Plastics Manufacturing Safety Guide

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Our objective is to provide high-quality services that add value to our underwriting results and positively impact our customers. We will focus on management controls, impact on employee behavior, root cause of accidents and account profitability by providing services that focus on measurable results. We provide an altruistic service to others by preventing accidents and injuries.

PLASTICS PROCESSING SAFETY

As one of the largest U.S. manufacturing industries, plastics processing has more than 1.3 million workers and provides more than $345 billion in annual shipments. Plastics processing companies usually specialize in a single type of product. The major markets for plastics are:

- Packaging products (29%): bottles, vials, food containers, drums, and blister and bubble containers
- Consumer and institutional goods (21%): kitchenware, toys, sporting goods, medical products and footwear
- Building and construction products (19%): pipes, conduits, bathroom fixtures, fittings, flooring and insulation materials
- Exports and miscellaneous bulk (12%): plastics resale and compounding
- Transportation products and parts (6%): motor vehicles, golf carts, aircraft, military vehicles and ships
- Electrical products (4%): home and industrial appliances, wire and cable coverings
- Furniture and furnishings (4%)

With increasing demand from the health care and electronics industries, a boost in production is to be expected for molded and extruded plastic products because they can be manufactured cheaply, quickly and in large quantities.

PLASTICS

There are more than 40 classes of plastic resins, including acrylics, nylons, and polyethylene, and hundreds of individual plastic resins. The two basic groups of plastics are:

- **Thermoplastic resins** can be repeatedly melted and solidified by heating and cooling. This property permits reuse of scrap. Thermoplastic polymers are supplied in the form of pellets which often contain additives to enhance processing or to provide necessary characteristics in the finished product, such as color and conductivity. Thermoplastics are by far the most common type of plastic produced by the industry.
- **Thermoset resins** undergo an irreversible change during processing. Once they cool and re-harden, thermosets cannot be reworked and will eventually melt at elevated temperatures. Thermoset scrap must be discarded or used as filler. Thermosets may be supplied in liquid form or as a partially polymerized solid molding powder.

In addition, fillers, colorants, fire retardants and numerous other additives can be used to provide necessary functional characteristics.

PROCESSES

Molding, extrusion and thermoforming are the three basic methods for processing plastics. There are many specific processing methods within each category. For example, injection molding and blow molding are both molding processes.

1. In molding, heated plastic materials are forced into molds where they cool and harden into their final shapes. After hardening, the mold is opened, and the product is released and may be trimmed. In injection molding, raw materials are heated and injected under pressure into a die or mold of the final product. In blow molding, pressure is used directly or indirectly to form hollow objects, such as bottles.

2. The extrusion process converts raw thermoplastic materials into continuous sheets, tubes or filaments using a rotating screw assembly that mixes and evenly heats the raw materials. The heated mixture is forced through a dye that contains an opening of the desired shape of the final product. The formed material falls onto a conveyor where it is cooled. Extrusion processes are also used for coating wires or other objects.

3. In the thermoforming process, plastic sheeting is heated into a formable state and is shaped to the contours of a mold by applying air and/or mechanical pressure.

This brochure addresses some of the major loss potentials encountered in: design, engineering, material storage and handling, plastics mixing and processing, inspection, finishing, reworking, product storage, packaging, and delivery of plastic products.

EMPLOYEE SAFETY AND HEALTH

Plastics processing exposures include unguarded machinery; heating equipment; burns from molten plastic; hazardous chemicals; excessive noise; materials handling; slips, trips and falls; lack of formal safety training; ungrounded or malfunctioning electrical machinery; excess static electricity; airborne debris; lifting injuries; poor housekeeping; dust, vapors and fumes; long-term chemical exposures; fires or explosions.

Processing hazards should be controlled through engineering or work-practice controls that eliminate or reduce employee exposure by changing the way a job is performed. Engineering controls typically involve machine guarding. Work-practice controls address operator training and instruction for machine use, maintenance, inspections, and use of guards and tools. When these controls are not sufficient, personal protective equipment (PPE) should be provided as a supplement.

Each year, one of 10 employees in the plastics processing industry experiences an OSHA-recordable injury. The major injuries for plastics manufacturing by frequency and severity are:

- Strains and sprains
- Cuts and lacerations
- Contact with objects and equipment
- Overexertion

In 2004, plastics products manufacturing reported 200 limb amputations, up from 110 amputations in 2003. About three-fifths of all work-related amputations involve a worker's finger or arm getting caught or crushed by machinery, such as a press or conveyer. These injuries also happen during material-handling activities and cleaning and maintenance activities involving stationary machines. The average cost of an amputation is $39,826.

