MIFACE INVESTIGATION REPORT #16MI071

SUBJECT: 23-year-old laborer was overcome and drowned when he entered a 10,500-gallon molasses tank to reposition a drain pipe.

Summary

A 23-year-old male laborer was overcome and drowned when he entered a 10,500-gallon molasses tank to reposition a drain pipe. The decedent and a coworker were in the process of draining an 11.8-foot wide by 13.9-foot high, 10,500-gallon tank which had held a mixture of molasses and water. Near the bottom of the tank was a pipe to drain the contents. The drain pipe had been turned "up" rather than "down". The workers hooked up a gasoline-fueled pump to the bottom valve to pump the molasses/water mixture from the tank. When no more of the mixture could be removed, his coworker indicated that a sufficient quantity of the molasses/water mixture had been pumped from the tank. The coworker stepped away, and several minutes later, noticed the decedent preparing to enter the tank. At the top of the tank was a 15-inch hatch opening. After some discussion, the coworker, who told the decedent not to enter the tank, agreed to "spot" the decedent while he entered the tank to rotate the drain pipe to the "down" position in order to be able to pump more of the mixture from the tank. To enter the tank, the decedent placed a lift truck in front of the tank and raised the forks to a position so the forks were straddling the 15-inch opening. Suspended from the mast and the forks were two cargo tie-down straps. The decedent donned a pair of full-length waders and a full-face respirator equipped with ammonia cartridges and rappelled to the base of the tank to reposition the drain pipe. He pushed the drain pipe into position, and then attempted to climb out of the tank by holding the straps and placing his feet on the side of the tank and pulling/walking up. The decedent twice attempted to climb out of the tank. The coworker observed the decedent become unresponsive and attempted to pull him out of the tank, but was unsuccessful. The spotter then ran to the firm's office and emergency response was summoned. Firm personnel used a circular saw to cut a 4-foot by 4-foot hole in the tank. Two employees entered the tank and found the decedent submerged in the mixture. They pulled the decedent from the tank and began CPR. Emergency response personnel arrived and the decedent was transported to a local hospital where he was declared dead.

Figure 1: Inside tank wall following decedent's attempt to climb out

MIFACE identified the following key and possibly contributing factors:

- The business did not have a permit-required confined space program in place, and consequently workers had no training in confined space hazards, entry, or rescue.

- The hatch door was not locked, which provided unrestricted entry into the molasses tank. The atmosphere of the tank was not tested prior to, or monitored throughout, entry.
- Employees were not empowered to prohibit the entry of coworkers into a confined space.

RECOMMENDATIONS

- Prevent unauthorized access to confined spaces via the use of locks or barriers.
- Implement a permit-required confined space program, including the labeling of permit-required confined spaces, the training of workers around associated hazard recognition and awareness, and a protocol for authorized confined space entry and rescue.
- Employers should, in addition to developing and implementing a health and safety program, develop mechanisms to ensure adherence to the health and safety program. This includes developing workplace rules and practices that recognize and support workers having the authority to stop work because of a safety hazard.
- Tank manufacturers should explore the feasibility of permitting tank users to rotate fittings/inlet piping and/or perform other tanks from outside of the tank to minimize or eliminate the need to enter the tank.

BACKGROUND

A 23-year old male laborer was killed in the summer of 2016 when he was overcome and drowned after he entered a 10,500-gallon molasses tank to reposition a drain pipe. MIFACE researchers were made aware of the fatality through the MIOSHA 24-hour ASAP reporting system. MIFACE contacted the employer of the decedent, who agreed to be interviewed by MIFACE researchers alongside another employee who was witness to the incident. During the writing of this report, the death certificate, medical examiner and police reports, and the MIOSHA compliance file were reviewed. The pictures used in this report were courtesy of the County Sheriff's Office, and have been altered to maintain confidentiality.

