Massachusetts Concrete Plant Driver/Yardman Asphyxiated in Materials Hopper

Massachusetts FACE Investigation 94MA010
June 9, 1994

SUMMARY

On January 20, 1994, a 39 year old male driver/yardman was asphyxiated when he was buried in pea stone in a hopper at an automated concrete processing plant. A concrete mixture was under preparation when the system shut down and the control room instrumentation panel indicated there was an obstruction in the hopper. This was a common occurrence in colder winter months, and it was usually caused by a mass of frozen pea stone creating a blockage. The victim left the control room and scaled the yard conveyor catwalk to access the hopper, which was approximately sixty-six feet from the ground. Approximately ten minutes later, when the victim did not return, the plant owner left the control room to look for him. The owner found the victim in the hopper, with all but the top of his head buried in the material. It took emergency responders five hours to retrieve the victim, who was pronounced dead before extrication efforts began. The MA FACE Program determined that to prevent similar future occurrences, employers should:

- **ensure that potentially hazardous systems and processes are locked out and tagged out prior to performing maintenance or repair of any kind;**
- **explore the feasibility of covering hopper bins with locked out, reinforced steel, false floors;**
- **explore the feasibility of using a different type of sensing device for indicating problems in the bin filling;**
- **develop, implement, and enforce a confined space entry program;**

- **develop systems for preventing the blockage of material during bin loading.**

INTRODUCTION

On January 24, 1994, the Massachusetts Fatality Assessment and Control Evaluation Program (MA FACE) was notified by the state Medical Examiner's office through its 24 hour fatality hotline, that a 39 year old male concrete worker was asphyxiated four days prior in a materials hopper. An investigation was immediately initiated.

On February 2, 1994, the MA FACE Project Director and Field Investigator travelled to the incident site and interviewed employer representatives. The death certificate, police report, site schematic and multiple photographs were obtained during the course of the investigation.

The victim was a truck driver/yardman who had been employed by the company for two years. His training was primarily on-the-job.

The employer was a small dry batch concrete processing plant which had been in business for seven years. A total of seven persons were employed, including the owner, a marketing/estimator executive and five over-the-road drivers. Each day one of the five drivers remained on site to perform the yard work. The company owner acted as a part time safety officer who devoted less than 20% of his time to safety. There were no comprehensive written safety rules or procedures in place for most plant job tasks at the time of the incident.

INVESTIGATION

The company was an automated dry batch concrete processing plant which produced custom concrete mixtures. Company trucks delivered the concrete, to be poured as directed, at various construction sites in the area.

The facility was comprised of a cement silo, and a large sixty-foot high hopper tower which was fed with various materials, such as pea stone, gravel, crushed stone, or sand, from an automatic conveyor. The materials were first fed into one of four bins at the top of the hopper; they then dropped down to a scale, and then on down through the hopper to trucks waiting below. The pea stone and/or other materials were mixed with cement and water in the trucks below the hopper.

The entire system was computer controlled, and each of the bins in the hopper tower contained three “bindicators,” or sensors, which would shut down the entire system if the bins became either over-filled or under-filled.

In the moments prior to the incident, pea stone was being fed into bin number one in the hopper. The control room instrumentation indicated that the top most bindicator had shut the system down. The bindicators were small, slowly turning propellers which were located in three different positions in the hopper. The upper-most bindicator, located eight inches below the top of the bin, signalled that too much material was in the hopper. When accumulating material reached the bindicator, the prop would stop turning, shutting the system down. Often during colder weather, the bindicator would stop turning not because the bin was too full, but because incoming hopper material had frozen in a mass around the propeller.

When the system shut down on the day of the incident, the victim was told by the plant owner to go free the bindicator. The victim had reportedly performed this routine task on numerous occasions, and earlier in the day had received on-the-job training on this procedure from the marketing/estimator executive.

The victim left the control room to perform the routine task, and shortly after he left the system reactivated. After approximately ten minutes when the victim failed to descend the tower, the company owner accessed the hopper tower to check on him. Puzzled not to find him, and noting that by this time the conveyor had shifted to another bin, the company owner surveyed the yard area from the sixty-six foot height. Not finding him either in the yard, the owner took a closer look into bin number one only to see the top left corner and temporal area of the victim's head exposed in the accumulated pea stone. He immediately yelled for emergency assistance to the personnel below, and all systems were simultaneously shut down.

Emergency municipal fire and police units responded four minutes after they were notified. Approximately twenty minutes following the incident, and while still engulfed, the victim was pronounced dead. Rescue efforts were hampered due to the confined space and the unstable nature of the pea stone.

Rescue workers set up a makeshift two-by-four and plywood material shoring system to prevent their possible entrapment and to expedite removal of the pea stone in five gallon buckets. They succeeded in extricating the victim from the hopper approximately five hours following the incident, and Chief Medical Examiner's personnel transported him to a regional mortuary.

Although it will never be known exactly how the victim came to be engulfed in the hopper pea stone, MA FACE identified two possibilities: the victim either fell or climbed into the bin. If the victim fell the approximately four or five feet from the unguarded catwalk into the bin, the force of his fall may have freed the bindicator of accumulated material, re-established the gravity feed of pea stone from above, and reactivated the conveyor system, entrapping and engulfing the victim in pea stone.

