

# Silage & Hay Safety: Accidents are Preventable

*Matt Akins, University of Wisconsin-Madison*

A farm's forage management program is key to profitability for all dairy producers; however, safety is not always top of mind when busy harvesting, storing, and feeding forages. Hay-related fires occur each year which result in significant loss of life (especially animals) and property but are preventable using good hay harvest and storage management techniques. Also, numerous people have been injured or killed by silage-related accidents. Many of these accidents have been documented by Ruth Bolsen and her late husband, Dr. Keith Bolsen, with many having been preventable if a safety plan had been in place and followed. You can find some of the testimonials and silage safety information on the Bolsen Safety Foundation website ([silagesafety.org](http://silagesafety.org)). Remember, we have nothing to lose by practicing safety, but everything to lose by not practicing it! The following provides information on hay and silage safety to help minimize fire and injury risks.

**Hay harvest and storage management to prevent fires.** Proper hay harvest moisture is key to minimizing risk of a hay fire caused by internal heating. Harvesting dry hay in humid conditions is often challenging with moisture levels >18% for small bales and 16% for large bales, which allows for microbial activity within the hay for several weeks after harvest. Typically, moist-hay temperatures will increase slowly the first few days, then rapidly increase as microbial activity increases. When bales are stacked tightly, the heat is trapped in the hay mass and temperatures continue to increase, which can result in a fire. Larger bale packages stacked in piles outside are also at risk, as they have a large mass which retains heat. The following are options to help reduce hay heating and risk of fire:

- For dry hay, harvest at moistures <18% for small bales and 15% for large bales to minimize microbial activity and heating.
- Use an organic acid preservative (usually a propionic acid blend) to help control microbial activity. Refer to acid and applicator manufacturer recommendations, as these may differ. Larger bales may not respond as favorably to acid application at recommended rates (0.5-1% of bale weight), according to Coblenz et al. (2012), especially for hays >25% moisture. Increased acid rates may be needed for large round bale packages (4-5' bales).
- Wrapping of wet, acid-treated hay has potential to control microbial activity through both chemical control and limiting oxygen. Recent work at Marshfield ARS (Coblenz et al., 2021) showed good results with minimizing heating and quality losses when wrapping acid-treated, moist hay (25% moisture).
- Do not store suspected wet bales in barns or outside stacks, as this will not allow heat to dissipate and increase fire risk. Allow bales to heat for a few weeks until bale temperatures reach environmental temperatures.
- If suspect bales were stored inside or in a stack, check internal temperatures often to monitor heating. Temperatures <120°F are normal, 120-140°F are in a caution range, and >160°F are at high risk of fire (Ball et al., 1998). Consider removing bales from barns or stacks if temperatures are high to allow heat to dissipate.

**Training is key.** Training of any person (employees, nutritionist, veterinarian, custom operator, etc.) working as part of the silage program is necessary so all persons understand proper management and safety around silage equipment and storage areas. Also, family members must be educated about the dangers related to the silage program. A safety plan should be reviewed with all persons before working in the silage areas, along with frequent reminders of the hazards to help staff and family remember these dangers.

**Silage avalanches or collapses.** Silage avalanches occur no matter how well-managed the pile is. Areas that look to be solid may have a fissure behind them that is about to collapse. The following guidelines can reduce the risk of injury or death by a silage avalanche:

- Work with another person around silage structures in case of a collapse or fall.
- Do not approach the silage face for any reason, such as sampling or removing fallen tires. Sample during feed-out with silage pushed away from the face.
- Do not fill bunkers or piles above the height that unloading equipment can reach easily. This will limit undercutting of the silage face.
- Plan your silage inventory and storage structures to fit that inventory. If excess forage is harvested, it is better to use additional land for silage storage than attempt to put extra forage into a space that is too small.
- When near the silage face, do not stand closer than 3 times the face height since collapsing silage travels a considerable distance.
- Never undercut the silage face by digging the loader bucket into the bottom of the silage.
- If a new crop of silage is put against a previous crop, mark where the two crops meet, as this is where the pile is more likely to collapse.

**Fall from heights.** Falls from silage piles, bunkers, or tower silos can result in severe injury or death. Guidelines to reduce the risk of falls include:

- When going on top of a silage pile or bunker, do not work closer to the face than the silo's height. Remove more tires and plastic than needed (equivalent to the silage face height) to avoid getting close to the edge. Having a small amount of additional surface spoilage is better than risking serious injury or death. A safety harness tethered with a heavy rope or cable across the bunker or pile is recommended to minimize fall risk.
- Do not "fork off" spoilage from the top of a face, as it is not worth the risk of falling off the edge.



A worker dangerously close to the silage face edge removing spoilage.

**Run over by or entangled in equipment.** With more people working in a silage program and larger equipment with more blind spots being used, the risk of accidents increases. These accidents can be avoided by:

- Keeping all shields in place to protect from moving parts; do not cross over the PTO shaft.
- Not allowing non-working persons near harvesting equipment, especially children.
- Wearing highly visible clothing to be easily seen by operators.
- Ensuring operators are well-rested and nourished so they are alert during operations.

**Tractor or truck overturn.** Pack tractor overturns in a bunker silo or silage pile can lead to injury or death, even with protective equipment. These accidents can be avoided by:

- Not filling bunker silos above sidewalls or building silage piles with steep slopes (>1' rise for each 3' of run), especially on the sides.
- Ensuring equipment has a functional rollover protective system, and all employees use seatbelts.
- Installing sight-rails on bunker walls so operators can see the edge.
- Using low-center-of-gravity pack tractors with ample weight, and back-up slopes to reduce risk of rollbacks or flip overs.

**Silage gas.** Silage gases are dangerous and can overcome a person quickly. Nitric oxide forms during the first few weeks of ensiling, especially days 1 to 3. It is a reddish-orange to yellowish-brown gas that accumulates on the silage surface. Nitric oxide changes to nitrogen dioxide when it contacts oxygen and is highly toxic – it burns the mouth, throat, and lungs and can lead to death. Carbon dioxide is odorless and colorless and gives little or no warning before asphyxiation. Carbon dioxide forms in the first 3 weeks and accumulates in closed spaces (unventilated rooms at bottom of tower silos). Feed rooms should be ventilated by opening windows and outside doors, but doors leading to livestock areas should remain closed. When it becomes necessary to enter a tower silo, run the blower for 30 minutes with the top open to ventilate. Use of a rescue-breather and lifeline going to someone outside the silo is recommended. Remember to use the buddy rule!

**Take home message.** Schedule regular meetings with your forage team to discuss safety and include all employees whether or not they work in the forage program. Reward employees and forage team members for safety compliance and accident-free periods.

**References:**

Ball et al. 1998. Minimizing Losses in Hay Storage and Feeding. National Forage Information Circular 98-1.

Coblentz et al. 2012. Effects of a propionic acid-based preservative on storage characteristics, nutritive value, and energy content for alfalfa hays packaged in large-round bales. *J. Dairy Sci.* 95:340-352.

Coblentz et al. 2021. Storage characteristics of baled alfalfa-grass forages treated with a propionic-acid-based preservative or wrapped in stretch plastic film. *App. Anim. Sci.*