



The National Institute for Occupational Safety and Health (NIOSH)

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Maintenance Worker Suffocates From Engulfment After Falling Into Sawdust Silo

FACE 9104

SUMMARY

A maintenance worker (victim) for a furniture manufacturing company fell headfirst into a sawdust storage silo and suffocated. The silo is 17 feet in diameter, 36 feet high, and has a 24-inch diameter manhole on top near the edge. Although there were no witnesses, evidence suggests that the victim did the following: a) climbed to the top of the silo to check the sawdust level inside, b) removed the manhole cover, c) stuck his head inside the manhole and noted that the silo was nearly full of sawdust, d) reached inside the manhole with a hoe-like tool to "rake down" the sawdust pile, e) slipped from this position, and f) fell headfirst into the sawdust 7 feet below. The upper half of the victim's torso became submerged in the sawdust and the victim suffocated in an upside down position. NIOSH investigators concluded that, in order to prevent future similar occurrences, employers should:

- provide appropriate fall protection equipment to all workers who may be exposed to a fall hazard
- develop and implement safe work procedures for employees who work in, or near, confined spaces containing unstable materials
- develop and implement a comprehensive confined space safety program
- consider retrofitting silos and similar storage facilities with mechanical leveling/raking devices, or other means to minimize the need for workers to climb and enter silos.

INTRODUCTION

On September 21, 1990, a 52-year-old male maintenance worker died after falling headfirst into a sawdust silo. On September 25, 1990, officials of the Virginia Occupational Safety and Health Administration notified the Division of Safety Research (DSR) of the death, and requested technical assistance. On November 15, 1990, a research industrial hygienist from DSR traveled to the incident site and conducted an investigation. The DSR investigator reviewed the incident with company representatives and employees, the medical examiner, and the Virginia OSHA compliance officer assigned to this case. Photographs of the incident site were obtained during the investigation.

The employer in this incident is a furniture manufacturer that has been in business for 60 years. Most of the work performed by the company involves machining hardwood and the assembly of furniture components. The company employs 275 full-time employees, including 6 maintenance workers. The victim had been employed by the company for 8 years as a maintenance worker. The company has a written safety program consisting of hazard communication, lockout/tagout, respiratory protection, and confined space entry components. A safety committee composed of supervising laborers and management is responsible for the safety program. New employees receive on-the-job safety training from supervisors and co-workers.

INVESTIGATION

Wood scraps and sawdust from the plant production areas are removed by a system of mechanical conveyors and suction ducts. The sawdust is stored in one of two steel silos, then burned in the plant boiler. The sawdust is drawn into each silo through an 8-inch diameter duct at the top center of the structure. The larger silo, measuring 25 feet in diameter and 55 feet high, operates about 80 percent of the time. When it is full or being emptied, sawdust is diverted to a smaller silo (measuring 17 feet in diameter and 36 feet high). The smaller silo will fill up in about 5 days when the plant is in full operation (Figures 1 & 2).

The victim was responsible for keeping the scrap wood conveyors, sawdust removal ducts, and the two silos operating. Whenever the smaller silo was in operation, the victim would visually check the sawdust level inside the silo twice a day. The victim would climb a staircase attached to the side of the silo, remove the cover to a 24-inch-diameter manhole located at the top near the edge, and peer inside (Figure 3). If the tip of the sawdust pile or cone was close to the inlet duct, the victim would "rake it down." This was done by reaching inside the manhole with a tool resembling a garden hoe with a 10-foot-long aluminum handle. The victim kept this tool on top of the silo near the manhole (Figures 2 & 3).

The smaller silo was in operation on the day of the incident. At 1:15 p.m., the victim entered the boiler room and informed the maintenance supervisor that he believed the smaller silo was nearly full, and that he was going to check the sawdust level. Although there were no eyewitnesses to the incident, based on the circumstances and evidence, it is presumed that the following sequence of events occurred (Figures 3 & 4):

- the victim climbed the stairs to the top of the small silo and opened the manhole cover
- the victim crouched, or laid down, stuck his head inside the manhole and noted that the silo was nearly full of sawdust
- the victim reached inside the manhole with the hoe to rake down the sawdust pile
- the victim slipped from his position and fell 7 feet, headfirst into the sawdust
- the upper half of the victim's torso became submerged in the sawdust and the victim suffocated in an upside-down position.

About 30 minutes later, a co-worker entered the boiler room and asked the maintenance supervisor if he had seen the victim. The maintenance supervisor told the co-worker that the victim had gone to check on the sawdust level in the smaller silo. The co-worker climbed to the top of the silo and peered inside the manhole. He saw the victim's legs sticking out of the sawdust, and the hoe lying on top of the sawdust. The co-worker yelled to the victim, but there was no response.

