Assistant Supervisor Dies while Releasing a Jammed Product from a Plastic Injection Molding Machine - Massachusetts

Investigation: # 04-MA-002-01
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SUMMARY

On February 7, 2004, a 25-year-old male assistant supervisor (the victim) was fatally injured while trying to release a jammed product from inside a plastic molding injection machine at a manufacturing facility. The victim went to the machine and noticed that the product being manufactured was stuck on one half of the machine's die. The victim climbed inside the machine with a brass chisel and a hammer to try and cut the plastic product off the mold. While inside the machine, reportedly with the gate open, the machine cycled bringing the dies together crushing the victim. Coworkers notified Emergency Medical Services (EMS). EMS responded to the incident site within minutes and pronounced the victim dead at the scene. The Medical Examiner's Office was notified and arrived to remove the victim's body. The Massachusetts Fatality Assessment and Control Evaluation (FACE) Program concluded that to prevent similar occurrences in the future, employers should:

- **Develop, implement, and enforce a comprehensive hazardous energy control program including a lockout/tagout procedure and routinely review and update the program and training**

- **Ensure that their comprehensive safety program includes training on hazard recognition and the avoidance of unsafe work practices and conditions by conducting a job safety analysis (JSA)**

The American National Standards Institute (ANSI) should:

- **Consider revising standard ANSI/SPI B151.1 to require all plastic injection molding machines, regardless of size, to have an additional safety device to protect workers from the moving parts in the mold processing area**

Manufacturers of plastic injection molding machines should:

- **Consider an additional safety measure for all HIMMs, regardless of size, to protect workers from the moving parts in the mold processing area**

INTRODUCTION

On February 9, 2004, the Massachusetts FACE Program was notified by the Occupational Safety and Health Administration (OSHA) through the 24-hour Occupational Fatality Hotline, that on February 7, 2004, a 25-year-old male was fatally injured when he was crushed by a plastic injection molding machine. An investigation was immediately initiated. On February 11, 2004, the Massachusetts FACE Program Director and a co-worker traveled to the incident location where the company's vice president of manufacturing and another company employee were interviewed. On that same day, the FACE Program Director and the coworker also traveled to the local police department where a police representative who responded to the incident was interviewed. On March 11, 2004 the Massachusetts FACE Program Director and a co-worker traveled back to the incident location to complete their investigation. The death certificate, corporate information, police incident report, and the OSHA fatality and catastrophe report were reviewed. Photography during the site visit was not allowed by the company.

The employer, a plastic houseware product manufacturer, had been in business for approximately 65 years at the time of the incident. The company had six locations, two of which, the company’s headquarters/manufacturing facility and a warehouse, were in Massachusetts. The company employed approximately 350 workers at the incident location. The victim had been employed by the company for approximately seven years. When he started working for the company he held the job title of machine operator. At the time of the incident the victim had held the job title of assistant supervisor for approximately three years. The company’s workday was split into two 12 hour shifts. The victim worked the first 12-hour shift on Saturday, which started at 7:00 a.m.

The company had a designated person in charge of employee health and safety and a health and safety program. The health and safety program included both on-the-job and classroom training. The employer provided classroom training, including computer-based interactive training. The company reported that the training was updated annually and addressed the control of hazardous energy and lockout/tagout. On their first day of work, new employees were required to go through an initial two hour training followed by an extended period of on-the-job training with an experienced employee. Employees were not part of a union collective bargaining unit.

INVESTIGATION

The machine involved in the incident was a computer controlled 770-ton horizontal thermoplastic injection molding machine (HIMM). The machine was manufactured in 1994 and purchased by the company that same year. The machine’s function is to produce molded plastic products by injecting melted plastic into a mold. The molds consist of two halves that are each attached to platens. One of the platens is fixed and the other is movable. During the manufacturing process the two halves of the mold are closed together when the movable platen is moved toward the fixed platen. Once the two halves of the mold are closed together, the machine clamps them with pressure of up to 770 tons and the melted plastic is injected into the mold.

The plastic used in the manufacturing process is initially in pellet form. The plastic pellets are loaded into the plastic injection machine's hopper where they are then fed into a cylinder. The plastic pellets are heated inside this cylinder to a molten form. The molten plastic is injected via a hydraulic ram into the tightly clamped mold. The mold and plastic are cooled by water that has been chilled to about 54 degrees Fahrenheit. The movable platen retracts, separating the mold and allowing the finished product to be released. When the product is released from the mold, it drops down a chute located directly below the mold processing area. An electric eye located inside the chute detects the product as it is discharged, which triggers the machine to start the cycle over again.

