SAFETY IN SILAGE OPERATIONS

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ABSTRACT

In today's complex and highly mechanize silage programs, consistently protecting employees, equipment, and property throughout harvesting, filling, and feeding does not occur without thought, preparation, and training. It is best to take steps to eliminate hazards in advance than to rely upon yourself or others to make the correct decision or execute the perfect response when a hazard is encountered. Only experienced people should be permitted to operate equipment associated with harvesting, filling, packing, sealing, and feeding in a silage program. Remember, the silage industry has nothing to lose by practicing safety: it has everything to lose by not practicing it.

Key Words: silage, safety, avalanche, bunker silo, drive-over pile

INTRODUCTION

Few farming operations invite as many different opportunities for injury or fatality as a silage program (Murphy 1994). Silage-related tragedy knows no age boundary as workers and bystanders of all ages have been injured or killed during silage harvest and feedout (Murphy and Harshman, 2006). Although silage injury statistics are not easily collated, countless stories of PTO and harvesting machine entanglements, highway mishaps between farm equipment and automobiles, entanglement in self-unloading wagons and blowers, and encounters with silo gas exist. Increasingly, stories involve bunker silos and drive-over piles (Murphy and Harshman, 2006; Murphy, 2007; Ag Weekly, 2008; and Bolsen and Bolsen, 2010).

Presented here are six hazards involved with managing silage in bunker silos and drive-over piles, and the primary ways these hazards can be eliminated, reduced, or controlled.

SILAGE SAFETY HAZARDS

Tractor or truck roll-over. Tractor roll-overs account for about 50 percent of the approximately Tractor roll-overs account for about 50 percent of the approximately 200 tractor-related fatalities reported annually in the USA (**Figures 1** and **2**).

- Roll-over protective structures (ROPS) create a zone of protection around the tractor operator. When used with a seat belt, ROPS prevent the operator from being thrown from the protective zone and crushed by the tractor or equipment drawn by it.
- A straight drop off a bunker silo wall is a significant risk, so never fill higher than the top of the wall.

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Figure 1. Silage truck and packing tractor operators in dangerous positions above the wall in a bunker silo being filled with field-wilted alfalfa.

- Sight rails should be installed on above ground walls. These rails indicate the location of the wall to the tractor operator but they are not intended to hold an over-turning tractor.
- Install lights to the rail if filling will occur at night.
- When filling bunker silos and drive-over piles, pack tractor operators should always form a progressive wedge of forage, which provides a slope for packing.
- To reduce the risk of a tractor roll-over, it is very important to maintain a minimum slope of 3 to 1 on the sides and ends of a drive-over pile.
- Tractors should be backed up steep slopes to prevent roll backs.
- Use low-clearance, wide front end tractors equipped with well lugged tires to prevent slipping.
- Add weights to the front and back of the tractors to improve stability.
- Never use large rectangular or round hay or straw bales for temporary bunker walls.
- When using front-end loaders to move forage to the bunker or pile, do not carry the bucket any higher than necessary to help keep the center of gravity low.
- When two or more pack tractors are used, establish a driving procedure to prevent collisions.

Figure 2. Pack tractor operator in a dangerous position working on top of a 30-foot high pile (left), and the front-end loader bucket blocking the vision of the pack tractor operator (right).

Large scale beef and dairy operations typically use trucks for transporting chopped forage to the bunker or pile (Swartz, 2010).

- Trucks can overturn on steep forage slopes, particularly if the forage is not loaded and packed uniformly.
- Raise the dump body only while the truck is on a firm surface to prevent an overturn.
- As the bed is raised for unloading, it is important that the load center of gravity stay between the frame rails of the truck frame.
- Trucks are less stable as the bed is raised, particularly if the surface is not perfectly flat.
- A tire rut or depression from a previous load, low tires on one side of a truck, uneven loading of a truck or a wind gust increase the risk of a truck tipping over during unloading, especially when two or more of these hazards combine at a single time point.

A 14-year-old Steele County (Minnesota) youth was killed in a farm accident Thursday night; the Steele County Sheriff's Office has reported (Waseca County News, 2009). Evan Jacobson and his uncle, Jim Jacobson, were unloading sweet corn silage from the back of a tandem axle in the 8900 block of Lemond Road. The box of the truck was raised by a hoist for unloading when the load suddenly emptied, trapping both Evan and Jim Jacobson under the silage, according to a press release issued by Steele County Sheriff Gary Ringhofer. Jim Jacobson managed to free himself and called Evan's father, John Jacobson, to call 911. John Jacobson was found unconscious beneath the silage, the statement said. All efforts to revive the youth were unsuccessful, and he was pronounced dead at the Owatonna Hospital.