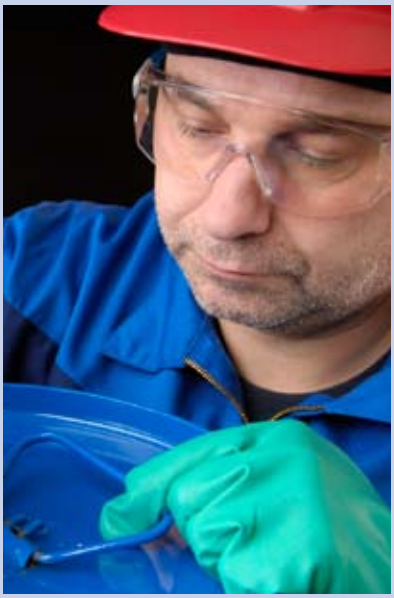
MACHINE GUARDING

Most plastics processing machinery is fully automated, which limits worker exposure involving the operation of heavy machinery. However, older production machinery may still require more worker involvement to operate the equipment.

Production machinery operated by workers must have interlocking barriers, two-handed controls and emergency stop bars or buttons. Proper guarding is required for moving equipment parts such as in-running nip points, as well as high machinery voltages and temperatures.

Plastics processing is especially hazardous when machines are not properly used or do not have required safeguards. While all machines have the same basic components, their safeguarding needs widely differ due to varying physical characteristics and operator involvement. Moving machine parts must be safeguarded by the point of operation, the power transmission apparatus and the rotary or reciprocating parts.

MACHINE SAFEGUARDING INVOLVES USE OF:



- Guards that provide physical barriers preventing access to hazardous areas
- Devices that may replace or supplement guards and help prevent contact with points of operation. These devices prevent the operators' hands from reaching into the point of operation, withdraw of the operators' hands if they enter a hazardous area, or interrupt the normal cycle of the machine when operators' hands are in the point of operation.

Crushing injuries and amputations can occur from guards that are missing, improperly installed, removed or bypassed. Workers often reach into a machine to loosen a part that is stuck and may reach around, under or over guards. A worker may also intentionally disable machine guarding to speed up production. To prevent all related injuries, machine guards should be checked before the start of each shift.

Skin burns from contact with the heated barrel or burns from splatter of hot plastic and gases can happen from slip/falls at the material-feed location or from hands getting caught in a machine while loosening trapped materials. The equipment injection unit and other accessible parts should be insulated or guarded where temperatures can exceed 176 degrees Fahrenheit. Warning signs should be placed on exposed areas with high temperatures.

Operators should not climb machines. A ladder, rolling stairs, platform or other suitable means should be used to access the hopper or feed throat area.

LOCKOUT/TAGOUT PROGRAM

Production machinery and conveyor systems should be regularly inspected and serviced. Before maintenance is performed on a machine, an energy control program must be established to address employee training needs, energy control procedures and scheduled inspections. The program should ensure that the machine or equipment is isolated from the energy source and rendered inoperative for service.

When safeguards are removed for machine servicing, written lockout procedures that describe all power sources and the correct procedure for shutting down, testing and re-energizing the machine must be followed. If the power sources cannot be shut down, workers must be protected with insulation, guarding and appropriate personal protective equipment.

Machine design should permit routine lubrication and adjustment without removal of safeguards. Oil reservoirs — located with a line leading to the lubrication points — should be located outside the guard. Maintenance personnel must know which machines can be serviced while running and which cannot. The danger of accident or injury is greatly reduced by shutting off and locking out all sources of energy.

NOISE LEVELS

Source controls for reducing excessive noise levels start with equipment analysis and identification of noises produced by motors, gears, belts and pulleys, and points of operation where blades touch metal, etc. Sound may also be transmitted by vibration or resonance from the frames, footings and housings of the equipment. Basic noise source controls are equipment maintenance and lubrication, and engineering controls of isolation, stabilization and damping.

Path controls for reducing noise intensity before it reaches the human ear involve:

- Segregating operations to limit the number of employees exposed
- Enclosing equipment within barriers designed to absorb or reflect noise
- Relocating noise-producing equipment away from employees

Hearing protection devices will likely be required given the nature of metalworking operations. They should be used as the final line of defense against excessive noise when engineering and work practice controls are not sufficient. Employers must implement an effective hearing conservation program when employee noise exposures are at or above an eight-hour, time-weighted average (TWA) of 85 dBa.

CONFINED SPACE ENTRY

The cleaning, repair and inspection of boilers and large sections of process machinery, as well as underground vaults, tanks, storage bins, silos, and dike areas may require employees to enter confined spaces. Confined-space entry increases the risk of exposure to serious physical injury from entrapment and hazardous atmospheric conditions.

A confined space is defined as having limited or restricted means of entry or exit; is large enough for a worker to enter and perform assigned work; is not designed for continuous occupancy by the worker. Prior to confined-space entry, testing is required for oxygen level, combustible gas and vapor levels, and toxic gas and vapor levels. OSHA regulations must be followed for work in confined space and further address the use of proper respiratory equipment, confined-space attendants, communications equipment and rescue personnel.