The co-worker ran back to the boiler room and told the maintenance supervisor what had happened. The maintenance supervisor radioed the plant superintendent, who called the emergency medical service (EMS). The plant superintendent, maintenance supervisor, co-worker and several other workers ran up the stairs to the top of the silo. The superintendent tied a rope around his waist, the other workers lowered him into the silo through the manhole, and he tied a rope around the victim's waist. The workers pulled the victim out while the superintendent assisted from inside the silo. After the superintendent was pulled out of the silo, he carried the victim down the stairs to the ground. By this time, EMS personnel had arrived at the scene (about 10 minutes after the emergency call was received). EMS personnel administered cardiopulmonary resuscitation to the victim at the scene and en route to the local hospital. The victim was pronounced dead on arrival by the attending physician.

CAUSE OF DEATH

The medical examiner listed the cause of death as suffocation due to submersion in sawdust.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should provide appropriate fall protection equipment for all workers who may be exposed to a fall hazard.

Discussion: Employers should provide appropriate fall protection equipment for all workers exposed to fall hazards, and should provide worker training in the proper use of this equipment. Once this training is provided, employers should initiate measures to ensure the use of this fall protection equipment. A safety belt and lanyard, suitably anchored, would be appropriate fall protection equipment for use on top of sawdust silos. This type of fall protection equipment has an additional life-saving benefit. When properly installed, such fall protection equipment will prevent workers from being engulfed if they fall into a silo or other confined space containing unstable materials.

Recommendation #2: Employers should develop and implement safe work procedures for employees who work in, or near, confined spaces containing unstable materials.

Discussion: OSHA construction safety standard 29 CFR 1926.250(b)(2), General Requirements for Storage, requires workers to use safety belts while working on stored materials in silos, bins, or other similar storage areas. The Mine Safety and Health Administration (MSHA) has requirements for storage of materials in the mining industry (39 CFR 56). These requirements address the storage of loose, unconsolidated materials, safe access, and the use of safety belts and lines. In the absence of general industry standards covering such work, these requirements are appropriate for application to similar situations in general industry. Life lines and harnesses should be present at the entrances of confined spaces containing unstable materials, and should be used by all workers (including rescuers) entering confined spaces. Optimally, lifelines and harnesses should be incorporated into the design of the silo by the manufacturer. Silos without this design feature should be provided with appropriate safety equipment, by the employer, and use should be mandatory. Workers should be trained in the proper use of this equipment. Some lifelines, harnesses, and human hoisting devices designed for confined space entry are also rated for fall protection (Recommendation #1). A NIOSH Alert entitled "Request for Assistance in Preventing Entrapment and Suffocation Caused by the Unstable Surfaces of Stored Grain and Other Materials" provides additional recommendations pertaining to work on or around silos.

Recommendation #3: Employers should develop and implement a confined space safety program.

Discussion: Employers should ensure that employees are aware of the potential hazards, possible emergencies, and specific procedures to be followed prior to working in, or around, a confined space. At a minimum, as discussed in NIOSH publications 80-106, "Working in Confined Spaces," and 87-113, "A Guide to Safety in Confined Spaces," the following items should be addressed:

1. Testing the air quality to determine adequate oxygen level and the presence of combustible and toxic air contaminants
2. adequate ventilation to remove air contaminants
3. monitoring the space to determine that a safe atmosphere is continuously maintained
4. training employees in confined space entry, testing, and the use of personal protective equipment, safety harnesses, respirators, clothing, etc.
5. stationing a standby attendant outside the space for communication and visual monitoring
6. emergency rescue procedures
7. identifying and controlling the hazards associated with unstable surfaces.

Recommendation #4: Employers and manufacturers should consider retrofitting silos and other similar storage facilities with mechanical leveling/raking devices, or other means to minimize the need for workers to climb or enter silos.

Discussion: Silos, bins, hoppers, tanks, transport vehicles, and surge piles where loose materials are stored, handled, or transferred should be equipped with mechanical leveling/raking devices or other means for remotely handling materials. Such devices would minimize the need for workers to climb or enter such storage facilities. Usually cone shaped piles of loose material can be leveled, and bridging of material prevented, by mechanical agitation or vibration of stored materials.

REFERENCES

Office of the Federal Register, Code of Federal Regulations, Labor, 29 CFR 1926.250(b)(2), U.S. Department of Labor, Occupational Safety and Health Administration, Washington, D.C., July 1989.

Office of the Federal Register, Code of Federal Regulations, Labor, 39 CFR 56.16002, 39 CFR 56.11001, and 39 CFR 56.15005, U.S. Department of Labor, Mine Safety and Health Administration, Washington, D.C., July 1989.

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National Institute for Occupational Safety and Health, Criteria for a Recommended Standard...Working in Confined Spaces, DHHS (NIOSH) Publication Number 80-106, December 1979.

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