K·STATE Research and Extension

Leachate from Silage and Wet Feed Storage

Why is Leachate a Problem?

"Leachate" is the term used to describe liquid seepage from wet feed ingredients stored in upright silo structures, commodity sheds, bags or bunkers. Leachate is an organic liquid that results from feed pressure in the storage structure or the presence of excess water. Properly stored wet feed ingredients will result in reduced or no leachate.

Leachate seeping from storage structures presents a serious environmental problem. On average, silage leachate (SL) is 40 times stronger than dairy parlor wastewater and up to 200 times stronger than raw sewage. The acidity of silage leachate can adversely affect groundwater or kill vegetation in the drainage area. Leachate also has a high biochemical oxygen demand (BOD), which has high potential for consuming oxygen. When leachate enters a stream or pond, oxygen levels necessary for aquatic life may be reduced, and resulting phytonutrients may cause algal blooms. High ammonia levels in leachate are also toxic to fish.

Leachate can be lethal to humans and animals. Leachate should not be stored in enclosed structures because this can enable production of hydrogen sulfide and/or other hazardous gases. Leachate from silage structures should be stored in open-top structures to prevent accumulation of harmful gases.

Storage of Silage and Wet Feed Ingredients

Animal feed rations may contain ingredients above 50% moisture content. Examples of wet feed ingredients include silage and wet distillers grain. Livestock producers can store silage in upright silos, three-sided bunkers, or silage bags. Producers may store wet distillers grain under a roof or in a bunker mixed with lower-quality ground forage. Bunkers may have earthen or concrete sidewalls. Bunkers and silage bags should have an impermeable floor or a firm, compacted pad on which to store silage and allow access to the silage face in inclement weather.

Concrete silage pits improve sealing of the pile floor. The silage storage floor should be watertight and constructed with a slope toward a drainage channel. Seal expansion joints with a flexible compound. Divert storm water from extraneous drainage areas with a channel on the upslope sides of silage storage structures. Leachate is corrosive and can damage concrete and steel.

Inadequate covering of silage allows rain and air contact, which increases liquid runoff and decreases silage quality. Cover stacks during and immediately after filling, seal the edges to keep rain out, and keep the cover intact as long as possible when feed-out begins. Storing wet ingredients in sealed plastic tube bags also prevents leachate from draining from the storage site.

Importance of Silage Moisture Content at Harvest

Ingredient moisture content determines the potential volume of leachate that drains from the storage area. With harvest moisture contents above 70%, leachate ranges from 3 to 80 gallons per ton. In most cases, if the harvest moisture content is less than 65% to 70%, there will be minimal leachate. However, delaying harvest until the moisture content is 60% or lower will result in poor quality silage with reduced nutritional value. Figure 1 illustrates the impact of harvest moisture content on leachate amounts.

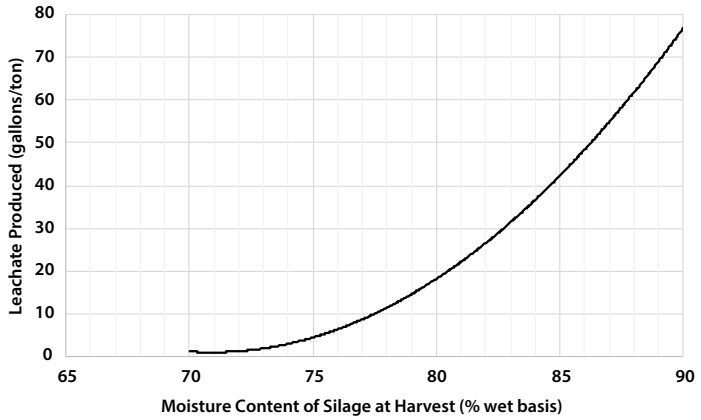

Figure 1. Impact of silage moisture content at harvest on amount of leachate produced.