Entangled in or run-over by machinery. Keep machine guards and shields in place to protect the operator from an assortment of rotating shaft, chain and v-belt drives, gears and pulleys, and rotating knives on forage harvesters, wagons, and silage feeding equipment. Keep non-workers away from traffic areas, and never allow people on foot (especially children) in or near a bunker or pile during filling or feedout (**Figure 3**). Adjust rear view mirrors and install back-up warning alarms.

Figure 3. An employee walking in a pile to apply an inoculant to the forage during the filling operation (left), employees standing in a dangerous area while sealing an over-filled bunker silo (center), and two people in a payloader bucket taking samples for density measurements (right).

Fall from height. It is easy to slip on plastic when covering or uncovering a bunker or pile, especially in wet weather (**Figure 3**). Standard guardrails should be installed on all above ground level walls. Use caution when removing plastic, tires, or pea gravel bags near the edge of

the feedout face, and never stand on top of a silage overhang, as a person's weight can cause it to collapse. Where necessary, use equipment operating from the ground to remove spoiled silage from the surface of bunker and piles. Never allow a person to ride in the bucket of a front end loader (**Figure 3**).

Crushed by an avalanche/collapsing silage. A major factor contributing to injury or fatality from silage avalanche/collapsing silage is over-filled bunker silos and drive-over piles (Holin, 2010a) (**Figures 4** and **5**).

On December 3, 1999, at 3:45 p.m., six tons of haylage in a bunker silo collapsed on Nick Schriner of Athens, Wisconsin. Schriner was rescued in a matter of minutes but he suffered a C6 spinal cord injury, which classifies him as a quadriplegic (cited by Bolsen and Bolsen, 2009).

It started out as a typical day for dairy nutritionist Doug DeGroff of Tulare, CA (Holin, 2010b). He pulled up to a client's corn silage pile for a forage sample, bucket and pitchfork in hand. After filling the bucket, he turned to walk back to his pickup to mix and core a sample. "The sun basically went out – I could not see any light and the feed hit me on my head and covered me completely," says DeGroff. "I knew what was happening before I hit the ground. The entire face fell on me ... about 20 tons broke away." DeGroff, who had celebrated his 36th birthday with his wife and two toddlers two days before August 27 last summer, was caught in a silage avalanche. DeGroff offered these additional comments, "This particular pile did not look unsafe at all. It was only 11 to 12 feet tall at the time that I sampled it and was mechanically shaven. personally have taken feed samples from piles where I should not have been. I knew they were not safe, but I took the risk. This pile looked safe from any angle you looked at it from. I feel very blessed to be here and that everything still works. Yes, it was a broken back, but it could have been so much more. I am not on pain medication, and I don't think there are going to be long-term issues."

Figure 4. Payloader operators removing corn silage from overfilled bunker silos.

An 11-year old boy died from injuries suffered after a feed pile collapsed on top of him at a Claremont farm (WMUR TV, 2010). Andy Wheeler had previously been listed in critical condition at Dartmouth-Hitchcock Medical Center. Police said it took as long as 20 minutes to find and free Wheeler from the feed pile after the accident Tuesday. Police said the boy was on vacation from Maple Avenue School which is why he was hanging out at the MacGlaflin Farm,

where his father works. He was riding his bike near a silage crib, where livestock feed is stored, police said. "The boy was in a silage crib where there was a large pile of silage, and that overhang collapsed," said Police Chief Alexander Scott. Scott said it took some time for anyone to realize there was a problem. "No one was working on it and no one saw what happened," he said. When he was found, an adult started CPR, and the boy was taken to a hospital … "It's probably a pile close to 25 feet high, so when they are taking silage out, they are digging it out and that can sometimes result in an overhang," he said. School officials said they are preparing for questions from students when they return from spring break.

