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NON-CIRCULATING

Texas Preventable Disease



NEWS

Frank Bryant, Jr. MD, FAAFP
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Robert Bernstein, MD, FACP
Commissioner

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**Bureau of Disease Control and Epidemiology,
1100 West 49th Street, Austin, Texas 78756 (512-458-7455)**

FATALITIES ATTRIBUTED TO METHANE ASPHYXIA IN MANURE WASTE PITS -- OHIO, MICHIGAN, 1989*

In June and July 1989, a total of seven farm workers in two separate incidents died after they were asphyxiated by methane gas in manure pits. Brief reports follow.

Ohio. On June 26, 1989, a 31-year-old male dairy farmer and his 33-year-old brother died after entering a 25-foot-square by 4 1/2-foot-deep manure pit inside a building on their farm. A pump intake pipe in the pit had clogged, and the farmer descended into the pit to clear the obstruction. While in the pit, he was overcome by lack of oxygen and collapsed. His brother apparently saw him collapse and entered the pit in an attempt to rescue him. The brother, too, was overcome and collapsed inside the pit. Four hours later, another family member discovered the two men, and the local fire department was called to rescue them. The coroner's report attributed the cause of death in both cases to drowning, secondary to loss of consciousness from methane asphyxia.

Michigan. On July 26, 1989, five farm workers in one family died after consecutively entering an outdoor manure pit on a farm. The pit measured 20 feet by 24 feet by 10 feet deep. The victims were a 65-year-old male dairy farmer, his two sons (aged 37 and 28 years), a 15-year-old grandson, and a 63-year-old nephew. The index victim, the 37-year-old son, initially entered the pit by ladder to replace a shear pin on an agitator shaft. While attempting to climb out of the pit, he was overcome and fell to the bottom of the pit. The grandson then entered the pit to attempt rescue. He, too, was overcome and collapsed. One by one, the nephew, the younger son, and dairy farmer entered the pit in attempts to rescue the others, were overcome by lack of oxygen, and collapsed. A carpet installer working at the farm then entered the pit as a rescuer and was overcome; however, he was rescued by

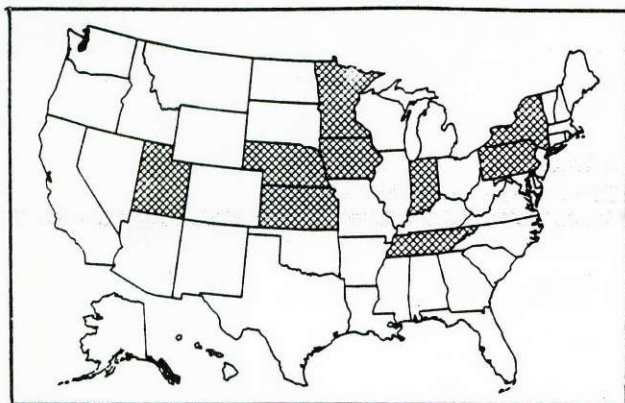
his assistant and subsequently recovered. Finally, the owner of a nearby business arrived with two additional workers and, using a rope, extricated the five victims from the pit. When paramedics arrived, they began cardiopulmonary resuscitation. The nephew was pronounced dead at the scene, and the other four victims were transported to the emergency room of a nearby hospital. The dairy farmer and his younger son were pronounced dead on arrival at the hospital; the 37-year-old son died one hour after reaching the emergency room. The grandson was transferred by helicopter to a major trauma center but died within six hours of his removal from the pit. For the four older victims, the medical examiner attributed the cause of death to methane asphyxia. Assignment of the official cause of death for the grandson awaits completion of the autopsy report.

MMWR Editorial Note: Acute traumatic occupational deaths** in the US are monitored by the Division of Safety Research, National Institute for Occupational Safety and Health (NIOSH), CDC, through the National Traumatic Occupational Fatalities (NTOF) file. For 1980 through 1985, the NTOF data file includes 16 work-related deaths that involved asphyxiation of workers in manure pits (or similar waste tanks) on farms. These deaths resulted from nine separate incidents in nine different states (Figure 1). Five of these episodes resulted in multiple fatalities. Because NTOF only includes deaths of workers >16 years of age that are clearly identified as work-related, these 16 deaths represent the minimum number of asphyxiation fatalities that occurred during this period among US farmers, farm family members, farm workers, and others working in manure pits.