The HIMM involved in the incident was equipped with an operator's gate, which is a physical barrier guard preventing the machine operator from accessing the mold processing area while the machine is running. The gate, which slides on a horizontal track, is operated manually. A 30-inch by 30-inch polycarbonate window located within the machine's gate allowed monitoring of the mold processing area. The HIMM was designed with three safety interlocks: electrical, hydraulic, and mechanical[1]. The three safety interlocks are activated simultaneously by the gate position. When the gate is open, providing employees with direct access to the mold processing area, all three interlocks automatically engage which stops the machine's cycle and prohibits the platens from closing and clamping together. Opening the gate engages: 1) the electrical interlock preventing the platens from closing; 2) the hydraulic interlock, triggering a valve that releases the hydraulic pressure used to move and clamp the platens preventing the platens from closing; and 3) the mechanical interlock releasing a drop bar that physically drops between the platens preventing the platens from closing. Once the gate is returned to the closed position, all three interlocks are inactivated simultaneously and the machine automatically starts up at the point where the cycle was interrupted.

On the day of the incident, the HIMM involved in the incident had been running nonstop for five months, producing the same product. The product was the bottom section of a 54-quart square clear plastic storage bin. The approximate cycle time for the machine to produce one of these pieces was 30 seconds. The machine operator/packer's main tasks were to inspect the finished product for any irregularities and place a brand name sticker on the product. As in this case, when a problem occurs within the manufacturing process, the operator/packer activates a trouble box switch that engages a warning light and sounds an alarm to notify the shift supervisor.

The victim had arrived to work at approximately 7:00 a.m., which is the first of two shifts for the company. At approximately 11:30 a.m. the operator/packer of the HIMM involved in the incident engaged the trouble box, alerting the victim that the machine had encountered a problem. Upon walking over to the machine, the victim noticed that the product had jammed on one half of the mold. The victim opened the gate, which would have engaged the interlock systems described above. The victim then climbed into the mold processing area of the machine with a hammer and a brass chisel to remove the plastic product from the mold. At this time, the gate was in the open position and the machine was in the automatic mode, a setting where the HIMM continuously cycles. While the victim was inside the mold processing area working to free the jammed product, the machine cycled, bringing the platens together and crushing the victim between the two halves of the mold. The machine operator/packer was yelling for help while trying to turn off the machine to free the victim. Emergency Medical Services (EMS) were notified immediately and arrived within minutes. EMS personnel pronounced the victim dead at the scene. The Medical Examiners Office was notified and arrived to remove the victim's body.

After the incident, the plastic injection molding machine was inspected by the manufacturer and an independent contractor and both parties found the machine to be operating properly. The exact position of the operator's gate at the time of the incident is still unknown.

CAUSE OF DEATH

The medical examiner listed the cause of death as blunt force abdominal trauma.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should develop, implement, and enforce a comprehensive hazardous energy control program including a lockout/tagout procedure and routinely review and update the program and training.

Discussion: In this case, the company's hazardous energy control program was not comprehensive. OSHA regulation 1910.147 requires that employers establish procedures for isolating machines or equipment from the input of energy by affixing appropriate locks or tags to energy isolating devices[2]. This is done to prevent any unexpected energization, start-up or release of stored energy that would injure workers during servicing and maintenance of machines and equipment. All forms of energy must be considered, including electrical, hydraulic, pneumatic, and mechanical[3]. Therefore, for each machine an individual lockout/tagout procedure is needed that specifies the requirements to properly perform lockout/tagout on that machine, as well as when the lockout/tagout should be implemented, such as while removing a jammed product from the mold of a plastic injection molding machine.