Permit-required, confined space or "permit space" refers to confined space that contains health or safety hazards including a potentially hazardous atmosphere, material that can potentially engulf an entrant, and/or an internal configuration that could cause an entrant to become trapped or asphyxiated.

DUST AND CHEMICALS

Plastics processing generates a variety of toxic dusts, vapors and fumes from the molding, forming and extruding of plastics. Resins, various chemical additives and modifiers present a significant chemical exposure hazard for production workers. Some commonly used hazardous chemicals are ketones, polyvinyl acetate, styrene, mineral spirits and acetones. Studies show that plastics processing workers have elevated risks of liver cancer and brain tumors because some plastics processing chemicals contain carcinogens. Other associated ailments are heart and kidney disease, occupational dermatitis and various long-term respiratory problems.

Inherently hazardous to workers, welding activities present health hazards from noise, electric shock, fires and explosions, and exposure to welding smoke (gases and fumes). Welding smoke can lead to acute or chronic respiratory diseases, carcinoma of the lungs, eye irritation, skin irritation, skin cancer, reduced sperm count and motility, and infertility.

Flammable solvents for degreasing, parts cleaning and chemical treatment operations are noted for long-term adverse health effects. The negative effects include elevated risks of liver and kidney disease, respiratory illness, dermatitis, allergic reactions and cancer.

Engineering controls that reduce dust and chemical exposures should include provisions of exhaust ventilation and dust collection systems (such as dust and fume hoods) for process machinery and job activities that produce harmful dusts, fumes or vapors.

Hazardous chemicals that are stored, handled and processed should be identified and permissible exposure levels (PELs) should be determined. A formal hazard communication program that includes written procedures, hazardous materials inventory, MSDSs, worker training and container labeling should be implemented.

A hazard assessment should be made to determine what personal protective equipment (PPE) should be worn to prevent employee exposure to harmless substances. PPE, such as hard hats, safety shoes, gloves, boots, aprons, face shields, goggles, hearing protection, respirators, welding helmets, etc., may be necessary to prevent worker injury. In addition, workers should be trained on the proper selection, use and maintenance of PPE. Where required, NIOSH-approved respiratory protection equipment should be worn, and workers should comply with maximum allowable time limits for exposures to toxic materials.

An industrial hygiene program should be established for periodic monitoring of plastic dust and, where appropriate, other chemical exposures. Employee use of respirators requires a written respiratory protection program that addresses selection, fit-testing, use, cleaning and maintenance of NIOSH-certified respirators, employee training and medical evaluations. A medical program – based on periodic medical checks – may be required to monitor employee health effects from long-term exposure to toxic chemicals.

Emergency eyewash facilities and safety showers capable of providing at least a 15-minute flush of running water are required for chemical handling and truck lift battery-charging areas. Emergency showers should be in accessible locations that require no more than 10 seconds to reach.

Worker protection from hazardous chemicals should establish written spill-control plans and should also address spill clean-up kits in accessible locations.




ERGONOMICS

The primary musculoskeletal injuries reported from plastics manufacturing are upper limb and neck injuries resulting from the operation of presses and finishing parts. The strains are due to static and forceful exertions and awkward positions.

These injuries can be reduced with proper ergonomic design of workstations. The work height or platform should be adjusted to a level that is comfortable to the worker for the type of job being performed. Working with raised elbows and/or arms adds strain on the employee's arm or shoulder muscles. Awkward bending, twisting or reaching motions should be avoided.

The point of operation should allow for the neutral position of the shoulder/arm (i.e. 90-100 degrees at the elbow, elbows close to the body and upper arm close to vertical). Controls should be reachable in the proper arm, shoulder and hand position. The most important and most often utilized items should be placed directly in front of the worker. Material should be placed 16 to 18 inches in front of the body and between the elbows and the shoulder.

Lifting heavy objects or repetitively lifting light objects can cause back injuries. Extended reaching and carrying activities, lowering, pushing and pulling cans also cause back injuries. Lifting objects from a bent-over or twisted position may also result in lower back problems. Material-handling devices such as cranes or hoisting equipment may be used to move work to and from a table.

Typical injuries are chronic foot and leg problems. Provision of a stool or stand bar with foot rail can relieve back and foot fatigue for jobs that require long periods of standing. Machine operators often complain of foot and leg problems due to venous pooling after standing on hard surfaces for long hours. These problems can be alleviated with special shoe inserts and anti-fatigue mats.