The recommended harvest moisture content for corn silage depends on the type of storage structures in use (Table 1). Corn stover in corn silage is less digestible if harvested too dry. As moisture content decreases, the silage will contain corn kernels with harder seed coats, less digestible stover and starch, and lower amounts of vitamins A and E. It is impractical to attempt adding moisture to dry corn silage during packing, due to the volume of water required.

Producers should harvest sorghum silages at a higher moisture content (70% to 75%) than corn silage (60% to 65%). When sorghum silage is harvested at lower moisture contents (64% to 68%), the kernels will harden and pass through an animal's digestive tract. It may be necessary to swath sorghum silages to reach optimum dry matter prior to ensiling. Sorghum silages should be stored horizontally in bags or in bunkers.

Table 1. Recommended moisture content of silage vs. storage structure

Type of Storage Structure	Recommended Moisture Content (% wet basis)
Bunker silos	65-68%
Upright silos	60-65%
Upright "oxygen-limiting" silos	50-60%
Silage bags	55-65%

Wet Distillers Grains

The authors of this publication are unaware of any current research on the relationship between the moisture content of wet distillers grains and leachate. One best management practice (BMP) with wet distillers grains is to store the distillers grain under a roof to minimize the impact of rainfall events. As an additional measure, some producers place ground hay in the vicinity where liquids drain away from the storage slab. The ground hay absorbs the leachate before feeding to cattle. Occasionally, buyers purchase and store large volumes of wet distillers grains in a bunker. A recommended BMP is to mix the wet distillers grains in a feed wagon with ground hay to ensure the moisture content is 60% to 65% prior to packing and storing in a bunker. Wet straw, corn stalks, and low-quality forage are additives that can be mixed with wet distillers grains.

Grass/Legume Silage

Well-made, good-quality silage will produce little, if any, silage leachate. Wilting may be required with grass silages. Wilting the cut grass before ensiling will reduce the leachate quantity (Table 2) and increase feed quality. Mechanical conditioning and chopping increases the speed of wilting. When the crop cannot wilt due to wet weather, ensure measures are in place to deal with the leachate. Silage moisture level may be assessed by twisting a handful of silage:

- Juice comes out easily = 82% (wet basis)
- Juice comes out with difficulty = 78-82% (wet basis)
- No juice, but hands are moist = 73-78% (wet basis)
- No juice, and hands are dry = less than 70% (wet basis)

Table 2. Estimate of silage leachate vs. dry matter for grass silage

Preparation of grass ensiled	Leachate per ton of grass (gallons/ton)
Leafy grass, no wilting	12.5
Wilted to 20% dry matter	12.5 – 30
Wilted to 25% dry matter	0 - 7.5

To maximize dry matter, allow a minimum of six hours drying time after cutting, although 24 hours is preferable.

Environmental Considerations

Leachate problems tend to occur within 30 days of harvest and placement in a storage structure (Figure 2). Approximately 90% of the leachate or effluent drainage occurs within 14 days after packing the silage in a structure. However, normal rainfall may create potential problems throughout the year, and rainfall affects silage storage types differently. For example, upright silos generally have a roof covering that diverts rainfall from the silage, while runoff from bunker storage structures is similar to the runoff from a concrete parking lot as bunkers generally have an impermeable floor and plastic covering. "The plastic tarp covering the silage should divert rainfall away from the silage pads. Any unprocessed (uncut) tires used to weigh down the plastic tarp could hold rainwater, however; this can become a breeding ground for insects, causing a potential health issue for

animals or humans. Tires processed to avoid holding rainwater can function as weights for plastic tarps.

