The National Institute for Occupational Safety and Health (NIOSH)

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Hog Farm Co-Owner and Employee Die of Hydrogen Sulfide Poisoning in Manure Pit–Minnesota

FACE 9228

SUMMARY

A 27-year-old male hog farm employee (victim #1) died as a result of hydrogen sulfide poisoning when he entered a manure- waste pit to extract a pump. The 46-year-old farm co-owner, the victim's uncle (victim #2), also died from hydrogen sulfide poisoning when he entered the pit in a rescue attempt. The manure pit was a holding facility for manure that drained from five holding barns on the property before being pumped to a holding pond 150 feet away. When victim #1 and a co-worker tried to pump the manure from the pit, they discovered that the pump intake was clogged. A tripod-mounted come-a-long was positioned directly over the pit so the pump could be extracted for servicing. A 3-inch wire rope was attached to an eye bolt at the top of the pump. As the workers tried to raise the pump from the pit, the wire rope broke. The following morning victim #1 went to one of the barns to get a length of rope with a hook at its end to attach to the pump's eye bolt. As he prepared to descend the ladder into the pit, he was warned by his co-worker that poisonous gases might be present in the pit. Victim #1, explaining to the co-worker that he had entered the pit several times in the past and that he would be fine, descended the ladder into the pit. As he reached for the pump, he collapsed and fell into the manure. The co-worker ran to the farm office and called the rescue squad, then contacted the co-owner by two-way radio and told him what had happened. When the co-owner arrived, he decided to enter the pit with a rope to tie around the victim. The co-worker tried to restrain the co-owner from entering the pit, but the co-owner insisted that he had to go into the pit and help his nephew. The co-owner (victim #2) then entered the pit, and, as he attempted to tie the rope around the victim, collapsed on top of the victim. The rescue squad, equipped with self-contained breathing apparatus, removed the victims from the pit. NIOSH investigators concluded that, to prevent future similar occurrences, employers should:

- **identify manure-waste pits as confined spaces and post hazard warning signs at all entrances**
- **instruct farm employees never to enter manure-waste systems unless absolutely necessary, and only when following safe entry procedures**
- **instruct farm employees never to enter a manure pit, or any other confined space, to attempt a rescue operation without proper consideration for their own safety**
- **periodically inspect equipment for physical damage, especially equipment located or used in corrosive environments**
- **equip manure-waste systems with some type of powered ventilation system.**

Additionally, manufacturers of equipment designed for use in manure-waste pit systems should:

- **include warnings on the potential hazards associated with these systems.**

INTRODUCTION

On August 8, 1992, a 27-year-old male farm worker (victim #1) died of hydrogen sulfide poisoning when he entered a manure-waste pit to attach a rope to a pump so that the pump could be removed from the pit. The 46-year-old farm co-owner (victim #2) also died from hydrogen sulfide poisoning when he entered the pit in a rescue attempt. On August 12, 1992, officials from the Minnesota Fatality Assessment and Control Evaluation (FACE) program notified the National Institute for Occupational Safety and Health (NIOSH), Division of Safety Research (DSR) of these fatalities, and requested technical assistance. On September 2, 1992, a DSR safety specialist and two FACE field investigators from the state of Minnesota traveled to the incident site to conduct an investigation. The investigative team reviewed the incident with the farm co-owner and county extension agent, photographed the incident site, and obtained reports from the sheriff, coroner and emergency rescue squad.

The employer was a multi-farm hog-farming operation that processed approximately 10,000 hogs annually. These hogs, separated by different stages of growth, were housed on nine farms in the area. The farm employed 10 workers and had been in operation for 18 years. The employer had no written safety program or safe work procedures. The employer had no previous fatalities.

INVESTIGATION

The manure-waste pit in this incident was 12-feet deep and 49 inches in diameter. It was covered by a 7-inch-thick circular concrete slab with a 28-inch diameter opening in its center. The interior of the pit was accessed by a ladder anchored to the side of the pit. The manure entered the pit through five gravity-fed drains leading from five holding barns. Occasion- ally, the pump intake, located within the pit, would become clogged with debris from one of the barns. When this occurred, the pump was extracted from the pit using a tripod-mounted come-a-long that was positioned directly over the pit. A 3-inch wire rope from the come-a-long remained attached to the eye bolt on the top of the pump at all times.

On the afternoon before the incident, the farm worker (victim #1) and a co-worker went to the manure pit to pump it out, but found that the pump intake was clogged with debris. The men tried to raise the pump from the pit but the 3-inch wire rope attached to the eye bolt at the top of the pump broke. The two men then decided to wait until the following morning to repair the pump and replace the wire rope.

On the following morning, victim #1 told the co-worker that he was going to climb down the ladder to attach a new wire rope and hook to the eye bolt on the pump. The co-worker warned the victim not to enter the pit because of the possibility of poisonous gases in the pit. The victim told the co-worker that he had entered the pit several times in the past and had never experienced any problems. He then descended the ladder approximately 9 feet into the pit. As the victim bent over to attach the hook to the eye bolt he collapsed into the manure. The co-worker immediately ran to the office and called the emergency rescue squad, then contacted the co-owner by two-way radio and told him what had happened. The co-owner (victim #2) arrived at the farm, found some rope to tie around the victim, then ran to the pit. The co-worker repeated his warning about the presence of poisonous gases to the co-owner, but the co-owner insisted that he had to try to rescue his nephew. The co-worker tried to physically restrain the co-owner from entering the pit but failed. The co-owner then descended the ladder into the pit, and as he tried to tie the rope around victim #1, he was overcome and collapsed on top of victim #1. The emergency rescue squad arrived 10 minutes after the co-owner entered the pit and approximately 20 minutes after victim #1 was overcome. Using self-contained breathing apparatus, the rescue squad removed the victims from the pit. The victims were transported to the hospital where they were pronounced dead.