TRAINING PROGRAMS

Initial and refresher training should be provided to employees who are involved in operating, maintaining and supervising plastic processing facilities. Annually certified, documented training should ensure that all employees are knowledgeable about the following:

- General orientation and establishment of comprehensive safe-work procedures including development of safety related, worker-incentive programs, use of personal protective equipment, hazard analysis, chemical review, industrial hygiene monitoring, medical surveillance, and reporting accidents and unsafe conditions
- Instruction in safe storage and handling of hazardous materials, including maintenance of monitoring records
- Instruction in emergency procedures and emergency response plan, including the location and operation of fire protection equipment, manual pull-stations and alarms, emergency phones, first-aid supplies, and safety equipment
- Process description, equipment operation, safe startup and shutdown review, and response to upset conditions
- Equipment maintenance requirements and practices, including lockout procedures, the necessity for proper functioning of related fire and explosion protection systems
- Housekeeping requirements

PROPERTY AND FIRE PROTECTION

While infrequent, fire losses can be severe and are a basic safety concern for plastics manufacturing. Major fire loss exposures involve:

- High values in expensive processing machinery.
- Large stockpiles of raw materials and finished products. Many plastics, such as thermosetting resins, are difficult to ignite and do not burn easily. Some are even self-extinguishing materials. At the other end of the spectrum, there are highly flammable plastics including celluloid film and foamed plastics that ignite easily and are difficult to extinguish. In general, most plastics are just as combustible as wood.
- Numerous ignition sources including heating machinery, grinding operations, welding, hot surfaces, faulty/malfunction wiring and equipment, and static electricity.
- Plastic molding, forming and extruding processes with volatile fire loads including explosive plastic dust that can lead to total losses.

Strict fire prevention, detection and suppression measures are critical. Effective fire protection controls require that dust-collection equipment be placed outside the building, but not on the roof. Automatic sprinkler protection should be provided for all areas of plastics processing. The sprinkler system should be monitored by a central station and inspected quarterly by an authorized sprinkler contractor. A fire alarm system required for life safety should be installed, tested and maintained in accordance with requirements of National Fire Protection Association (NFPA) 72 National Fire Alarm Code. The system should be monitored by a central station alarm company, with automatic retransmission of fire alarm signals to the fire department.

BUILDING CONSTRUCTION

The building should comply with local building and fire prevention codes. While codes can vary widely from state to state, some basic measures include: use of fire barriers or building separation to limit fire exposure from adjoining facilities or nearby structures; protect or fire stop concealed spaces; provide floor construction in multistory buildings that also serves as a smoke barrier; protect vertical openings to prevent the spread of smoke and fire.

Buildings in which materials produce combustible dusts are stored, handled or processed should be of single story, noncombustible or fire-resistant construction. Beams, ledges, flat and wide ductwork, and other structural features where dust may settle, should be limited. For better access to fires, production buildings should be single-story structures that are long and narrow rather than large and square. Overall, no single building on the insured's premises should exceed 50,000 sq. feet. Structures larger than that tend to impede fire fighting efforts.

When plastic materials burn, large quantities of smoke are generated, making manual fire fighting difficult. To limit the spread of smoke and fire, large facilities should be divided into fire areas separated by fire walls, fire barriers and approved self-closing fire doors. Roof venting is desirable due to large quantities of smoke that can be generated in a fire. Production areas should be equipped with adequate explosion venting that serves to channel shock wave energy and reduce potential structural damage in the event of an explosion.

FLAMMABLE AND COMBUSTIBLE LIQUIDS

Flammable compounds used in finishing activities produce vapors with low flash points that ignite within known concentrations. Another source of fires is paint buildup from spills and overspray that can spontaneously ignite or ignite from sparks or other sources.

Spray booths must be constructed with noncombustible materials such as steel, concrete or masonry. Explosion-proof equipment, wiring and lighting and mechanical ventilation that operates during spraying activities should be provided. Spray application of flammable and combustible materials requires an approved automatic extinguishing system that protects the spray booth or room and ventilation exhaust ducts. If automatic sprinkler protection is not provided due to inadequate water supply, then a dry chemical, CO2, automatic foam, or clean agent extinguishing system is acceptable. All sprinkler heads should be covered with cellophane or thin paper bags to prevent accumulation of overspray.

FIRE SUPPRESSION AND ALARM SYSTEMS

In accordance with NFPA 13, automatic sprinklers that meet the requirements for Group A or B plastics and should be provided for all areas of plastics processing. The degree of sprinkler protection will vary based on the specifics of the operation. Each operation should be evaluated for the fuel loading and flame propagation potential to determine the flow density requirements. In general, Early Suppression Fast Response (ESFR) sprinkler systems are required to protect plastics due to their tendency to melt and burn like flammable liquids. For adequate protection, in-rack sprinkler heads should be provided for high-rack storage areas more than 15 feet in height.

The sprinkler system should be monitored by a central station and inspected quarterly by an authorized sprinkler contractor. The fire department should be notified when service, repair or maintenance activities will disable the sprinkler system for more than a four-hour period. In addition, the building should be evacuated or a fire watch established during the period of system impairment.

A fire alarm system with manual and automatic initiation devices that provide immediate evacuation notification to building occupants is required. Activation of the system should cause the release of hold-open devices on smoke compartment doors. The system should be monitored by a central station alarm company with automatic retransmission of fire alarm signals to the fire department. The alarm system should be covered by a maintenance and service contract. Boilers, presses and extruding equipment should be equipped with process alarms that are remotely supervised and provide visible and audible warnings when system temperatures, pressures or operational parameters are exceeded.