*CDC. MMWR 1989;38(33):583-6.

**International Classification of Diseases, Ninth Revision, E800-R000

Figure 1. States with fatal work-related incidents in manure pits -- US, 1980-1985



Source: National Traumatic Occupational Fatalities database.

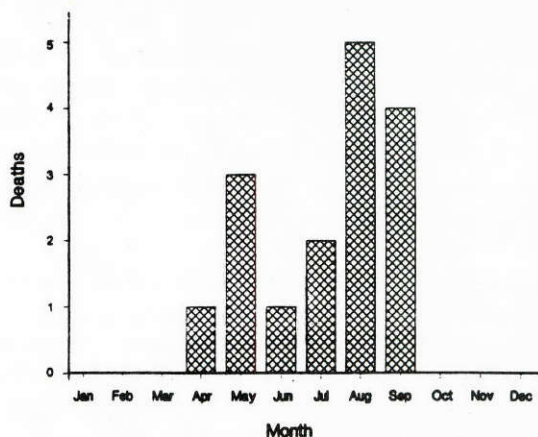
A farm manure waste pit is a confined space, defined by NIOSH as a space that "by design has limited openings for entry and exit; unfavorable natural ventilation which could contain or produce dangerous air contaminants; and which is not intended for continuous worker occupancy." Manure pits are fermentation tanks where raw animal wastes undergo anaerobic bacterial decay. This bacterial action generates methane, hydrogen sulfide, and other gases. Methane is a colorless, odorless, and flammable gaseous hydrocarbon. It can displace oxygen in confined areas, resulting in an oxygen-deficient atmosphere. Hydrogen sulfide is a highly toxic, colorless gas that at concentrations of >300 ppm can cause unconsciousness, respiratory failure, and sudden death. If these gases are not properly vented from a tank or other confined space, an oxygen-deficient or toxic atmosphere may be created. In industrial settings, the Occupational Safety and Health Administration (OSHA) limits permissible peak exposures to hydrogen sulfide to a ceiling of 50 ppm (for <10 minutes); NIOSH recommends a ceiling of 10 ppm (for <10 minutes). There is no OSHA permissible exposure limit for methane. OSHA exposure standards are not enforceable on farms with <10 employees.

The apparent tendency for episodes such as those described here to result in multiple fatalities is of major concern. Fatal incidents resulting from entry into manure pits often involve more than one victim; the deaths of any additional workers

occur during rescue attempts conducted without use of appropriate equipment and safety precautions. Investigations performed by NIOSH as part of the Fatal Accident Circumstances and Epidemiology Project show that approximately 43% of confined-space-related deaths involved co-workers or other persons who were attempting to rescue the initial victim(s) (NIOSH, unpublished data). The hazards of confined spaces and improper rescue methods have been addressed in previous NIOSH publications, including a guide to safe work practices in confined spaces.

In the two events reported here, hot humid weather may have contributed to the generation of methane gas and increased the amount of gas in the manure pits. The possible connection between hot weather and increased gas accumulation in manure tanks is also suggested by the NTOF data (Figure 2). All 16 deaths identified in the NTOF file occurred in April through September, with the highest number occurring in August. Farmers should be made aware of the particular hazards of entering manure pits during the summer months.

Figure 2. Work-related deaths in manure pits, by month of year -- US, 1980-1985



Source: National Traumatic Occupational Fatalities database.

NIOSH is preparing information for farm operators on the hazards of manure pits and recommendations for safely evaluating, ventilating, and entering (when absolutely necessary) manure pits. Recommendations will also be provided for the safe conduct of rescue operations in circumstances such as those described in this report. NIOSH will disseminate this information during the fall.

PREVENTING OCCUPATIONAL FATALITIES IN CONFINED SPACES*

BACKGROUND

The deaths of workers in confined spaces constitute a recurring occupational tragedy; approximately 60% of these fatalities have involved would-be rescuers. Persons required to work in a:

Sewer Silo	Storage Tank	Ship's Hold
Vat	Reaction Vessel	Septic Tank
Duct	Sewage Digester	Boiler
Pit	Pumping/Left Station	Pipeline
	Sewage Distribution or Holding Tank	Utility Vault

or similar type of structure or enclosure, are working in a **confined space**. The Occupational Safety and Health Administration (OSHA) defines a confined space in 29 CFR 1926.21 as "any space having a limited means of egress, which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere." The National Institute for Occupational Safety and Health (NIOSH) maintains a similar definition, adding that such spaces are "not intended for continuous employee occupancy."

