The National Institute for Occupational Safety and Health (NIOSH)

Farmer Asphyxiated in Manure Waste Pit

Minnesota FACE Investigation 94MN045

November 4, 1994

SUMMARY

A 32-year-old male farmer (victim) died from asphyxiation after entering an underground manure waste pit. The victim and his wife worked for several days pumping manure from the pit. The nearly empty pit contained approximately 2 feet of liquid manure at the time of the incident. Manure was drawn or vacuumed from the pit into a manure spreader tank using a power take-off driven air pump. The pump was mounted on the spreader in front of the manure tank. A hose from the spreader tank was inserted into the pit through a round access opening located near the south end of the pit. The spreader air pump filled the spreader tank by creating a vacuum within the tank. After filling the spreader tank, the victim closed a tank valve and disconnected the hose from the bottom of the tank. He left the end of the hose which had been connected to the tank, on the ground next to the pit opening. When he returned from spreading a load of manure on a farm field, he parked the tractor and spreader near the opening to the pit. Apparently, while he attempted to reconnect the hose to the tank, the hose slipped from his hands and fell into the pit.

He inserted a ladder into the pit and climbed down to retrieve the hose. While standing on the ladder, he was unable to grasp the hose. After a few minutes, he felt the effects of the hazardous gases he was exposed to and exited the pit. Approximately ten minutes later, he re-entered the pit and attempted to retrieve the hose. Again, he was unable to reach the hose while standing on the ladder. When he again felt the effects of the hazardous gases, he climbed to the top of the pit to breath fresh air. He remained on the ladder with only his head and shoulders above ground level for several minutes. He descended the ladder a third time to attempt to retrieve the hose. He again failed to reach the hose and began to climb the ladder. As he neared the top of the pit, he lost consciousness and fell into the pit. His wife immediately called emergency personnel. Rescue personnel equipped with self-contained breathing apparatus entered the pit and removed the victim. He died a short time later at a local hospital. MN FACE investigators concluded that, in order to reduce the likelihood of similar occurrences, the following guidelines should be followed:

- **positive-pressure, self-contained breathing apparatus should always be used by workers when entering manure waste pits;**
- **manure waste pits should be identified as confined spaces and posted with hazard warning signs at all entrances;**
- **workers should never enter manure waste pits unless absolutely necessary and only when following established confined space entry procedures;**
- **manure waste pits should be equipped with a powered ventilation system; and**
- **farm workers and family members should never enter a confined space to attempt a rescue operation without proper consideration for their own safety.**

INTRODUCTIONS

On August 25, 1994, MN FACE investigators were notified of a farm work-related fatality which occurred August 25, 1994. A site investigation was conducted, in conjunction with a local police department, by a MN FACE investigator and a Minnesota Farming Health Project public health nurse on September 27, 1994. During the site investigation, information concerning the incident was provided by the victim's wife.

INVESTIGATION

The victim and his wife worked for several days pumping manure from an underground manure waste pit. The nearly empty pit contained approximately 2 feet of liquid manure at the time of the incident. The pit was located adjacent to an older traditional hog barn which was modified for use as a confinement building two years ago. Manure was washed from the floor of the building into a gutter along the perimeter of the building. From the gutter, the manure drained through an underground pipe into the north end of the pit. The pit was 30 feet long, 10 feet wide, and approximately 8 feet deep. Near the south end of the pit was a 30 inch diameter round opening which was covered with a removable, 4 inch thick, concrete cover. The pit was not equipped with any type of ventilation system or gas monitoring equipment.

Manure was drawn or vacuumed from the pit into a manure spreader tank using a power take-off driven air pump. The air pump was mounted on the spreader in front of the manure tank. The pump was used to either fill or empty the spreader tank by pumping air out of or blowing air into the tank, respectively. A hose, 6 inches in diameter and 25 feet long, was connected to the bottom of the spreader tank. The victim removed the cover from the access opening and inserted the hose into the pit. The air pump filled the spreader tank by creating a vacuum within the tank. After filling the spreader tank, he closed a tank valve and disconnected the hose from the bottom of the tank. He left the end of the hose which had been connected to the tank on the ground next to the pit opening. When he returned from spreading a load of manure on a farm field, he parked the tractor and spreader near the opening to the pit. Apparently, while he attempted to reconnect the hose to the spreader tank, the hose slipped from his hands and fell into the pit.

He inserted a ladder into the pit and climbed down to retrieve the hose. While standing on the ladder, he was unable to grasp the hose. After a few minutes, he felt the effects of the hazardous gases he was exposed to and exited the pit. Approximately ten minutes later, he re-entered the pit and attempted to retrieve the hose. Again he was unable to reach the hose while standing on the ladder. When he again felt the effects of the hazardous gases, he climbed to the top of the pit to breath fresh air. He remained on the ladder with only his head and shoulders above ground level for several minutes. He descended the ladder a third time to attempt to retrieve the hose. He again failed to reach the hose and began to climb the ladder. As he neared the top of the pit, he lost consciousness and fell into the pit. His wife immediately called emergency personnel who arrived at the scene approximately 30 minutes later. They entered the pit, equipped with self-contained breathing apparatus, and removed the victim. He died a short time later at a local hospital.