Annually tagged Class ABC fire extinguishers should be appropriately located throughout the premises. Workers should be trained in their location and use.

STORAGE AREAS

Supply Rooms

To reduce the fire hazard, plastics storage should be limited where possible and should not exceed a maximum height of about 20 feet. Storage rooms should be protected with a fire suppression system and segregated by fire barriers. In-rack sprinklers are suggested for storage more than 15 feet.

Based on NFPA Commodity Classification of Plastics, the majority of plastics are Group A and have the highest fire hazard of all commodity classifications including Class I through Class IV. This group includes ABS, acetal, acrylic, fiberglass, PVC, styrene, PET, rubber and poly blends such as polyethylene, poly propylene, polystyrene, polyurethane, polycarbonate, and polybutadiene. General storage practices require:

- Stock storage on stable surfaces and in stable configurations that do not block access to fire and emergency exits
- Adequate aisle spacing to limit congestion, prevent the spread of fire and provide easier fire fighting access
- Separate storage of ordinary combustible materials (such as records, tools and paper supplies) from flammables liquids
- Provisions for sprinkler protection or fire barriers to separate storage rooms, trash rooms and similar areas from other areas

FLAMMABLE AND COMBUSTIBLE LIQUIDS (CONTINUED)

Internal flammable liquid storage should not exceed 120 gallons of flammable or combustible liquids in any one approved cabinet. No more than three approved cabinets may be present in the same storage area. Flammable and combustible liquids in excess of 360 gallons may be stored in a noncombustible internal storage room with a minimum two-hour fire resistance rating. In addition to self-closing fire doors, the storage room should be protected by an automatic sprinkler system; spill-containment; explosion-proof electrical equipment; and ventilation equipment designed to maintain a change of air at least six times per hour.

Limit the use of flammable materials outside a storage cabinet or room to the amount required for a single day's work. Solvents and thinners with a flash point below 100 degrees Fahrenheit should not be transferred between containers unless both containers are bonded and grounded. Keep flammable materials in covered containers when not in use.

Use of flammable or combustible liquids for cleaning equipment should be conducted in well-ventilated areas, away from open flames and other ignition sources. Liquid-soaked rags and paper from cleaning operations should be placed in covered metal containers and disposed of on a daily basis.

Where possible, flammable hydraulic fluids used in equipment such as presses and extruders, should be substituted with recommended synthetic fluids.

UTILITIES

Large machinery in plastics processing operations requires that the electrical service be of sufficient capacity and properly grounded to prevent electrical shock and generation of sparks. Molding and extrusion operations using resistive or inductive heating elements can lead to a failure of the electrical system from overheating. Electrical systems should be rated for the projected use and protected by appropriate, labeled circuit breakers. Where required, explosion-proof electrical equipment switches and non-sparking tools should be used in areas of flammable liquid spray application, storage and dispensing. Fully enclosed, dustproof electrical equipment is required for dust collection and plastics processing activities where combustible dust is normally suspended in the air. Fully enclosed dust-tight electrical equipment should be present in plastic manufacturing operations that produce moderate dust levels.

Some basic electrical system requirements are securely fastened electrical conductors; properly secured and covered outlet and junction boxes with no evidence of overheating; no frayed or loose wiring insulation in outlet and junction boxes; an adequate number of electrical outlets/circuits to avoid overloading of circuits; prohibited use of extension cords; accessible electrical panels and branch circuit disconnects; and inspection and maintenance of all electrical equipment according to the manufacturer's instructions. Only licensed personnel should perform electrical inspection and service work.

Air circulation systems should be designed to automatically shutdown in the event of a fire. These systems should be properly maintained to prevent overheating of motors, which could result in fires.

Gas or oil-fired boilers that produce steam for molding and extrusion processes should have manually operated emergency fuel shutoff valves. These valves should be prominently located, preferably outside the area of the operation.

PROCESSES

While there are many manufacturing processes, most use heat to soften the plastic and pressure to force the molten material into a mold cavity or through a dye. An effective process safety management program should establish procedures for routine documented machinery inspection and service to monitor excess heat, friction, leakage, malfunction, and control potential ignition of flammable or combustible materials.

Remotely located emergency shutoff or automatic shutoff switches should be provided for hydraulic equipment.

Plastic Dust

A large quantity of easily ignitable dust may be generated in plastic production areas. Plastic dust only requires a small ignition source to create a severe explosion. If not controlled, the presence of ignitable dust and static can lead to total losses. Due to plastic's natural insulating ability, static electricity build up occurs in:

- The manufacturing process
- Pneumatic conveying systems used in transferring and blending plastic pellets
- Finishing activities such as shaping, trimming and sanding
- Grinding activities
- Rolling or calendaring process that forms plastic films and sheets

Machinery that produces dust should be properly fitted for a dust collection system.