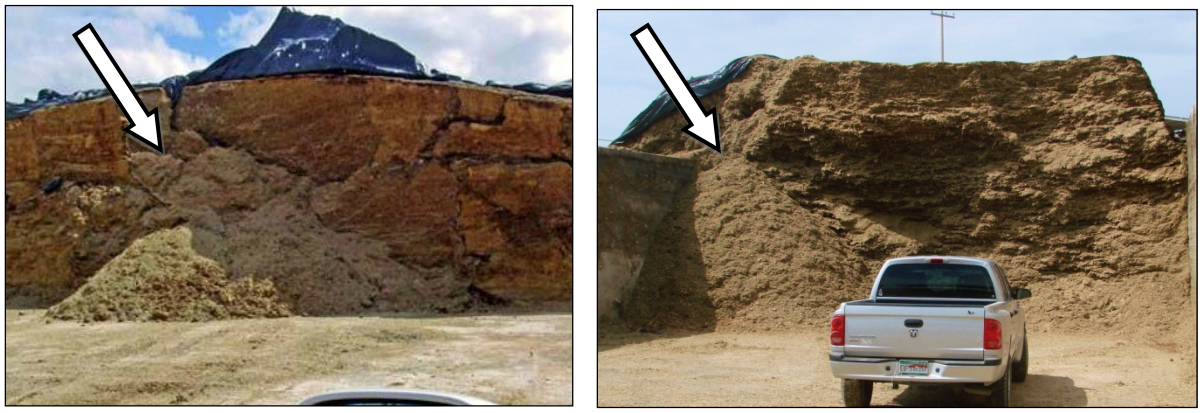

Figure 5. Photos taken just minutes after the avalanches occurred in the two bunker silos.

Sugar Valley Volunteer Fire Company responded to a farm accident in Greene Township after Kenneth R Hettinger, 63, of Rebersburg, PA, became entrapped under three tons of silage (The Express, 2007). Fire personnel said Hettinger was removed from the silage by farm personnel. Sugar Valley Volunteer fire company personnel attempted resuscitate Hettinger but were unsuccessful, and he was pronounced dead at the scene by the Clinton County coroner.

An Eden, NY man was injured Friday, February 24, 2006 after almost five tons of silage fell on him at about 8:40 am (cited by Bolsen and Bolsen, 2009). According to Town of Eden Police Lt. John McCarthy, the employee at Preischel Farm on Belknap Road was cutting the strings to a large bale of hay. When he stepped back, the top of the silage shifted, sending about five tons of loose matter onto the victim, burying him. "He doesn't remember what happened, but he dug himself out of there, crawled away and used his cell phone to get help," said McCarthy. His hat and a pool of blood were found later about 6-feet into the mound of silage, police said. The victim was transported by Mercy Flight to the Erie County Medical Center to be treated for multiple injuries, including some fractured bones, police said.

Avalanche/collapsing silage does not have to happen. Bunker silos and piles should not be filled higher than the unloading equipment can reach safely, and typically, an unloader can reach a height of 12 to 14 feet. Use proper unloading technique that includes shaving silage down the feedout face and never "dig" the bucket into the bottom of the silage. Undercutting, a situation that is quite common when the unloader bucket cannot reach the top of an over-filled bunker or pile, creates an overhang of silage that can loosen and tumble to the floor. Never allow people to stand near the feedout face, and a rule-of-thumb is never stand closer to the feeding face than

three times its height. When sampling silage, take samples from a front-end loader bucket after it is moved to a safe distance from the feedout face. Fence the perimeter of bunker silos and drive-over piles, and post a sign, "Danger: Do Not Enter. Authorized Personnel Only". Numerous gases, including carbon dioxide and nitric oxide, are produced during the first 2 to 3 weeks of the harvesting, filling, and ensiling periods. Silage gases can accumulate in silos, feed rooms or livestock housing areas and can be fatal to humans and animals alike.

Nitrogen dioxide. Nitric oxide changes to nitrogen dioxide (NO_2) when it contacts oxygen in the air. Nitrogen dioxide is a toxic gas, and it can produce a sudden death (Bolsen and Bolsen, 2010). Even a brief exposure to NO_2 can be fatal. Nitrogen dioxide is a reddish-orange to yellowish-brown heavier than air gas, which smells like laundry bleach. The highest levels of NO_2 are usually present during the first 24 to 72 hours after the forage is put into the silo, but dangerous levels can persist for up to 3 weeks.