MA FACE personnel identified the second possibility on the day of the investigation when they learned that the victim had most likely not used the cyndrilical steel rod to dislodge the amassed material on the day of the incident. The company owner had reportedly found the rod in its storage place in the corner of the hopper tower when he went to look for the victim. Because the bindicator is located less than one foot below the surface of the bin, the victim may have opted to clear the somewhat delicate propeller area by hand, rather that use the wobbly fifteen foot rod. If so, he only needed to descend several rungs of the permanently affixed ladder in the hopper bin to reach the frozen bindicator. In so doing, the victim may have stood on top of the pea stone material and his body weight and/or actions may have freed the bindicator of the obstruction, and re-established the gravity feed of material, partially or wholly engulfing him. The re-engaged conveyor system may have then further engulfed him in the pea stone.

CAUSE OF DEATH

The Medical Examiner listed cause of death as asphyxia by compression of chest.

RECOMMENDATIONS/DISCUSSION

Discussion: Before ANY inspections or repairs of machinery are made, all energy sources of the equipment should be locked out and tagged out. When electrical current is the machinery's only energy source, the equipment should be turned off at the switch box, and the switch padlocked in the off position. At the same time, the switch or controls locked out of service should be securely tagged to show which equipment or circuits are being worked on. Only fully trained and designated personnel should be allowed to service the machinery, and each worker should be able to affix their own padlock to the switch. OSHA 1910.147 mandates that employers follow the above procedures when repairing or installing new equipment with potentially dangerous sources of energy. In addition, employers are required to develop a written program on their lock out tag out policy.

In this particular situation, locking out the door to the hopper tower might be an effective means of ensuring that lock out procedures are consistently followed. A lock could be placed on the door such that the system would deactivate itself when the door was opened and unlocked. The system could be reenergized by the employee opening and locking the door upon leaving the tower.

Had lock out tag out procedures been followed in this case, the victim would probably not have been engulfed in the pea stone.

Recommendation #2: Employers should explore the feasibility of covering the bins with locked out, false floors made of reinforced steel.

To prevent employees from falling into hopper bins, employers should consider covering the bins with locked out, false floors. A (half-inch) reinforced steel plate with slots wide enough to allow material to pass through, but narrow enough to prevent passage of a person, could be installed on top of a hopper bin. Such a cover would be bolted down to prevent employees from lifting it during routine tasks, such as cleaning a bindicator. A chain lift or other device could be installed to facilitate removal of the plate during maintenance. The cover would be locked out such that opening it would shut down the system. Covering hopper bins with a false floor would diminish the risk of employees falling in and becoming engulfed during routine tasks.

Recommendation #3: Employers should explore the feasibility of using a different type of sensing device for indicating problems in the bin filling.

Although the bindicator is widely used in industrial processes with automated hopper systems, it requires the mechanical removal of material when it becomes blocked. Other sensors for indicating bin filling problems that do not require material to be mechanically removed could reduce the need for employee interaction with hazardous machinery, and thus minimize the risk of fatal injury. For example, a beam of light or energy source such as radiation could be used as a scanner in solids handling automated hopper situations. The scanner would shut the system down when the bin was too full, too empty, or was otherwise filled incorrectly.

Recommendation #4: Employers should develop, implement, and enforce a confined space entry program.

Discussion: In this case, the employer did not recognize the cement hopper as a confined space. Employers should remain fully aware that confined spaces typically have some combination of the following characteristics: limited access, unfavorable natural ventilation, the risk of physical injury or entrapment, and a design that does not allow for continuous worker occupancy. The primary hazard in the cement hopper was the risk of physical engulfment.

According to OSHA regulation 29 CFR 1910.146, employers who require their employees to enter confined spaces must develop a confined space entry program. Included in this program are evaluation of the confined space, a permit system for entry, training, and provisions for emergency response. Employers should provide the necessary training and equipment to allow employees to effectively and safely carry out work in confined spaces. When the primary hazard is risk of physical engulfment, respiratory protection would probably not be necessary; however, employers should consider the use of safety harnesses and lifelines. Note that while pre-entry atmospheric testing was not relevant in this incident, it may be important at solids processing facilities where rotary kilns are used to dry the materials before they are introduced into the hopper. Back up of the flue gases may create an oxygen deficient or toxic environment.

Recommendation #5: Employers should develop systems for preventing the blockage of material during bin loading.

Although there was no evidence in this case that the employer did not take the appropriate precautions to prevent the blockage of material during bin loading, employer should consider the importance of preventive actions. By reducing the amount of materials blockage in the bins, employers can minimize the need for employee interaction with machinery at the hopper loading point, and thus the potential for fatal injury. To reduce the potential for blockage in the bin, employers should set up a hopper with a grate in the yard to screen materials as they are loaded on to the conveyor. Furthermore, when purchasing bins for solids processing, employers should ascertain that they are acquiring a bin with the correct recline for the material they are processing. Not having the correct bin recline can increase the likelihood of blockage.

REFERENCES:

1. Office of the Federal Register: Code of Federal Regulations, Labor 29, July 1, 1993: Parts: 1910.146 and 1910.147

To contact Massachusetts State FACE program personnel regarding State-based FACE reports, please use information listed on the Contact Sheet on the NIOSH FACE web site Please contact In-house FACE program personnel regarding In-house FACE reports and to gain assistance when State-FACE program personnel cannot be reached.

Page last reviewed: November 18, 2015
Content source: National Institute for Occupational Safety and Health