The type of collection system and safeguards required will depend largely on the volume of dust being generated and the size of the particles.

Most plastics manufacturing operations regrind plastic scrap and poor quality parts/products. The small self-contained regrind units typically do not generate quantities of dust to be considered hazardous. Large regrinders, normally found in bag manufacturing plants do generate significant quantities of airborne dust which require controls to prevent dust explosion. Plastic regrind dust is a combustible dust comparable to wood or grain from an explosion standpoint.

Portions of system-handling powdered materials from which dust can escape should have permanent dust collection systems. Production machinery such as hoppers, storage bins, conveyors, conveyor ducts and grinders that come into contact with plastic dust should be constructed with dust-tight seals and explosion venting. Controls for static generation are variable and depend on the process involved.
Anti-static coatings, additives and sprays, and grounded metal static combs may be used to reduce the surface resistance of plastic material. The use of conductive belting, low conveyor belt speeds and short center drives is advisable.
Pneumatic dust conveying systems should be restricted to handle only dust and no other waste.

Dust Collection

Dust collection typically involves placement of local exhaust ventilation systems close to the source of dust emissions. The systems may be integrated with machine guards. They should have an efficient air cleaning device and be properly maintained at regular intervals. The dust collection ductwork should be galvanized metal provided with explosion venting, and should be properly bonded and grounded.

If installation of a dust collection system is not feasible, HEPA vacuums should be used to clean the facility on a routine basis. The collected dust should be properly disposed outside and away from any ignition sources. The areas in which combustible dusts are processed or handled should be segregated, separated or detached to minimize damage in the event of an explosion. Dust collection and venting equipment are typically located outside the production building. Access to dust collection areas should be restricted. The dust collection equipment may be protected by an automatic sprinkler system, as well as a number of other options including suppression systems, spark detection, abort gates, flame quenching devices, and explosion venting. The duct from the central collector to the storage bin should have a flashback prevention to keep explosions from blowing back through the conveying ductwork into the building or into other equipment. Dust bins should have an audible or visual warning system with smoke, heat or light detectors that shut down fuel and oxygen supply in event of a fire. When automatic sprinklers are used to protect a dust collector, the sprinkler system should be hydraulically designed to provide a minimum density of 0.20 gpm/ft2.

Housekeeping

Good housekeeping near dust-producing operations is essential for control of potential primary dust explosions and more severe secondary flash fires. Routine cleaning of all surfaces with dust layers more than 1/8 inches in depth should be performed. A vacuum system equipped with HEPA filter and static reducing devices should be used to remove dust from beams, ceilings and hidden spaces above equipment. Dust should never be blown using air equipment.

Scrap plastic should be removed from around machines, placed in a non-combustible container and suitably stored.

Used combustible packaging materials and trash should be removed to an outside dumpster. Storage rooms, trash rooms, inside dumpsters and similar areas should be separated from other areas by one-hour fire barriers or protected by automatic sprinklers.

PROCESSES (CONTINUED)

Welding

Welding, brazing and cutting operations should require job-hazard analysis to identify potential fire hazards. Welding and cutting operations should be performed in areas separated from other operations by firewalls and fire doors. Before starting hot work, the work area atmosphere should be tested for combustible or explosive gases. Flammable or combustible materials should be removed prior to performing hot work.

Multipurpose, portable fire extinguishers should be kept close to hot-work operations. A fire watch should be provided during hot-work operations and for at least one hour after welding or cutting operations in areas where the potential for fire exists. A hot work permit should be developed to help identify and control highhazard situations.

Equipment, including torches and fuel/gas cylinders, should be regularly inspected and serviced and provided with the proper safety mechanisms. Gas cylinders should be secured in storage and used to prevent them from falling or being knocked over. Stored oxygen cylinders should be separated from combustible materials and fuel gas cylinders by a minimum distance of 20 feet or by a noncombustible barrier at least 5 feet high. Noncombustible shielding protects people and the surrounding work area from the light of the welding arc, heat and hot spatter.

Smoking

If smoking is permitted in the building, designate smoking areas away from flammable and combustible material storage and painting. Provide noncombustible receptacles for smoking material disposal. Post "No Smoking" signs in all other areas of the facility.

MATERIAL HANDLING

Material handling is usually performed with forklifts and other powered industrial trucks. Careless handling of this equipment may result in property loss such as collision with fire doors or sprinkler piping and dropping loads or containers of flammable liquids. Possible fires can occur from fuel spills or may start with electrical short circuits or battery explosions during recharging of battery-operated trucks.

Only forklifts approved for the electrical classification of the area shall be operated and refueled by trained and certified employees. It is preferable to operate batterypowered industrial trucks. If this is not possible, propane or diesel-powered industrial trucks should be properly tuned-up or catalytic converters added to minimize carbon monoxide emissions.