A machine specific lockout/tagout program should be documented in writing and include, but not be limited to:

- Identification and labeling of all hazardous energy sources

- Procedures to de-energize, isolate, block, and/or dissipate all forms of hazardous energy, and verify by tests and/or observations that all energy sources are de-energized before work begins
- Requirements that workers secure the machines' energy control devices with their own individually assigned locks and keys, and that:
    - Each lock assigned to a worker only has one key for regular use, which is held by that worker
    - Locks are clearly labeled with durable tags to identify the worker associated with the lock
    - Workers who install locks are the only ones who remove the locks
- Requirements that if work is not completed when the shift changes, workers arriving on shift apply their locks before departing workers remove their locks
- Inspecting repair work before reactivating the equipment
- Ensuring that all workers are clear of danger points before re-energizing the system
- Inspecting each energy control procedure at least annually, to ensure that the procedures and the requirements of the OSHA standard are being followed

Involving the employees in the process of inspecting and updating the hazardous energy control program and training is important. The employer should seek input from employees by having employees evaluate the effectiveness and limitations of the hazardous energy control program. Employers should ask employees about techniques involved in completing tasks that require them to expose any part of their bodies to machine hazards, especially maintenance activities and common procedures that are not typically thought of as part of the everyday operation, such as removing jammed products from molds. Employees who spend the majority of their time operating and performing maintenance tasks on equipment will be able to contribute valuable information that might have been overlooked, and these employees will likely be able to contribute the most information about the effectiveness and limitations of the hazardous energy control program.

A comprehensive hazardous energy control program is not going to be effective if the employer does not strictly enforce the procedures outlined in the program. Enforcing a hazardous energy control program should include random inspections of employee work habits related to procedures outlined in the hazardous energy control program.

Recommendation #2: Employers should ensure that their health and safety program includes training on hazard recognition and the avoidance of unsafe work practices and conditions by conducting a job safety analysis (JSA).

Discussion: Employers should include hazard recognition and the avoidance of unsafe conditions in their health and safety program. This can be accomplished by conducting a job safety analysis (JSA) to evaluate how to perform tasks safely and to identify all potential hazards and hazardous situations that could occur when performing tasks, such as entering the mold processing area when the machine is not properly locked out. These identified hazards and their appropriate controls should then be incorporated into the company's health and safety program and developed into hazard recognition training. At a minimum, hazard recognition training should provide employees with the ability to avoid unsafe conditions by identifying hazards and knowing how to abate these hazards or who they should contact for help. Employers should ensure that the training program's content and the names and dates of employees completing the training are documented and retained. Only trainers that are qualified through education and/or experience should be used to conduct these trainings. In addition, employers should develop, implement, and strictly enforce policies that address avoidance of unsafe conditions and policies that prohibit employees from risking physical harm to accomplish tasks.

Recommendation #3: The American National Standards Institute should consider revising standard ANSI/SPI B151.1 to require all plastic injection molding machines, regardless of size, to have an additional safety device to protect workers from the moving parts in the mold processing area.

Discussion: ANSI standard ANSI/SPI B151.1 currently requires all large HIMMs, with horizontal or vertical distances between tie bars greater than 47 inches, have additional safety measures. This includes an emergency stop or emergency reverse button in a location that is readily accessible from the area between the gate and the mold processing area. Large HIMMs are also required to have one of the following:

- Gate block – a mechanical device that operates with each opening movement of the operator's gate to prevent unintentional return of the gate to the closed position;
- Double acknowledgement system – a system that consists of two push buttons, one located inside and one located outside of the operator's gate, where the restart of a cycle will occur only after pushing the inside button, closing the gate and then pushing the outside button;
- Presence-sensing device – a device that checks for the presence of a worker between the gate and the mold processing area by detecting their weight or by the interruption of a photo-electric beam, and will prevent the gate from being able to close, thus preventing the cycle from resuming. For systems with motor driven gates the presence-sensing device is able to stop or reverse the closure of the gate[4, 5].

The machine involved in this incident was not considered a large HIMM under the ANSI standard ANSI/SPI B151.1 because the distance between the tie bars was 37 inches. In this case, 37 inches between the tie bars was large enough for the victim to access the mold processing area and be fatally crushed. ANSI should consider revising standard ANSI/SPI B151.1 to require all plastic injection molding machines to have an additional safety device to protect workers from the crushing hazard that exists in the mold processing area.

Recommendation #4: Manufacturers of HIMMs should consider an additional safety measure for all HIMMs, regardless of size, to protect workers from the moving parts in the mold processing area.

