

TO: Director, National Institute for Occupational Safety and Health

FROM: Iowa FACE Program

SUBJECT: Man dies after getting his leg caught in a grain auger-- Iowa.

SUMMARY:

A 65 year old man working for a farmer during harvest was unloading a gravity flow wagon of corn into a partially unguarded floor hopper. His right leg was caught in the auger at the bottom of the hopper, severing his leg in the mid-thigh region. The man was found lying unconscious next to the hopper with significant bleeding. The auger was still running at the time he was found by the farmer's mother. A chewed up broom handle was found next to him.

The two foot wide floor hopper was covered with grating made of steel bars allowing vehicles to ride over the hopper. Nine of these bars were removed during the time of the incident, leaving an 18 inch section of the auger exposed. The auger consists of two sections; an open U-shaped horizontal section at the bottom of the floor hopper and a closed inclined section leading to the vertical conveyor outside the building (see Picture 1). Since the wagon was empty, it appears that he was finishing the unloading, and possibly sweeping up spilled corn on the floor when his foot slipped into the uncovered hopper and was caught by the moving auger. The man was familiar with the equipment and procedures for unloading, having performed this job several times that season and the year before when this grain facility was built. He had worked part time for the past 4 years for the farmer.

First responders were notified and arrived within a few minutes, but rescue efforts were ineffective due to the large amount of blood loss. The man was taken to a local hospital where he was pronounced dead.

RECOMMENDATIONS based on our investigation are as follows:

Recommendation #1 Workers should not remove protective grates or shields from augers or other conveying equipment while the equipment is in operation.

Recommendation #2 Conveying equipment should be constructed to avoid clogging and operate with minimal cleaning.

Recommendation #3 Employers should ensure that employees have adequate training and supervision to work safely.

INTRODUCTION

In October 1995 a 65 year old man was killed while helping a farmer friend harvest corn. The man was unloading corn from a large gravity flow wagon into a floor hopper and a conveying system at the farmer's private grain facility. He had removed a portion of the steel grating covering the hopper to help unload the corn. While finishing the unloading he apparently slipped and caught his leg in the partially unguarded moving auger. The Iowa FACE program became aware of the incident a few weeks later from the medical examiner's office and began an investigation. Two investigators conducted an on-site visit in January, 1996. Additional information was gathered from police reports, newspaper articles, the coroner's report, and an interview with the farmer who owned the facility.

The farm operation involved grain and beef cattle production on 1000 acres, 650 acres at this location and 350 acres 20 miles away at the other farm location. The owner worked the ground with his teenage son and occasional help from the victim. This was the fourth year the victim had worked during harvest. He was familiar with equipment he was using and the procedures of unloading grain at this two year old facility. There was no written procedure for unloading and safety training was informal. The victim was unloading at the facility alone, while the farmer was combining in the field.

Some modifications to the conveying system had been made due to flooding the previous year. A deeper hopper had been replaced with approximately 1.5 feet deep and two feet wide hopper with a horizontal auger at the bottom.

INVESTIGATION

The private grain facility involved in this accident was two years old and was located on the edge of a field farmed by the owner. It consisted of an unloading building, conveyer system, several storage bins, and a grain dryer. The unloading building was on a raised cement slab allowing large gravity flow wagons to drive through and unload grain into the floor hopper.

The grain conveying system consists of approximately 24 inch wide hopper across the floor area of the unloading building. A 12 inch diameter horizontal floor auger is located at the bottom of the hopper in a u-shaped channel. The auger is driven by a 5 hp electric motor through a transmission and v-belts outside the building on the north side. The floor auger is connected to the second auger section with a U-joint (see Picture 1). This enclosed second auger section is approximately 5 feet long and at 20 degree angle upwards. It leads to a vertical conveyer, a "grain leg", outside the building on the south side.

About one foot section at the south end of the floor auger over the U-joint is covered with a metal structure. The edge of this structure above the auger forms a pinch point with the auger flighting (see Picture 2). When the grate bars were removed this pinch point area was exposed. The victim obviously removed the bars to facilitate unloading, however, the exact reason remained unclear.

Possible explanations include the following:

- 1) If the grain is fed too fast it will pile up on the floor which requires extra cleaning,
- 2) Kernels may bounce off the grate bars to the floor making it necessary to sweep up the floor,
- 3) If the moisture of the corn is high the grating may cause clogging, or
- 4) A small amount of residue corn may be left at the U-joint area of the augers, which may need to be cleaned by reaching into this area.

When a large gravity flow wagon is unloading the space between the wagon and the wall is approximately 4 feet. There is not much room to walk around the opening, and the danger of falling into the unexposed auger is evident. It is necessary to work close to the hopper while unloading for at least these reasons:

- 1) opening, adjusting, and closing the gravity flow wagon's unloading opening
- 2) operating the auger, grain leg and other switches at the electrical panel, which are located on the wall next to the hopper,
- 3) sweeping any spilled corn into the hopper, and
- 4) monitoring the unloading.

According to ASAE S361.3, Section 4, auger flightings must be guarded. 4.2.1.2. states that "slotted openings in baffle style guard(s) shall be no wider than 38 mm (1.5 in.) or closer than 89 mm (3.5 in.) to the exposed flighting." The steel grate over this hopper consisted of bars of approximately 1/2 inch steel stock, 2 inches in height by 24 inches in length. These bars were positioned 2 inches apart down the entire length of the hopper, covering the floor auger. When all bars are in place, the guarding appears to be adequate and according to the ASAE standard. If any of the bars are removed, the guarding is inadequate. Nine bars were removed at the time of the incident.