Battery-charging areas should have local exhaust ventilation and take place away from any ignition source. Material-handling equipment, using gasoline, diesel fuel, or LP gas as fuel should be garaged in a detached building or in a room segregated from storage areas by firewalls or fire barriers and automatic closing fire doors. Equipment repair should never be conducted in storage areas.

GENERAL LIABILITY

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Exposures include standard office exposures; tours; slips, trips and falls; poor housekeeping; excessive noise; plastic dust explosions; fires; retail operation on the premises.

Premises Safety

Liability exposures are usually low without an ancillary retail operation. Visitors are typically customers, agency inspectors, delivery personnel and outside repair workers. Slips and falls are the primary losses. Cuts, lacerations and/or dismemberment may result from accidental contact with sharp or moving parts on the equipment or automated machinery. Visitors to the plastics processing area should be accompanied by an employee, follow the plant safety policies and wear required personal protective equipment (PPE), such as safety goggles, hearing protection and dust masks.

Good housekeeping practices, along with a scheduled maintenance program, are the best control measures. Aisles, stairways and walkways should be free of clutter and debris. Dust collectors should not be located within 20 feet of any means of egress. Production areas should be swept or vacuumed daily. Signs should be posted restricting visitors from the production and other areas that are off-limits to nonemployees. Excessive noise may generate complaints. Buildings with noisy process machinery should have their roofs and outer walls sealed and sound-absorbing panels should cover interior walls.

While uncommon, plastic explosions due to the ignition of confined flammable dust clouds can cause property damage and bodily injuries several hundred yards from the blast point. Because of the dangers posed by explosions, the insured's plant should be as isolated as possible.

Life Safety and Emergency Preparedness

Employees should be informed of the hazards in their work area and a written Emergency Action Plan (EAP) that details the actions employees are to take in the event of an emergency should be established. Employees should be trained in the selection, location and use of portable fire extinguishers. Semi-annual evacuation drills should be conducted and clear escape and alternate escape routes from the building(s) established. The local fire department, hospital and health officials, utilities and police must be informed about the location of chemicals in the building.

In addition to fire detection, alarm and communications systems, illuminated exit signs and emergency lighting units should be provided.

Independent Contractors

Liability exposures arising from faulty workmanship and damage to premises exist with the use of independent contractors including waste disposal companies and equipment maintenance personnel. The potential for large settlement losses is reduced with selection of qualified and experienced contractors, contractual agreements, hold harmless statements and certificates of insurance including endorsement as an additional insured.

Contractors should be instructed in the manufacturer's written safety policies, especially procedures in event of an accident. Contractors working in hazardous areas should wear the required personal protective equipment (PPE) and be made aware of the potential hazards of and exposure to fire, explosion or toxic releases. They should follow the facility's emergency response and evacuation plan. Annual meetings should be conducted with regular contractors to review the facility's safe work practices and policies.

PRODUCT LIABILITY

Exposures include faulty product design; defective or malfunctioning process machinery; human error while operating process machinery; use of flawed plastic; use of improper type/grade of plastic; retail store. The product liability exposure for plastics processing varies according to the types of products manufactured (toy footballs vs. critical plastic components in automotive airbags).

Product Quality and Safety

All client-supplied product designs and specifications that are in accordance with recognized standards should be reviewed for completeness and obvious errors. Ambiguous requirements and safety concerns should be discussed with the client and documented. The potential of liability claims may increase as more plastics manufacturers become involved in the designing and engineering of parts using manual and/or computeraided design (CAD) techniques. Product safety review should consider possible hazards of the product itself (e.g., sharp edges) and hazards that could develop because of the expected use or abuse of the product. The customer's signature should be obtained on all designs before machining the parts. The product review should also be documented along with any corrective actions taken.

PRODUCT LIABILITY (CONTINUED)

Materials should conform to client-supplied specifications and written approval should be obtained for substitutions. Reliable vendors who provide detailed specifications for purchased raw materials and services should be used. All materials should be inspected or tested upon delivery.

Production operations should be controlled to ensure that products are produced according to specifications. Well-maintained and calibrated machining equipment capable of operating to specified design tolerances is required. Properly trained operators should follow written work instructions prepared for each product. Instructions should identify raw materials, additives, processing equipment and finishing applications to be used, the proper sequence to do a job, how to setup and adjust equipment, the proper operating conditions, and required inspections and testing.

Quality control procedures should be established to verify that finished products meet desired product specifications. Test equipment should be regularly calibrated. Products that do not meet specifications should be segregated and reworked or reprocessed. Finished goods should be stored so that they are not damaged prior to shipment.

Legal posture evaluations should encompass records for all phases of product design, production, and testing document QC procedures; establishment of product identification, marking and traceability; written product recall program; customer complaint handling; review of product warranties, warnings and instructions, as well as advertisements and websites. Packaging materials should provide protection from damage during shipping.