The decedent was employed by an agricultural services company, which mixed and manufactured agricultural chemicals and fertilizers. The decedent had been working at the business for 2 years as a full-time hourly employee, and had been working for the employer in other capacities (e.g. assisting with landscaping at the employer's residence) for 7-8 years. Although the employee was granted the ability to make his own schedule, he generally worked a normal day shift.

The business maintained multiple large round tanks of molasses (12 feet in diameter x 14 feet tall, 10,500-gallon capacity) outside of the main building to use as an ingredient in these products. These tanks would periodically need to be emptied, which was accomplished by pumping out the contents via a valve located near the bottom of the tank. The molasses was often diluted with water to a 1:1 molasses: water ratio to make the pumping easier. The tank was sometimes then rinsed or cleaned, depending on how the tank was to subsequently be utilized, although this was accomplished from outside the tank without any entry.

The owner held regular strategic planning meetings for employees of the business, which oftentimes included discussions of operations that touched broadly on safety topics (presented by the owner himself). Notably, during one such planning meeting the owner recounted a previous fatality related to the entering of a molasses tank that had occurred at another business in the region, and had instructed his employees not to enter the molasses tanks. The business utilized full-face respirators affixed with ammonia cartridges to protect employees from ammonia vapors during certain processes and work tasks.

The business had no overall formal safety program nor a specific safety program related to confined spaces (permit-controlled or otherwise), and instruction regarding the hazards inherent in the molasses tanks was limited to discussions during planning meetings and references to a similar fatality that had occurred in the region.

Remediation

Since the incident described here, the business implemented a safety program involving training on elements including hazard awareness, permit-required confined spaces, and stop work authority. The business also created a respiratory protection program. Permit-required confined spaces are now labeled and display warnings. Finally, the owner changed the management structure of the business to more clearly indicate which employees are in charge when the owner is not present and instituted a disciplinary program.

MIOSHA Citations

MIOSHA General Industry Safety and Health Division issued the following Serious citation to the employer at the conclusion of its investigation.

SERIOUS: PERMIT-REQUIRED CONFINED SPACES [REF 325.63002], OH PART 490, RULE1910.146(c)(3): If the employer decides that its employees will not enter permit spaces, the employer shall take effective measures to prevent its employees from entering the permit spaces and shall comply with paragraphs (c)(1), (c)(2), (c)(6), and (c)(8) of this section.

On *the incident date*, an employee entered a workplace space [i.e., molasses tank] meeting the definition of a permit-required confined space and drowned. The above ground molasses tank met the definition of a confined space, i.e., the space was physically large enough to bodily enter, had limited means for entry and exit, and was neither designed nor intended for human occupancy. Furthermore, this space contained hazards characteristic of a permit-required confined space, i.e., the space contained both engulfment and atmospheric hazards. Though entry into this space was prohibited, effective measures were not in place to prevent employee entry into the permit space.

Develop and implement measures that effectively prevent employee entry into the above ground molasses tanks, as well as any other permit spaces where entry is prohibited. Such

measures may include permanently closing the space and erecting barriers, supplemented by training employees and posting danger signs. Any steps taken must be effective in preventing employee entry into the permit spaces. Provide to the department documentation that such measures are in place.

SERIOUS: RECORDING AND REPORTING OF OCCUPATIONAL INJURIES AND ILLNESSES, ADM PART 11, RULE 408.22139(1): Fatalities. Within 8 hours after the death of any employee from a work-related incident, you must report the fatality by telephone to the MOSHA toll-free central telephone number: 1-800-858-0397.

A work-related fatality that occurred on *incident date*, was not reported to Michigan OSHA [MIOSHA] within 8 hours after the death. *Two days after the incident*, a representative of the local county sheriff department notified the MIOSHA Agency regarding the details of the work-related fatality that occurred on *incident date*.