Discussion: As stated in Recommendation #3, ANSI requires all large HIMMs to have one of the following additional safety devices: a gate block, a double acknowledgement system, or a presence-sensing device. The HIMM involved in this incident, not considered a large HIMM, was designed to automatically resume operation where it left off when the gate was closed after being open. This design would allow an employee to be inside the mold processing area while the machine automatically resumed operation if the gate was to close without the employee's knowledge. If the HIMM involved in this incident had been equipped with any of the three safety devices mentioned above, the HIMM would not had been able to cycle without the victim knowing that the machine was going to cycle.

REFERENCES

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2. Code of Federal Regulations [2004]. 29 CFR 1910.147. The control of hazardous energy (lockout/tagout). Washington DC: U.S. Government Printing Office, Office of the Federal Register.
3. NIOSH [1999]. NIOSH Alert: Preventing worker deaths from uncontrolled release of electrical, mechanical, and other types of hazardous energy. Cincinnati, OH: U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 99-110.
4. ANSI/SPI B151.1-1997, American National Standard for Plastics Machinery – Horizontal Injection Molding Machines – Safety Requirements for Manufacture, Care, and Use.
5. ANSI/SPI B151.1- 2005, Revision of ANSI B151.1-1997, American National Standard for Plastics Machinery – Horizontal Injection Molding Machines – Safety Requirements for Manufacture, Care, and Use. Accessed August 15, 2006 at www.plasticsmachinery.org/B151.1REV-19.3.pdf.

SUMMARY OF OSHA'S DRAFT PROPOSED SAFETY AND HEALTH PROGRAM RULE FOR EMPLOYERS

(29 CFR 1900.1 Docket No. S&H-0027)

Core elements

- Management leadership and employee participation
- Hazard identification, assessment, prevention and control
- Access to information and training
- Evaluation of program effectiveness

Basic obligations

- Set up a safety and health program, with employee input, to manage workplace safety and health to reduce injuries, illnesses and fatalities.
- Ensure that the safety and health program is appropriate to workplace conditions taking into account factors such as hazards employees are exposed to and number of employees.
- Establish and assign safety and health responsibilities to an employee. The assigned person must have access to relevant information and training to carryout their safety and health responsibilities and receive safety and health concerns, questions and ideas from other employees.

Employee participation

- Regularly communicate with employees about workplace safety and health matters and involve employees in hazard identification, assessment, prioritization, training, and program evaluation.
- Establish a way and encourage employees to report job-related fatalities, injuries, illnesses, incidents, and hazards promptly and to make recommendations about appropriate ways to control those hazards.

Identify and assess hazards to which employees are exposed

- Conduct inspections of the workplace at least every two years and when safety and health information change or when a change in workplace conditions indicates that a new or increased hazard may be present.
- Evaluate new equipment, materials, and processes for hazards before introducing them into the workplace and assess the severity of identified hazards and rank those hazards that cannot be corrected immediately according to their severity.

Investigate safety and health events in the workplace

- Thoroughly investigate each work-related death, serious injury, illness, or incident (near miss).

Safety and health program record keeping

- Keep records of identified hazards, their assessment and actions taken or the plan to control these hazards.

Hazard prevention and control

- Comply with the hazard prevention and control requirements of the OSHA standards by developing a plan for coming into compliance as promptly as possible, which includes setting priorities and deadlines for controlling hazards and tracking the progress.

Information and training

- Ensure each employee is provided with safety and health information and training.
- If an employee is exposed to hazards, training must be provided on the nature of the hazards to which they are exposed to and how to recognize these hazards. Training must include what is being done to control these hazards and protective measures employees must follow to prevent or minimize their exposures.
- Safety and health training must be provided to current and new employees and before assigning a job involving exposure to a hazard. The training should be provided routinely, when safety and health information is modified or a change in workplace conditions indicates a new or increased hazard exists.

Program evaluation and maintenance

- Evaluate the safety and health program at least once every two years or as often as necessary to ensure program effectiveness.
- Revise the safety and health program in a timely manner once deficiencies have been identified.

Multi-employer workplaces

- The host employer's responsibility is to provide information about hazards and their controls, safety and health rules, and emergency procedures to all employers at the workplace. In addition, the host employer must ensure that assigned safety and health responsibilities are appropriate to other employers at the workplace.
- The contract employer responsibility is to ensure that the host employer is aware of hazards associated with the contract employer's work and how the contract employer is addressing them. In addition, the contract employer must advise the host employer of any previously unidentified hazards at the workplace.

Date issued November 23, 1998. Full text available on www.osha-slc.gov/SLTC/safetyhealth/nshp.html.