CASE REPORTS OF FATAL INCIDENTS

Lack of hazard awareness and unplanned rescue attempts led to the following deaths:

- On July 23, 1985, a city worker was removing an inspection plate from a sewer line in a 50-foot deep pump station, when the plate blew off allowing raw sewage to enter the room. Two fellow workers and a policeman attempted to rescue the worker from the sludge-filled room and were unsuccessful. All four were dead when removed from the pumping station.
- On July 5, 1986, a worker entered a chemical degreaser tank to clean out the bottom and collapsed. Two fellow workers noticed the man down and went in to rescue him. All three workers died.
- On October 10, 1986, a self-employed plumbing contractor entered an underground water

line vault to inspect a backflow device. The contractor collapsed shortly after entering the vault. A supervisor noticed the man down and entered the vault in a rescue attempt. Both men had entered an untested oxygen-deficient atmosphere and died as a result.

- On February 6, 1987, two workers (father and son) at a wastewater plant were working on a digester that was being drained. They went on top of the digester and opened a hatch to check the sludge level. To provide light in the digester, they lowered an extension cord with an exposed 200 watt light bulb into the digester. The light broke and caused the methane gas in the digester to explode, killing both men instantly.

Based on the information derived from case studies such as these, NIOSH concludes that these fatalities occurred as a result of encountering one or more of the following potential hazards:

- lack of natural ventilation,
- oxygen deficient atmosphere,
- flammable/explosive atmosphere,
- unexpected release of hazardous energy,
- limited entry and exit,
- dangerous concentrations of air contaminants,
- physical barriers or limitations to movement, or
- instability of stored product.

NIOSH investigations indicate that workers usually do not **recognize** that they are working in a confined space and that they may encounter unforeseen hazards. **Testing and evaluation** of the atmosphere are typically not initiated prior to entry and **monitoring** is not performed during the confined space work procedures. **Rescue** is seldom planned and usually consists of spontaneous reaction in an emergency situation.

*Adapted from: DHHS/NIOSH. Alert: request for assistance in preventing occupational exposures in confined spaces. DHHS (NIOSH) publication no. 86-110, January 1986.

RECOMMENDATIONS

In light of findings to date regarding occupational deaths in confined spaces, NIOSH recommends that managers, supervisors, and workers be made familiar with the following three steps:

1. **Recognition:** Worker training is essential to the **recognition** of what constitutes a confined space and the hazards that may be encountered in them. This training should stress that death to the worker is the likely outcome if proper precautions are not taken **before entry** is made.
2. **Testing, Evaluation, and Monitoring:** All confined spaces should be tested by a qualified person before entry to determine whether the confined space atmosphere is safe for entry. Tests should be made for oxygen level, flammability, and known or suspected toxic substances. The confined space should be continuously monitored to determine whether the atmosphere has changed due to the work being performed.
3. **Rescue:** Rescue procedures should be established before entry and should be specific for each type of confined space. A standby person should be assigned for each entry where warranted. The standby person should be equipped with rescue equipment including a

safety line attached to the worker in the confined space, self-contained breathing apparatus, protective clothing, boots, etc. The standby person should use this attached safety line to help rescue the worker. The rescue procedures should be practiced frequently enough to provide a level of proficiency that eliminates life-threatening rescue attempts and ensures an efficient and calm response to any emergency.

HELPFUL PUBLICATIONS

NIOSH has published the following documents which contain further information:

Criteria for a Recommended Standard . . . Working in Confined Spaces, DHEW publication no. 80-106.

A Guide to Safety in Confined Spaces, DHHS (NIOSH) publication no. 87-113.

Copies of these and other NIOSH documents are available from:

Publications Dissemination, DSDTT
National Institute for Occupational
Safety and Health
4676 Columbia Parkway
Cincinnati, Ohio 45226
(513) 841-4287

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