



The National Institute for Occupational Safety and Health (NIOSH)



Farmer Dies After Being Engulfed In Corn Inside A Steel Grain Bin

Minnesota FACE Investigation 94MN058

December 22, 1994

SUMMARY

A 44-year-old male farmer (victim) suffocated after he was engulfed in corn inside a steel grain bin. The bin was equipped with an unloading auger mounted between a raised steel floor and the concrete base that supported the bin. It was also equipped with a ventilation fan designed to circulate air through the grain stored in the bin. The fan was not turned on at the time of the incident. The bin was approximately two-thirds full of corn at the time of the incident.

The victim and his brother were removing corn from the bin on the afternoon of the incident. They were both outside the bin as the unloading auger filled a farm wagon with corn. When the wagon was nearly full, the victim's brother entered the wagon to level the corn. As he leveled the corn, they both noticed that the flow of corn from the auger was gradually decreasing. They thought the reduced flow was caused by crusted grain blocking the auger intake in the bin floor. The victim walked around the bin and climbed a ladder to an access opening in the bin roof. He entered the bin with a steel rod to push through the corn to the auger intake. Apparently after he pushed the rod down into the corn, he broke the crusted grain blocking the auger intake. The flow of corn into the auger suddenly increased and he was quickly engulfed in the flowing grain.

Approximately five minutes after the victim entered the bin, the victim's brother stopped the unloading auger. He immediately climbed the ladder to the roof access opening and noticed only the victim's arm above the corn. He entered the bin and uncovered the victim's head but was unable to pull him from the corn. He exited the bin, placed a 911 call, and notified another brother of the situation. The victim's two brothers entered the bin and pulled the victim from the corn. They began performing resuscitation efforts which they continued until rescue personnel arrived. Rescue personnel removed the victim from the bin and continued resuscitation efforts as the victim was transferred to a local hospital. He was pronounced dead at the hospital approximately one hour after he entered the bin. MN FACE investigators concluded that, in order to reduce the likelihood of similar occurrences, the following guidelines should be followed:

- all equipment used to fill or empty a grain bin should be stopped, and the power source locked out, before workers enter the bin;
- workers should follow established confined space entry procedures when entering grain bins;
- grain bins should be identified as confined spaces and posted with hazard warning signs at all entrances; and
- grain bin ventilation fans should be turned on and operating properly before workers enter bins which are either full or partially full.

INTRODUCTION

On October 3, 1994, MN FACE investigators were notified of a farm work-related fatality which occurred on September 11, 1994. The county sheriff's department was contacted and releasable information obtained. Information obtained included a copy of their report of the incident. A site investigation was conducted by a MN FACE investigator on October 19, 1994.

INVESTIGATION

On the day of the incident, the victim and his brother were removing corn from a steel grain bin. The two year old bin was 30 feet in diameter and was 18 feet high. It had a storage capacity of approximately 10,000 to 11,000 bushels of grain. The bin was equipped with an air circulation system which consisted of a ventilation fan and a raised grated steel floor. When used, the ventilation fan forced outside air into the space between the concrete bin foundation and the raised steel floor. Air was then forced upward through the grain stored in the bin and escaped through seams in the bin roof. The ventilation fan was not turned on at the time of the incident.

The bin was equipped with a 7 inch diameter unloading auger. The unloading system consisted of a horizontal auger mounted below the raised steel floor of the bin, and a nearly vertical auger along the outside of the bin. A 14 inch by 14 inch square auger intake opening was located in the center of the bin floor. The opening was fitted with a steel safety grid. The grid allowed grain to pass through it but prevented workers from being directly exposed to the auger intake located below the bin floor.

The victim's brother estimated that the partially full bin contained approximately 6,000 bushels of corn at the time of the incident. The corn was a mixture of corn grown and harvested during the 1992 and 1993 growing seasons. The corn developed a thin crust during storage which collapsed as corn was removed from the bottom of the bin. The crust was not thick enough to cause bridging of the corn.

The victim and his brother removed corn from the bin on the afternoon of the incident. They were both outside the bin as the unloading auger filled a farm wagon with corn from the bin. When the wagon was nearly full, the victim's brother entered the wagon and leveled the corn in the wagon. As he leveled the corn, they both noticed that the flow of corn from the auger was gradually decreasing. They thought the reduced flow was caused by crusted grain which had reached the auger intake in the bin floor. The victim walked around the bin and climbed a ladder to an access opening in the roof of the bin. He entered the bin with a steel rod to push through the corn to the auger intake located in the bin floor. After he pushed the rod down into the corn, he broke the crusted grain blocking the auger intake. The flow of corn into the auger suddenly increased, and he was quickly engulfed in the flowing grain.

