

Isocyanates

GENERAL

Polyurethane resins have been in use for over 30 years in the U.S. They are used in construction materials including spray-on insulation, sound proofing materials, polyurethane paint systems, caulks, sealants, waterproofing agents, adhesives and concrete patching/repair materials. They are applied by spraying onto or injecting the mixture into a substrate.

Polyurethane resins are usually found as multi-part systems that must be mixed prior to use. These typically involve combining of a resin and a curing agent. The curing agent, also known as hardener, contain isocyanates which act as a catalyst and help in curing the resin to a hard plastic.

HEALTH HAZARDS

The significant hazard associated with polyurethane resin is the presence of isocyanates. Isocyanates are highly reactive chemicals typically found in the hardener of two-part polyurethane systems. Some common isocyanates are methylene bisphenyl diisocyanate (MDI), toluene diisocyanate (TDI), and hexamethylene diisocyanate (HMDI). The unreacted isocyanates in the system are a risk to health when they are released into the air or contact the skin during use.

Isocyanates are highly toxic and adverse health effects have been documented in occupational health literature. Exposure to isocyanate vapor may cause irritation of the eyes, respiratory tract and skin. Irritation may be severe enough to produce bronchitis and pulmonary edema.

Polyurethane resins contacting the eyes may cause severe irritation, and if polyurethane resins are allowed to remain in contact with the skin, they may produce redness, swelling, and blistering of the skin. Repeated skin contact may cause skin sensitization.

Respiratory sensitization, an allergic, asthmatic-type reaction, is the most severe health hazard associated with breathing unreacted airborne isocyanate. Once a worker is sensitized, further exposure to even very small amounts of isocyanate can cause the same symptoms. The reaction may occur immediately or several hours after exposure, following one exposure to a high airborne concentration or several exposures to lower concentrations. There is no proven method for predicting whether any particular person will become sensitized if exposed to isocyanates. Among the isocyanates, there is also evidence of cross-sensitization, in which a worker is sensitized to one isocyanate but reacts to others as well.

WORKPLACE CONTROLS

Good workplace controls are essential in controlling exposure to process materials. These materials present both a dermal and inhalation hazard. Ingestion may be a potential exposure hazard, but usually involves poor personal hygiene or contamination of eating facilities.

ENGINEERING CONTROLS

Regardless of the application method, engineering controls are the preferred method of control. The primary engineering controls are:

- Isolation of the process from other areas (e.g., isolated storage, separate process areas, enclosures, closed systems)
- Local exhaust ventilation

Spray painting of isocyanates containing enamels is common. Effective control of worker exposure to paint overspray requires the proper selection of spray

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painting equipment, a properly designed and ventilated spray painting booth, and personal protective equipment. Three types of control are recommended:

SPRAY PAINTING GUNS

High volume, low pressure (HVLP) spray painting guns are recommended instead of conventional gravity or siphon-feed spray painting guns because HVLP guns cut paint overspray concentrations in half. HVLP guns transfer paint more efficiently and can reduce paint usage and costs.

PAINT BOOTH VENTILATION

Downdraft ventilation spray painting booths are recommended instead of cross draft or semi-downdraft ventilation spray booths. Properly operated downdraft booths produce lower concentrations of paint overspray compared to the other two types of booths. Downdraft booths produce a cleaner paint job that requires less buffing.

RESPIRATORY PROTECTION

Properly used and maintained HVLP spray painting guns and downdraft booths will greatly reduce paint overspray concentrations, but they will not completely eliminate overspray from the air workers breathe. Therefore, respirators are recommended. Workplace controls should be designed for the specific application by a knowledgeable professional and may not provide adequate protection if not used as designed.

WORK PRACTICE CONTROLS

Work practices, as distinguished from engineering controls, involve the way a task is performed. Some fundamental and easily implemented work practices that can be used to minimize exposures when working with advanced composites are:

1. Good employee training and education;
2. Following the proper procedures for production, process and control equipment;
3. Strict adherence to manufacturer's instructions and mixing ratios;
4. Proper use, maintenance, and cleaning of personal protective equipment;
5. Good personal hygiene program;
6. Housekeeping;

7. Periodic inspection and maintenance of production, process and control equipment; and
8. Good supervision.

PERSONAL PROTECTIVE EQUIPMENT

SKIN PROTECTION

Full coveralls are required when spraying isocyanates paints and primers. Synthetic rubber or PVC gloves must be worn. These materials prevent isocyanates from reaching the skin.

A full face respirator is preferred. A half mask may be worn as long as the eyes and face are protected with a face shield or chemical goggles.

RESPIRATORY PROTECTION

Isocyanates have poor odor warning properties. In other words, if an employee smells the sweet, fruity pungent odor of an isocyanate they are probably overexposed. Therefore, a positive pressure supplied air respirator is required. The full face mask or hood will also provide protection for the skin and eyes. Other types of respirators do not provide adequate protection for workers spraying isocyanate containing materials since the worker can not detect when the chemical has broken through the filter.

A respiratory protection program must be implemented. See Risk Management Bulletin 110 – Establishing a Respirator Program.

When using a supplied air respirator, it is critical that the breathing air supplied to the respirator is clean. A non-oil type electrical compressor specifically designed for providing breathing air is the best choice. Compressed shop air may be used if filters are provided to remove water, oil and the breakdown products of oil. The compressor must be kept in good repair, and overheating of the compressor must be prevented so that carbon monoxide will not be produced. The source of the air must be clean and distant from vehicle or other exhaust to avoid contamination of the air breathed by the painter.

For additional information or assistance, contact your Zenith Safety & Health consultant.

Zenith provides workplace safety resources at: **TheZenith.com**

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