INVESTIGATION

On the day of the incident, the decedent arrived at work and attended a planning meeting for the day's operations. At the meeting, it was discussed that one of the molasses tanks needed to be emptied and refilled with water to prepare the tank to be recycled. The decedent and one coworker were assigned to drain the tank. The tank was located outside of the main building for the business, grouped with two other similarly large tanks and several smaller tanks and containers on a concrete pad. Beginning around 10:00 AM, the workers diluted the remaining molasses with an approximately equal volume of water, creating a mixture that was 5-6 feet deep. The workers then connected a gasoline-powered pump to a valve near the bottom of the exterior of the tank and began pumping out the molasses-water mixture.

Figure 2: Valve used to pump out contents of tank. Molasses and water mixture remaining in tank can be seen to right of photo.

After a period, the flow of the mixture through the pump stopped due to the level of the mixture falling below the intake portion of the valve on the interior of the tank (Figure 2), leaving about 2 feet of mixture still in the tank. The coworker told the decedent that this was likely sufficient, as the tank was going to be refilled with water soon. The coworker then left the area to begin working on another task elsewhere inside the building.

Soon afterwards, he observed the decedent gathering items to enter the tank so that he could rotate the intake valve to remove more of the residual mixture. The decedent had donned fishing-type waders and a 3M 6800 full-face respirator with ammonia cartridges. The decedent had also positioned a hi-lo truck adjacent to the tank, attached two ratcheting cargo straps to the mast of the lift, draped them over the forks, and suspended them through the unlocked 15”-diameter opening in the top of the tank (Figure 3). The decedent climbed the ladder leaning against Tank 1 and then walked across the top of Tank 1 to the top of the incident tank. The coworker advised him not to enter the tank, and then remained and ascended to the top of the tank to observe the decedent during his entry. The decedent requested that the coworker not inform the owner of the entry. The decedent then used one strap in each hand to rappel to the bottom of the tank.

Figure 3: Tank 1 with ladder and hi-lo and straps positioned for entry at incident tank.

After entering tank, the decedent rotated the valve down into the remaining mixture, and moved back to the straps in an attempt to use them to climb out of the tank, walking his feet up the tank’s

wall (evidence of the decedent's attempt to climb the inside of the tank can be seen in Figure 1). The coworker observed through the tank opening (shown from inside the tank in Figure 4) that the decedent slipped and fell back to the bottom of the tank and subsequently appeared to be standing still while holding the straps. The coworker yelled to the decedent asking if he was alright, but did not receive a response. The decedent then made another attempt to climb the side of the tank but again fell. The coworker unsuccessfully attempted to haul the decedent up using the straps. The coworker then descended from the top of the tank and ran to tell the owner and other coworkers that the decedent was trapped inside the molasses tank.

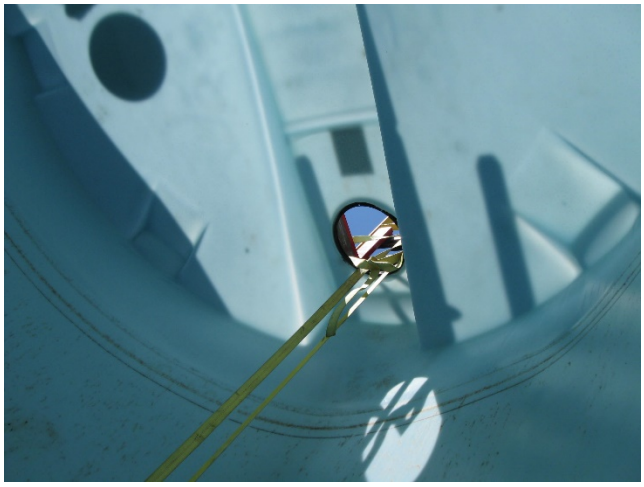

Figure 4: View of tank opening from inside.