Approximately five minutes after the victim entered the bin, the victim's brother stopped the unloading auger. He immediately climbed the ladder to the roof access opening and noticed only the victim's arm above the corn. He entered the bin and uncovered the victim's head but was unable to pull him from the corn. He exited the bin, placed a 911 call, and notified another brother of the situation. The victim's two brothers entered the bin and pulled the victim from the corn. They began performing resuscitation efforts which they continued until rescue personnel arrived. Rescue personnel removed the victim from the bin and continued resuscitation efforts as the victim was transferred to a local hospital. He was pronounced dead at the hospital approximately one hour after he entered the bin.

CAUSE OF DEATH

The cause of death listed on the death certificate was asphyxiation.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: All equipment used to fill or empty a grain bin should be stopped, and the power source locked out, before workers enter the bin.

Discussion: Workers are exposed to various hazards if they enter or work inside a grain bin while the bin is being filled or emptied. The lack of adequate ventilation inside a bin usually results in high concentrations of dusts as a bin is being filled. Workers not wearing adequate dust masks or respirators will be exposed to these dusts. Exposure to these dusts may have both short- and long-term hazardous health effects. In addition, a worker inside a bin that is being filled is at risk of being buried alive by the incoming grain. Even greater dangers may exist when a bin is being unloaded. When grain is allowed to flow from the bottom of a bin, a worker inside the bin may be quickly engulfed and buried by the flowing grain. Flowing grain acts similarly to quicksand and may create forces so great that once a worker is waist deep in the grain, he or she will be unable to escape, even with the aid of a safety rope. Typical auger unloading rates are high enough that a worker will be pulled below the surface of the grain in less than one minute. Because of these hazards, workers should never enter or work inside a bin when it is being filled or emptied. In addition, all power sources should be locked out to ensure that the loading and/or unloading equipment cannot start accidentally or be started inadvertently by someone else. This may require locking out all electrical circuits that operate electric motors, removing ignition keys from tractors or removing spark plug wires from gasoline engines. If the auger system involved in this incident had been stopped and the electric motor circuits had been locked out, this fatality might have been prevented.

Recommendation #2: Workers should follow established confined space entry procedures when entering grain bins.

Discussion: If entrance to a grain bin is necessary, workers should follow established confined space entry procedures such as those described in NIOSH Publications No. 80-106. Anyone entering a bin should wear a safety belt or harness and a lifeline which is attached to a fixed external anchor point. In addition, a standby person should be stationed outside the bin whenever a worker enters a bin. Visual contact and/or audible communication should be maintained between the worker in the bin and the standby person at all times. Details of a rescue must be discussed and understood by the worker and the standby person before entry into a bin. If established confined space entry procedures had been followed in this case, this fatality might have been prevented.

Recommendation #3: Grain bins should be identified as confined spaces and posted with hazard warning signs at all entrances.

Discussion: Grain bins meet the NIOSH definition of a confined space. A space is considered "confined" if it has any one of the following characteristics: (1) limited openings for entry and exit; (2) unfavorable natural ventilation; or (3) is not designed for continuous worker occupancy. Entrance into confined spaces are addressed in NIOSH Publication No. 80-106 (Working in Confined Spaces). Warning signs to alert farm workers of the hazards associated with grain bins should be posted at all entrances. In some areas, signs should be printed in more than one language for workers who might not be able to read and understand English. If the bin involved in this incident had been identified as a confined space and if warning signs had been posted at the bin entrances, this fatality might have been prevented.

Recommendation #4: Grain bin ventilation fans should be turned on and operating properly before workers enter bins which are either full or partially full.

Discussion: Older grain bins typically were not equipped with ventilation fans. Many grain bins built in recent years have been equipped with electric ventilation fans. These fans are used primarily to circulate unheated air through the stored grain. Ventilation fans force outside air into a space between the concrete bin foundation and a raised steel floor containing shall holes. The air is then forced upward through the grain and escapes through seams in the bin roof. When ventilation fans are operating, they are capable of providing a continuous flow of air through the stored grain. Although this flow of air is small, it may prevent a buried worker from suffocating if the worker is located within a short time after being buried in the grain. The presence and use of ventilation fans does not lessen or eliminate the confined space hazards of steel bins nor does their use reduce the need for workers to follow the guideline provided in Recommendations 1, 2, and 3. If the ventilation fan on the grain bin involved in this incident had been operating at the time of the incident, this fatality might have been prevented.

REFERENCES

1. NIOSH (April 28, 1993). [NIOSH Update: NIOSH Warns Farmers of Deadly Risk of Grain Suffocation](#). Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 93-116.

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