

SAFE FARM

Promoting Agricultural Health and Safety



Handle your grain harvest with care

Millions of bushels of grains flow safely from field to storage during harvest each year, but one person trapped in grain can stop the flow in a matter of seconds. All too often, farm workers or family members suffocate beneath the surface of grain. In Iowa, newspaper accounts show that this tragedy is repeated several times a year. Poor harvest or storage conditions can increase the risks, such as in 1993, when 10 Iowans died in grain. The real tragedy is that many of these people did not understand the potential danger of handling grain.

Seconds count in entrapments

Grain handling entrapments happen very quickly. Flowing grain can draw in a person within five seconds. That time is decreased with the use of high capacity unloading equipment, such as large wagons emptied quickly with large augers or legs. As farm equipment becomes faster, humans have less time to respond before they are helpless to the effects of flowing grain.

For example, a high capacity conveyor can move 5,000 bushels of grain an hour. At that rate, a 6-foot tall person would become submerged in only 15 seconds.

Children are at an even greater risk around flowing grain. They are shorter and become submerged quicker than adults. They also do not have the physical strength to pull themselves out of grain before they become entrapped.

Grain traps like quicksand

A grain surface may appear solid, but it is not. A small opening in the unloading gate gives the entire surface the quality of quicksand. When a single kernel is removed from the bottom of a wagon, kernels directly above it rush to fill the void, creating a fluid motion. Flowing

grain is like a fluid; objects on the surface sink, and heavy objects sink faster than light ones.

Even if grain has stopped flowing, submerged objects or people are difficult to extract. Victims with tremendous upper body strength cannot pull themselves out if they are buried to the chest. The force required to remove someone buried below the surface of grain easily can exceed 2,000 pounds, which is about the same as lifting a small car.

You can test your own strength against the force of grain. As an experiment, fill a large container such as a livestock watering trough with grain. Tie a rope to a plywood disk 2 feet in diameter, about the same diameter as a human body. Bury the disk in the grain at the bottom of the container, leaving the end of the rope above the grain surface. Then try to pull out the disk with the rope. It requires more force to pull out a 165-pound person than a wooden disk.

One devastating example of that force occurred when a man was submerged in grain up to his neck. Rescuers believed ropes would keep him from sinking farther into the grain while they emptied the rest of it from the bottom of the bin. However, the force on the rope was so great that two men could not hold the man's head above the grain. He was buried deeper and suffocated before the grain was removed.

How suffocation occurs

Suffocation occurs in several ways during grain-handling entrapments. Investigations reveal that some victims ingest grain. During submersion, grain will flow into voids and openings, such as the mouth or nostrils. In some cases, grain has been found in the stomach, lungs, and throat of victims.

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How much do you know?

1. How long does it take for someone to become helplessly trapped in flowing grain?
 - a) less than 6 seconds
 - b) less than 60 seconds
 - c) more than 60 seconds
2. How much physical force is required to pull out a person buried below the surface of grain?
 - a) less than 400 pounds
 - b) 400 to 1,000 pounds
 - c) more than 1,000 pounds
3. Identify possible way(s) a person can suffocate in grain.
 - a) chest is constricted, breathing is difficult
 - b) grain fills lungs and air passages
 - c) lack of breathable air surrounding a person
 - d) all of the above
4. Children never can ride safely in grain wagons. True or false?

See answers on back.

Suffocation also occurs when the victim is no longer able to inhale air. Pressure in a grain mass can restrict a person's ability to breathe. This happens when the chest cavity and diaphragm shrinks as a person exhales, and grain quickly flows around the body, filling any areas that are voids. On the next breath, the person will have less room to expand the chest cavity and inhale air. This is similar to the way a python strangles its prey. Panic hastens the process, and as the capacity of each breath becomes smaller, the person is unable to inhale enough air to survive.

Another factor is lack of a breathable atmosphere in the grain. Typically, a person requires a specific volume of air. In a grain entrapment, grain restricts the air flow to the area surrounding the submerged person. As the person uses oxygen and exhales carbon dioxide, the air surrounding the person is depleted of its oxygen.

How to prevent entrapments

The easiest way to reduce risk is to eliminate the situation. Always lock all access doors to grain storage structures.

Never allow children to play or ride on grain wagons, or be in the work area. With these rules, children are not exposed to suffocation hazards.

Farm workers, however, must be exposed to some risks. To reduce risk, follow these guidelines:

- Lock out power to all types of grain-handling equipment. Disconnect power and place locks over operating switches. This also helps discourage grain theft.
- Always use the buddy system when you are unloading or loading grain. Notify a second person where you are at all times, who can get help if needed.
- Never enter a bin when grain is caked or spoiled. Moldy, wet grain clumps and as it is unloaded a large air pocket may form just below the surface. This creates a grain bridge that can collapse at any time.

If someone is caught in flowing grain, there are several ways of handling the situation. The action required depends on whether the person is in a wagon, grain bin, or other type of storage structure. Check other references for specific rescue procedures.

Farm workers seldom have the strength or reaction time to save themselves once they are trapped in flowing grain.

However, all farm workers can recognize the dangers of flowing grain, and avoid taking risks in routine tasks.

Prepared by Charles V. Schwab, extension safety specialist, and Mark Hanna, extension agricultural engineer, with Iowa State University.

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What can you do?

The best way to prevent grain suffocation hazards is to avoid dangerous situations.

- Apply suffocation hazard decals to all grain wagons, grain bins, and grain storage structures.
- Lock access doors to grain bins; limit access to the top of grain wagons.
- Instruct everyone who operates grain wagons or grain handling equipment about potential suffocation hazards.
- Make a commitment to always have an extra person present when you must be in an area where there is a potential grain suffocation hazard.

Answers to quiz:

1-a; 2-c; 3-d; 4-True

For more information

Other ISU Extension and Outreach publications may help you develop guidelines for working with animals, or address other related issues. Go to <https://store.extension.iastate.edu>.

Contact your local extension office for other fact sheets in the Safe Farm series.

Materials to use in grain safety presentations for middle school and high school audiences are available in the Tug-of-War with Grain Safety Curriculum, EDC-116. Available from ISU Agricultural and Biosystems Engineering, abe@iastate.edu.

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Safe Farm is an Iowa State University Extension and Outreach project helping to make Iowa farms a safer place to work and live.

For more safety information, check the web at www.abe.iastate.edu.