Gas readings taken by the FACE team during their investigation showed no measurable levels of hydrogen sulfide or methane, and an oxygen level of 20.4%. It should be noted that on the day of the incident and the preceding day, the temperature was in the mid 90s and the humidity was about 95%; the barometric reading was 30.2 and there was no wind. These conditions would have been favorable for a buildup of hydrogen sulfide and/or methane inside the pit. At the time of the investigation, the temperature was 65 degrees and the conditions were windy.

CAUSE OF DEATH

The coroner listed the cause of death for both victims as hydrogen sulfide poisoning.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should identify manure-waste pits as confined spaces and post hazard warning signs at all entrances.

Discussion: Manure-waste pits, by their design, meet the NIOSH definition of a confined space. A space is considered "confined" if it: 1) has limited openings for entry and exit; 2) has unfavorable natural ventilation which could contain or produce dangerous air contaminants; and 3) is not intended for continuous employee occupancy. Entrance into confined spaces, as described in this incident, 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 tested prior to entry and monitored while work is being per- formed. Self-contained breathing apparatus should be utilized by those entering the pit if an oxygen-deficient and/or toxic atmosphere is found to exist. Although such specialized equipment and training in the use of this equipment may not be readily available to many farm workers, these workers should, at a minimum be made aware of potential hazards associated with manure-waste pits, such as oxygen-deficient or toxic atmospheres. Signs to alert farm workers of the hazards associated with manure-waste pits should be posted at all entrances. These signs should be understandable to workers who might not be able to speak or read English. In some areas, signs in more than one language might be necessary. NIOSH has prepared an Alert de- tailing the hazards associated with manure-waste pits on farms (NIOSH Publication No. 90-103). Additionally, NIOSH requests the assistance of agricultural extension agents, farm journals, agricultural associations, and farm equipment manufacturers in alerting farm workers to the hazards associated with manure-waste pits.

Recommendation #2: Employers should instruct farm employees never to enter manure-waste systems unless absolutely necessary and only when following safe entry procedures.

Discussion: In this incident, the manure pit was entered by the first victim on numerous occasions without incident. Previous uneventful entries may lead farm workers to feel safe about entering these pits. Because dangerous gases may be present, a manure-waste pit system should never be entered unless absolutely necessary. If entrance into the pit is necessary, workers must follow safe confined space entry procedures (See NIOSH Publications 80-106 and 90-103). Additionally, a standby person(s) with the capability of removing the person from the pit, if necessary, should be stationed outside the pit. Visual and/or audible contact must be maintained with the person in the pit at all times. If the standby person(s) is not physically capable of removing the person from the pit, then some sort of mechanical lifting device (a winch, hoist, etc.) should be in position over the pit. Anyone entering the pit to perform any work should wear a safety belt or harness and have a lifeline attached to a substantial anchor point outside the pit. This would enable a standby person(s) to remove someone from the pit without entering the pit. Details of a rescue plan must be resolved and understood before entry. Should an emergency develop, a short delay caused by lack of preparation could be fatal.

Recommendation #3: Employers should instruct farm employees never to enter a manure pit, or any other confined space, to attempt a rescue operation, without proper consideration for their own safety.

Discussion: Farm workers should never, under any circumstances, enter a manure pit to attempt a rescue operation unless properly equipped and trained in the use of the equipment and methods required for rescue. The agent that caused the victim(s) in the pit to be overcome will have the same effect on any would-be rescuer, and the rescuer(s) themselves may become a victim. Farm workers should be instructed that if anyone is observed to be unconscious or ill inside a pit, they should immediately contact the local fire department or emergency rescue squad. These squads will have the training and equipment needed to accomplish a rescue without further endangerment to life.

Recommendation #4: Employers should periodically inspect equipment for physical damage, especially equipment located or used in corrosive environments.

Discussion: In this incident, the unwritten standard operating procedure called for the pump to be raised from the manure pit for maintenance. A wire rope was connected to the pump for this purpose; however, when the workers attempted to raise the pump, the wire rope broke. Since the pump was raised from the pit at least once a month for maintenance or repair, a visual inspection for physical damage to the pump, wire rope, or any other components could have been conducted at this time. Any damaged component should be repaired or replaced immediately. This would be especially important for components used in a corrosive environment such as a manure pit.

Recommendation #5: Employers should equip manure-waste systems with some type of powered ventilation system.

Discussion: Ideally, manure-waste systems should be equipped with both supply and exhaust ventilation to eliminate the accumulation of gases. In the case of explosive gases such as methane, the system should be of sufficient size to prevent the gas from reaching its explosive limits and should be of explosion-proof design as defined in the National Electrical Code, Article 100-A. The system may be composed of portable fans, but must be of sufficient capacity to ensure constant circulation of fresh air throughout the waste system, and be of explosion-proof design.

Recommendation #6: Manufacturers of equipment designed for use in manure-waste pit systems should include warnings on the potential hazards associated with these systems.

Discussion: Manufacturers of this type of equipment should provide purchasers with information concerning the potential hazards that may be encountered when using this equipment in manure-waste systems. Information (such as diagrams, etc.) about installing this equipment so that it can be serviced without requiring workers to enter the pit should also be provided.

REFERENCES

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.

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.

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

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