Once the coworker reached the owner and other employees within the building, one employee called 911 and another ran to get a circular saw while the coworker and owner ran back to the tank. Using the saw, they cut a rectangular opening in the side of the tank to extricate the decedent, who had collapsed and was submerged under the molasses-water mixture (Figure 5). The decedent was pulled from the tank and CPR was administered until emergency services arrived. The decedent was transported to a hospital, where he was unable to be revived and was declared dead.

Figure 5: Saw used to extricate decedent alongside remaining tank contents and decedent's respirator.

MIFACE contacted the manufacturer of the molasses tank to find out of the valve the decedent entered the tank to rotate could be rotated from the outside of the tank. The equipment manufacturer told MIFACE investigators that the fitting used on the tank valve did not allow the intake siphon to be rotated via the fitting from the outside of the tank.

CAUSE OF DEATH

The cause of death as listed by the medical examiner on the death certificate was asphyxia due to drowning. The decedent was found to have nicotine, caffeine, and a low level of ethanol (0.02gm/dl, which is below the level of legal intoxication of 0.08 gm/dl.) in his blood; all other toxicological tests were negative.

RECOMMENDATIONS

- Prevent unauthorized access to confined spaces via the use locks or barriers.

Even in cases in which confined space entries are anticipated or required, tank hatches or entry points should be locked or otherwise blocked when an entry is not in progress. Hatches should only be opened by the business owner or other supervisor in charge of overseeing permit-required confined spaces, and only for entry by employees who have been trained in the confined space hazard awareness and entry protocols. If the hatch on the molasses tank had been locked, with entry only able to be granted by the business owner or an appointed delegate, such as the coworker of the deceased, then the decedent would not have been able to gain entry to the tank without approval. Instead, this layer of control was missing and employees were able to gain access to the molasses tank (and other tanks) whenever they deemed fit, without approval of the employer (and over the objections of coworkers, in this instance).

- Implement a permit-required confined space program, including the labeling of permit-required confined spaces, the training of workers around associated hazard recognition and awareness, and a protocol for authorized confined space entry, monitoring, and rescue.

MIFACE investigators noted at the time of the site visit that the molasses tanks had labels from the original manufacturer near the tank openings warning against any entry and the potential for dangerous atmospheres. However, there were no signs labeling the tanks as permit-required confined spaces, nor had employees been trained on such spaces and procedures surrounding permitted entry, if necessary. There was also no rescue plan for incidents such as this one. The hatches covering the entrances to the tanks were not locked, nor were there any other barriers to entry. It did appear, though, that both the decedent and his coworker recognized the tank as a hazardous space; the coworker attempted to stop the decedent from entering the tank, and the decedent in turn requested that the coworker not inform the owner that he was entering the tank. The decedent also donned respiratory protection, suggesting he was aware of the potential for a hazardous atmosphere to exist within the molasses tank. MIOSHA tested another molasses tank with a similar molasses-water mixture during their investigation, and found that the atmosphere contained 17.8-19.0% oxygen and 23.5-26.0 ppm hydrogen sulfide. The decedent's use of a full-face respirator with ammonia cartridges rather than an air-supplied respirator in turn shows that he was not trained or educated regarding the specific risks of a toxic or low-oxygen atmosphere possible within a confined space as would be provided during a permit-required confined space training program as required by MIOSHA.

Workplaces in which a permit-required confined space exists should develop a permit-required confined space program. This program should involve the labeling of permit-required and non-permit-required confined spaces in a way that is visible and understandable to all workers. All employees working with or around the confined spaces should be trained regarding the rules and policies around entry and the hazards associated with confined spaces including toxic or low-oxygen atmospheres, explosions, and engulfment/drowning. If entries are necessary or anticipated, a program for entry should be developed involving the method by which employees obtain

authorization to enter and work inside the confined space, further training for authorized employees, a protocol for air monitoring for oxygen, toxics, and explosive limits, methods of communication with employees inside the confined space, routes of egress, and emergency retrieval plans for incapacitated or injured employees. Local emergency responders can advise businesses in retrieval plans and protocols. The business in this incident had no permit-required confined space program. The decedent was able to enter the tank without authorization, despite his lack of knowledge and appropriate protective equipment for the hazardous atmosphere inside, the absence of an effective method of egress, the inability to communicate with the coworker observing the entry, and the need to improvise an emergency retrieval.