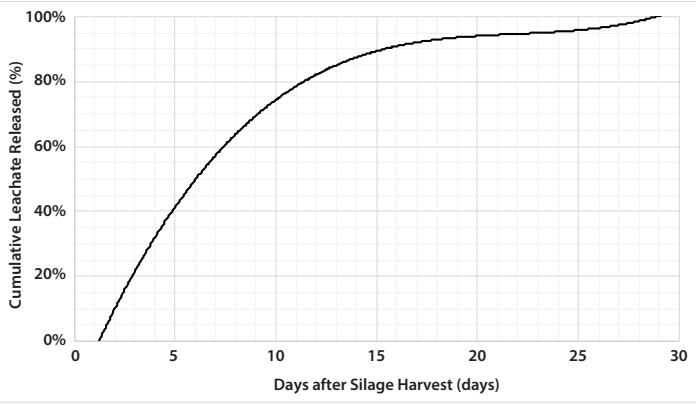

Figure 2. Occurrence of percentage of total silage leachate based on days after silage harvesting and filling of silage structure.

An important silage storage BMP is to use covers and diversions to minimize the chance that precipitation and runoff will reach the storage and load-out area. The diversion of rainfall runoff into a wide-bottom (flat) terrace or vegetative treatment area is necessary to provide infiltration time for the runoff. A recommended minimum size for treatment or buffer area is at least one to three times the floor area of the silage structure, plus the extraneous drainage area, depending on local rainfall. Operations with a federal operating permit will need to contain the leachate and runoff in containment structures, per federal requirements.

Reducing the volume of loose silage or wet ingredients that might float away during an extensive storm event also reduces the potential for nutrient and dry matter losses. The best methods to reduce the volume of nutrient runoff and pollution potential from silage structures are to remove only the necessary feed for each day and to keep the silage pad clean. This includes proper daily disposal or storage of spoiled silage not suitable for feed.

Causes of Leachate Contamination of Water Resources

- Locating or storing wet feed ingredients too close to a water source, where leachate may enter water through runoff or soil seepage.
- Allowing improper moisture content before ensiling or in wet feed ingredients. This greatly increases the liquid content and causes leaching from the silage pile as shown in Figure 1.
- Allowing silage or leachate from other wet feed ingredients to enter surface or subsurface drainage systems.
- Inadequate covering and sealing a storage pile containing wet feed ingredients. This allows rain and air access, resulting in a decline of feed nutrients.

Control and Disposal of Silage Leachate

- Construct an impermeable floor to prevent ground water contamination.
- Prevent leachate from draining into surface water bodies.
- Locate and construct silage and wet distillers grain bunkers so ground or surface water cannot enter and drain through the storage area.
- Locate bunkers as far as possible from water resources, including surface water, wells, sinkholes, and any direct path to groundwater. The minimum recommended distance is 300 feet.
- Divert leachate to a well-ventilated, open-top manure storage structure with secondary runoff overflowing to a vegetative buffer area or holding pond. Do not add leachate to any type of enclosed storage facilities (such as a tank used to capture milk parlor water). Leachate mixed with manure produces deadly gases.
- Use diversion channels, buildings, or covers to minimize clean water mixing with the stored ingredients. This protects the quality of the feed ingredient and decreases the potential for runoff.
- Dilute captured leachate with equal parts water (e.g., milk parlor wash water, feedlot runoff, etc.) to irrigate or fertilize crops.
- Reduce leachate volume by reducing the storage depth in upright silos proportionally to the increase in silage moisture content, as shown in research projects using upright silos.

Potential Uses for Silage Leachate

Silage leachate makes an excellent fertilizer. Leachate should be diluted 1:1 with water and spread at a rate of 2,500 gallons per acre. Table 3 lists estimates of the nutrients applied per acre when diluting silage leachate with water. Another option is to work with an animal nutritionist to formulate a ratio for utilizing silage leachate in feed rations.

Table 3. Estimated nutrient content of silage leachate when diluted 1:1 with water prior to land application.

Nutrient	Amount (lb/acre)
Nitrogen	25–75
Phosphorus	25
Potassium	100

Summary

Although heightened awareness of silage leachate and other runoff is necessary at harvest time, producers must realize leachate poses a serious environmental risk all year. As responsible stewards of the environment, producers need to remain aware of the risk of leachate from silage and other wet feed ingredient storages, and take appropriate steps to reduce and manage the leachate/runoff from feed storage and processing areas.

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