Quality Control Program and Records

An effective quality control program consists of design reviews, engineering analysis, adequate recordkeeping of raw materials and finished goods, inspection of incoming materials, testing during the manufacturing process and finished part inspections. These records should be of sufficient detail to document the steps that were performed in manufacturing the product. Such records should include results of design reviews; supplier information, product testing and inspection; equipment calibrations; and product tracing information. The records will assist in timely detection of safety hazards and trends and for tracing products or product components.

ISO Standards

The ISO 9000 family of standards represents a consensus on good quality management practices. The standards are guidelines and models for setting up and operating quality management systems. Because they are concerned with how an organization performs its work, rather than on the direct result of that work, these standards can be applied to any organization, regardless of size, product produced or service performed.

An organization that completes the mandatory elements of ISO 9001 will have assessed their operations and have a documented system in place. The documented system describes the steps the organization has taken to assure that a product (or service) is designed in accordance with state-of-the-art principles, validated as to its intended function, manufactured according to specifications, inspected to detect non-conformities, and made traceable. It also means that personnel producing the good (or performing the service) have been properly trained, a system for receiving customer feedback is in place, and quality assurance procedures are documented. These steps also improve the inherent safety of the product.

Contractual Risk Transfer

Legal counsel should draft and review all contracts and warranties that the manufacturer gives to clients. Hold harmless agreements, indemnification agreements or other risk transfer devices should be used to protect the manufacturer from product defects that arise because of errors in client-provided plans or specifications. The agreements should be made part of all contracts and should be signed by the client.

FLEET

Exposures include frequent product deliveries; travel between multiple production sites; long-haul deliveries; congested urban areas; traveling sales personnel; personal vehicles used for company business.

Motor vehicle collisions continue to be the leading cause of occupational fatalities in this country. In the decade between 1992 and 2001, more than 13,000 workers died in motor vehicle collisions – accounting for 22% of all injury-related deaths. Even with an overall decrease in the number and rates of occupational fatalities from all causes, the annual number of work-related roadway deaths has increased to a rate of 1.2 deaths per 100,000 full-time employees.

While the transportation industry leads in the number of motor vehicle crashes, the service industry accounts for 14%, manufacturing 8%, and the sales sector 7%. Sixty-two percent of the vehicles occupied by a fatally injured employee are registered to a business or to the government.

Plastics manufacturers often make routine deliveries of finished products to warehouses, distribution centers, customers, and other production facilities to which work is subcontracted. While many operations use small trucks and vans for delivery, some operations have a fleet of tractor-trailers to transport goods. The drivers typically encounter common driving hazards such as traffic and parking lot congestion, poor road conditions, and increased backing accidents. Sales people may also travel long distances or extensively for periods of time within an assigned regional area. In addition, some plastics are considered hazardous substances by the DOT and require special precautions during transport.

A motor vehicle loss control program should address operations; driver qualification and experience; training; and supervision vehicle selection; maintenance and inspection; emergency equipment; and accident reporting, recording, and analysis.

A thorough driver qualification program is critical to the success of any business in which the operation of motor vehicles is a necessary function. Motor Vehicle Records (MVRs) should be obtained on hire and reviewed at least annually for all drivers. Drivers should obtain pre-hire and random testing of alcohol and drugs. In addition to drug testing, CDL drivers are initially required to successfully complete a medical examination. Medical exams must be taken every 24 months.

A road test allows the employer to recognize deficiencies in driving skills and provide needed training prior to assigning a driving task. New employees should be trained in defensive driving and refresher training should be regularly provided for all drivers. Drivers should also be trained, certified and experienced in use of materials-handling devices such as handcarts and forklifts.

EMERGING ISSUES

Plastics applications are expanded with nanotechnology, which influences mechanical properties of polymers, such as stiffness or elasticity.

Nanocomposites are nanoclays or nanocarbon fillers in a polymeric matrix. Used in a variety of thermoplastics, nanocomposites outperform standard fillers and reinforcements in raising heat resistance, dimensional stability, stiffness, flame retardancy and electrical conductivity. Typical applications are automotive parts, including body side molding, fuel-line components and interior center consoles.

Using the same equipment and methods for processing traditional resins, nanocomposites can also produce thermoplastic resins that are more resistant to heat, dents and scratches.

Nanotechnology advances will lead to scratch-resistant auto body paints and nickelsize chips with memory storage equivalent to more than 20 DVDs.

EXPERTISE IN PARTNERSHIP

UBI Loss Control Representatives may visit your facilities to survey your premises and operations. The survey can result in either suggestions to reduce potential accidents or as a gateway to more specialized loss control services, including industrial hygiene and ergonomic evaluations. A Loss Control Representative can review existing programs or assist in the design of comprehensive safety programs for plastic molders, extruders and fabricators.

For more information or questions please call 800-777-2249 and ask for Loss Control Services. For questions about your policy, please contact your agent.

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