- Employers should, in addition to developing and implementing a health and safety program, develop mechanisms to ensure adherence to the health and safety program. This includes developing workplace rules and practices that recognize and support workers having the authority to stop work because of a safety hazard.

An effective safety program holds all employees (owners, supervisors/foreman, and employees) accountable for doing their jobs safely. In a strong safety culture, everyone feels responsible for safety and pursues it daily; employees seek to identify unsafe conditions and behaviors and intervene to correct them. Likewise, co-workers routinely look out for one another and point out unsafe actions and conditions to each other. These concepts and topics should be included in a comprehensive hazard recognition training program.

Businesses and employers involving hazardous occupations and tasks should ensure that there is explicit recognition and support for stop work authority across the workforce. All employees should receive training on stop work authority, and management should make it clear that its use is supported and will not be retaliated against or otherwise discouraged. Each case of the exercise of stop work authority should be investigated for potential hazards and risks that may have been avoided, and corrections should be implemented accordingly. In this case, if the decedent and his coworker had both been trained in stop work authority, the coworker likely would have felt more comfortable stopping work and bringing the impending confined space entry to the attention of other nearby employees and the owner.

- Tank manufacturers should explore the feasibility of permitting tank users to rotate fittings/inlet piping and/or perform other tanks from outside of the tank to minimize or eliminate the need to enter the tank.

In many cases a job or task requiring a confined space entry may be able to be completed from the exterior of the space, with different or modified equipment. In this incident, the decedent entered the space in order to rotate an inlet siphon on a valve fixture that the investigators were able to confirm with the equipment manufacturer was unable to be rotated from the exterior of the tank. If confined space entry is deemed to be likely during an assessment of anticipated work tasks, employers should explore whether equipment might be selected, or the equipment or work task

modified, so that the task would require shorter or more infrequent entries, or no longer require entries at all.

KEY WORDS: Agriculture, Agriculture Wholesalers, Confined Space, Asphyxiation, Drowning, Respiratory Protection

RESOURCES

More information regarding the hazards associated with confined spaces can be found in the following OSHA and MIOSHA publications:

OSHA: Permit-Required Confined Spaces Quick Card

OSHA: Procedures for Atmospheric Testing in Confined Spaces Fact Sheet

OSHA: Is 911 Your Confined Space Rescue Plan? Fact Sheet

MIOSHA: Confined Space Entry and Training Workshop

Other MIFACE investigations involving confined space fatalities in agricultural industries:

Farmer Asphyxiated Due to Lack of Oxygen After Entering an Oxygen-Limiting Silo 3 Days After Filling

59-Year-Old Male Worker at a Fruit Storage Facility Died After Entering a Controlled Atmosphere Storage Room

MIOSHA standards cited in this report may be found at and downloaded from the MIOSHA, Michigan Department of Licensing and Regulatory Affairs (LARA) website at: http://www.michigan.gov/lara/0,4601,7-154-11407_15368---,00.html. MIOSHA standards are available by writing to: Michigan Department of Licensing and Regulatory Affairs (LARA), MIOSHA Regulatory Services Section, Stevens T. Mason Building, 530 W. Allegan Street, Lansing, Michigan 48933, calling (517) 284-7740, or by FAX (517) 284-7735.

- MIOSHA General Industry Standard, Part 490. Permit-Required Confined Spaces: https://www.michigan.gov/documents/CIS_WSH_part490_55724_7.pdf
- MIOSHA Administrative Standard, Part 11. Recording and Reporting of Occupational Injuries and Illnesses: https://www.michigan.gov/documents/CIS_WSH_part11ad_37844_7.pdf

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