CAUSE OF DEATH

The cause of death listed on the death certificate was asphyxiation from gas in hog manure pit.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Positive-pressure, self-contained breathing apparatus should always be used by workers when entering manure waste pits.

Discussion: The anaerobic decomposition of manure in waste pits produces a variety of harmful gases. Among the most hazardous are hydrogen sulfide, methane, ammonia, and carbon dioxide. These gases are a primary concern because of the high levels which are produced and because of their toxic effects. When manure waste pits are pumped, any agitation

of the liquid manure causes a rapid release of gases suspended in the liquid. A rapid release of hydrogen sulfide, ammonia, and carbon dioxide quickly produces an extremely toxic atmosphere within an underground pit or possibly within a confinement building directly above a manure pit. Since hydrogen sulfide and carbon dioxide are heavier than air, these gases tend to settle and remain in high concentrations within pits as the pits are emptied. Because of the potential existence of an oxygen-deficient and/or toxic atmosphere within manure waste pits, positive-pressure, self-contained breathing apparatus should be used when workers enter these pits. Although self-contained breathing equipment and training in its proper use may not be available to farm workers, these workers should be informed of potential hazards associated with manure waste pits, such as oxygen-deficient or toxic atmospheres. If a positive-pressure, self-contained breathing apparatus had been used by the victim in this incident, this fatality might have been prevented.

Recommendation #2: Manure waste pits should be identified as confined spaces and posted with hazard warning signs at all entrances.

Discussion: Manure waste pits meet the National Institute for Occupational Safety and Health (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). Ideally, a manure pit should be ventilated, and the atmosphere within the pit should be tested prior to entry and monitored while work is being performed. Warning signs to alert farm workers of the hazards associated with manure waste pits 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 pit involved in this incident had been identified as a confined space and if a warning sign had been posted at the pit entrance, this fatality might have been prevented.

Recommendation #3: Workers should never enter manure waste pits unless absolutely necessary and only when following established confined space entry procedures.

Discussion: Manure waste pits should never be entered unless it is absolutely necessary because of the potential presence of hazardous concentrations of dangerous gases. If entrance to a pit is necessary, workers must follow established confined space entry procedures such as those described in NIOSH Publications 80-106. Anyone entering a pit should wear a safety belt or harness and a lifeline which is attached to a fixed external anchor point. These procedures also include the presence of a standby person stationed outside the pit. Visual contact and/or audible communication should be maintained between the worker in the pit and the standby person at all times. If the standby person is not physically capable of removing the worker from the pit, then a mechanical lifting device (winch, hoist, etc.) should be positioned over the pit entrance. Details of a rescue must be discussed and understood by the worker and the standby person before entry into a pit. In addition, NIOSH has prepared an Alert, Publication No. 90-103, which describes the hazards associated with farm manure waste pits. If established confined space entry procedures had been followed in this case, this fatality might have been prevented.

Recommendation #4: Manure waste pits should be equipped with a powered ventilation system.

Discussion: Manure waste pits should be equipped with supply and exhaust ventilation to eliminate the accumulation of hazardous gases. The system should be composed of fans with sufficient capacity to ensure constant circulation of fresh air throughout the manure waste pit system. In the case of explosive gases such as methane, the system should be capable of preventing the gas from reaching its explosive level or concentration. In addition, the system should be of explosion-proof design as defined in the National Electrical Code, Article 100-A. If the pit involved in this incident had been equipped with a ventilation system and if the system had been in operation at the time of entry, this fatality might have been prevented.

Recommendation #5: Farm workers and family members should never enter a confined space to attempt a rescue operation without proper consideration for their own safety.

Discussion: Manure waste pit incidents often result in multiple fatalities when coworkers or family members attempt to rescue the initial victim. In this case, a family member at the scene did not enter the pit but immediately placed a call to local rescue personnel. Personnel attempting rescue operations within a confined space should be properly equipped and trained in the use of the equipment and methods required for rescue. The hazardous agent(s) in a confined space which affected the victim(s) will have the same affect on any rescuer(s) who enter the space without proper personnel protective equipment. Farm workers and family members should immediately contact a local emergency rescue squad and/or a local fire department whenever someone in a confined space is in need of emergency assistance. These personnel are properly trained and equipped to safely accomplish rescues from confined spaces without additional endangerment to human life.

REFERENCES

1. NIOSH (1979). Criteria For a Recommended Standard: Working in Confined Spaces. Morgantown, WV: U.S. Department of Health, Education, and Welfare, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, DHEW (NIOSH) Publication No. 80-106.

2. NIOSH (1990). NIOSH Alert: Request for Assistance in Preventing Deaths of Farm Workers in Manure Pits. 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. 90-103.

3. National Electrical Code: ANSI/NFPA 70, An Americal National Standard. August 14, 1992.

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Back to NIOSH FACE Web

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