*	*Liquid Dairy Manure (Typical)*
Dry Matter	5% (2-10%)	5%
Total Nitrogen	1,500-4,400 mg/L	2,600 mg/L
Phosphorus	300-600 mg/L	1,100 mg/L
Potassium	3,400-5,200 mg/L	2,500 mg/L
pH	4.0 (3.6-5.5)	7.4
Biochemical Oxygen Demand	12,600-90,000 mg/L	5,000-10,000 mg/L

*(Holmes, 2007)

Silage leachate production

The volume of leachate produced depends upon the moisture content of the material when it is harvested and placed in the silo. In general, very little leachate is produced when the silage's moisture content is 70% or less when it is placed in a bunker silo. Leachate production increases sharply as the moisture content at harvest increases. The critical time for leachate production is in the month following the harvest of the silage. More than half of the leachate is produced during the first week, and the remaining volume is usually produced over the next three weeks. If silage is placed in an uncovered bunker or trench silo, leachate production will continue throughout the storage period. Also of concern in bunker silos is stormwater runoff from the bunker floor that can wash away waste feed following precipitation.

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Ways to prevent and manage leachate

Timing silage harvest

The first step to preventing leachate production is to harvest silage with an optimal moisture content. Excellent quality silage that produces little leachate can be produced if harvest occurs at 65% to 70% moisture for bunker silos and at 62% to 68% moisture for tower silos. In addition to timing of harvest, a number of other measures can be taken to reduce environmental impact.

Better silo construction

If you are constructing a new bunker silo, loss of leachate and contaminated runoff can be greatly reduced if you follow a few guidelines.

- Choose a silo location that is at least 300 feet from surface water and 50 feet from the nearest well.
- Ensure that the liner is water tight. If using concrete, expansion joints should be filled with a flexible compound.
- Slope the floor of the silo outward so that any produced leachate or runoff can be captured and properly handled.
- Install subsurface drainage beneath the concrete floor and direct to dirty water handling system.
- Significant volumes of leachate can move through cracks or old joints in concrete and have the potential to contaminate groundwater. An impervious liner beneath the gravel base can help with collection.
- If the silo is placed into the side of a hill, collect and divert clean groundwater from upslope through a separate drainage system to reduce the amount of dirty water to be handled.
- Plan for and install a leachate and stormwater handling and treatment system for surface and subsurface flows.

Design and maintain runoff/leachate handling and treatment systems properly

To manage leachate and stormwater runoff from bunker silos, design and maintain a proper handling and treatment system.

Exclude clean water

To minimize the volume of contaminated water to be handled, clean water should first be excluded from the silage where possible. For clean groundwater diversion, clean rainfall and snowmelt can be excluded by covering the silage with plastic so that runoff drains over the outside of walls. If plastic diverts water down along the inside of walls, not only will it become contaminated, but it will also spoil the outer layer of silage.

Install collection system

A leachate and stormwater collection system should be installed along the edge of the bunker to collect all surface runoff. This system should be designed so that concentrated leachate (or low flows) is separated from diluted stormwater (or high flows) for separate handling methods.

Low flow

Low flows are the most polluting, and should be directed to a well-ventilated waste storage structure and land-applied with manure according to a nutrient management plan. Significant danger exists from production of poisonous gases if leachate is mixed with manure in enclosed structures. This should be avoided. Simple low-flow separation can be achieved by overshot pipe system (see Figure 1). Effective low-flow collection systems will also collect the “first flush” of stormwater.

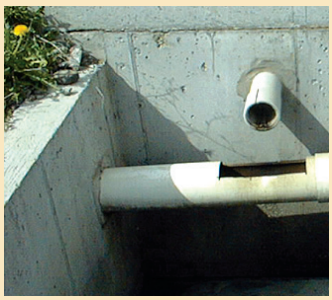

Figure 1. *Low-flow/high-flow separation with over-shot pipe design. Low flows trickle from upper opening into horizontal pipe and are stored. High flows drop into concrete basin and are directed to Vegetative Treament Area (VTA).*

High flow

High flows require a lower level of treatment and can be directed to a properly designed vegetative treatment area (VTA) where they can be treated by the soil profile and vegetation. To prevent clogging of a VTA distribution system, a cleanable screen apparatus is recommended to remove large silage particles from runoff before low-flow/high-flow separation (Figure 2). If screens are clogged or the low-flow/high-flow separation mechanism is not functioning properly, the effectiveness of a VTA for runoff treatment is greatly compromised.

Figure 2. *Three sets of screens have progressively smaller openings to filter particles from bunker runoff; screens can be removed for cleaning. Caged riser directs runoff to low-flow separation device.*

For assistance in your area

Your local U.S. Department of Agriculture Natural Resources Conservation Service office can assist you with developing a conservation plan and provide you with technical assistance for dealing with silage leachate and bunker runoff. Financial assistance may also be available.

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Created

January 2013

For more information

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