When inhaled, NO_2 dissolves in the moisture on the internal lung surfaces to form nitric acid. This strong acid burns the pulmonary membrane tissue, effectively stopping the supply of oxygen to the body. Depending on the NO_2 concentration, the presence of this "silo gas" might be recognized by a burning sensation in the nose, throat, and chest. Exposure to high concentrations of NO_2 can cause death within minutes, and the victim would not likely have time to detect respiratory symptoms. Exposure to low or moderate concentrations of NO_2 can cause permanent lung damage and pneumonia. Even small periodic doses of NO_2, such as those that result from working every day in a poorly-ventilated feed room located near the bottom of a tower silo chute, can lead to chronic respiratory problems, including shortness of breath, coughing, and fluid in the lungs. Remember: NO_2 does not give a second chance!

Complacency. Always pay attention to your surroundings and be alert! "The accident happened on June 14, 1974 while making silage at Kansas State University's Research Farm. The blower pipe plugged for about the eighth time that afternoon, and I started to dig the forage out from the throat of the blower. The PTO shaft made one more revolution. Zap! The blower blade cut off the ends off three fingers on my right hand". The injured person, Keith Bolsen, said later, "I was complacent and did something pretty stupid" (cited by Bolsen and Bolsen, 2006).

A dairy nutritionist, Mac Rickels in Comanche, TX, almost lost his life the day he took silage samples from a bunker silo with a 30 foot high feedout face. "Even though I was standing 20 feet from the feedout face, 12 tons of silage collapsed on me. I did not see or hear anything. I had been in silage pits hundreds of times, and you just become kind of complacent because nothing ever happens. It just took that one time" (Schoonmaker, 2000).

CONCLUSIONS

Think safety first! Silage-related injury knows no age boundary as workers and bystanders of all ages have been killed in a silage accident (Agricultural Injury Database, 1980-2004). Even the best employee can become frustrated with malfunctioning equipment and poor weather conditions and take a hazardous shortcut, or misjudge a situation and take a risky action (Murphy, 1994). It is best to take steps to eliminate hazards in advance than to rely upon yourself or others to make the correct decision or execute the perfect response when a hazard is

encountered. Only experienced people should operate equipment associated with harvesting, filling, packing, sealing and feeding in a silage program.

The risk of an accident can be dramatically reduced by the correct sizing of bunker silos and drive-over piles (Holmes and Bolsen, 2009) (**Figure 6**). Spreadsheet software is available to assist producers in designing safe and efficient bunkers and piles (http://www.uwex.edu/ces/crops/uwforage/storage.htm).

Bottom line. It is really not about shrink loss, milk over feed cost, feed conversion, cost of gain, or a close out. It is about sending all employees home to their family safe … everyday!

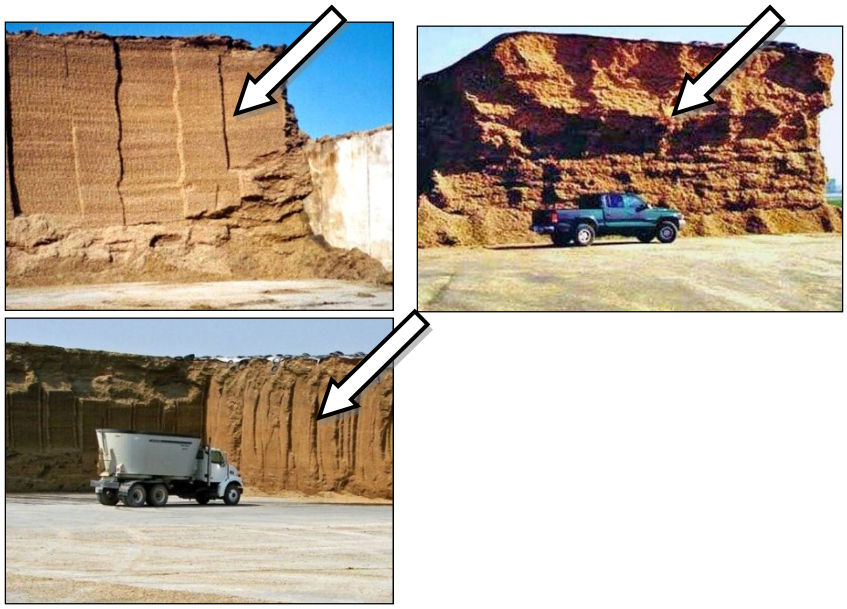

Figure 6. An over-filled bunker silo (left) and two over-filled piles (center and right).

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