There were no eyewitnesses to the accident. The victim was seen by the farmer 30 minutes before driving a tractor and pulling the gravity flow grain wagon. He was unloading the last load of corn for that day's work. He was found by the farmer's mother who had stopped by. She saw the victim lying to the east of the auger and noticed his missing leg and the large amount of blood. She thought he was dead at that time. She tried to shut off the auger by pushing several buttons on the electric panel, then drove to the field where her son and grandson were working. The farmer phoned 911 from a cellular phone and advised them that the man was presumed dead. When the three arrived at the grain storage site the floor auger was not running, evidently because the mother had shut it off, but the grain leg was still running. According to the farmer the victim may have tried to reach the switches to shut off the auger after he was injured. However, he did not manage to stop the auger.

The grain wagon was empty, and there was grain around the edge of the hopper on the floor. The stub of a chewed up broom handle lay next to the victim. There was no evidence that the auger had been clogged. It had been raining that day but according to the farmer, the corn was not wet. The farmer stated that the auger had become stalled before when large amounts of grain are fed to the auger. However, the victim was aware of this having unloaded grain many times at this location, and there was no evidence suggesting that the auger had stalled.

The V-belts on the auger were tight and the motor and its controls were all in normal operating

condition. It is assumed that the victim removed the grate to allow the grain to easier enter the auger. He may have been sweeping up spilled grain around the edge of the open space and slipped his leg into the auger, or possibly the broom itself became caught in the auger and he slipped while trying to pull it out.

Rescue workers arrived on the scene in a few minutes, however the man was unconscious and remained unresponsive to CPR efforts. Workers used a cutting torch to remove a two foot section of the auger tube over the inclined portion of the auger hoping to retrieve parts of the victim's leg. The man was transported to the local hospital where he was pronounced dead.

The victim had a history of hypertension and heart surgery 3 or 4 years ago, and it is possible he may have had an ischemic episode prior to the accident, however this is entirely conjecture. No autopsy was performed and it is assumed the cause of death was exsanguination, or critical loss of blood.

CAUSE OF DEATH

The official cause of death from the medical examiner's report was *"exsanguination due to traumatic amputation of right lower extremity"*.

RECOMMENDATIONS / DISCUSSION

Recommendation #1 Workers should not remove protective grates or shields from augers or other conveying equipment while the equipment is in operation.

Discussion: A section of steel bars forming a protective grate over the floor hopper and auger was removed. The auger was exposed and the worker got caught in the auger. The auger flighting and the covered section of the auger form a pinch point, which severed the workers leg. All augers must be guarded according to ASAE S361.3 standard to prevent workers coming in contact with the auger flighting. The guards must be kept in place to avoid injury when the auger is in operation. For cleaning up or maintenance the augers must be securely stopped and accidental starting should be eliminated by lock-out-tag-out procedures.

Recommendation #2 Grain conveying equipment should be constructed to avoid clogging and operate with minimal cleaning.

Discussion: This auger system consists of a horizontal floor auger connected with a U-joint to an angled enclosed section, which leads into a vertical grain leg conveyer. It is possible that in certain conditions this construction slows down the flow of grain. Because the hopper is shallow, it is easy to feed the auger too fast, causing the corn to spill on the floor around the hopper, which requires cleaning. In the U-joint area the auger flighting is discontinued. Small amounts of residual grain may be left in this small pocket under the U-joint. This construction may not be ideal for safe and trouble free unloading.

Recommendation #3 Employers should ensure that employees have adequate training and supervision to work safely.

Discussion: The worker was working alone at the time of the incident. He is assumed to

have removed the grating to facilitate unloading, which created a hazard. According to the employer, he was trained adequately to be aware of the hazards related to unloading, however, the training was informal and not documented. Typically there was no supervision at this site while unloading, since the employer was combining in the field while the employee was unloading. The employer should ensure that the employees have adequate training regarding all hazards. The employer should provide supervision to ensure that safe working procedures are followed.

Picture 1

Picture 2

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Fatality Assessment & Control Evaluation Program (FACE)

The University of Iowa, in conjunction with the National Institute for Occupational Safety and Health (NIOSH), is investigating the causes of work-related fatalities in the State of Iowa. FACE is a surveillance program that identifies all occupational fatalities, conducts in-depth, on-site investigations on specific types of fatalities, and makes recommendations for employers and farmers to help prevent similar fatal accidents in the future.

Iowa is a major farming state, and therefore the Iowa FACE Program deals with many occupational deaths on the farm. It is a very hazardous profession that claims hundreds of lives nationally every year. We publish detailed reports that are disseminated to key agricultural leaders in Iowa who share our concern for the safety of farmers. To reach and effectively communicate with this independent and vulnerable group is a worthy challenge here in Iowa.

NIOSH funded state-based FACE Programs include: Alaska, California, Colorado, Georgia, Indiana, Iowa, Kentucky, Maryland, Massachusetts, Minnesota, Missouri, Nebraska, New Jersey, Wisconsin, and Wyoming.



Additional information regarding this report or the Iowa Face Program is available from:

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