

# Fire Engineering®

## **Construction Concerns: Foamed-in-Place Insulation**

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One type of insulation that is being used more frequently today than in the past is plastic that is foamed in place. The most common of these is polyurethane foam.

Polyurethane foam is made by mixing a polyol (a form of alcohol) with one or more isocyanates or di-isocyanates. These two chemicals are pumped separately from tanks or drums to the spray nozzle, where the polyol and the isocyanate are mixed, and sprayed on the surface to be insulated. The reaction between the chemicals forms the foam and is exothermic (produces heat), so the foam must be applied in layers and allowed to fully expand and cool before the next layer is applied.

Foamed-in-place insulation has many applications.

Photo 1 shows polyurethane foam that has been applied as insulation and sealant inside a masonry cavity wall. This foam will be covered with brick veneer.



Photo 2 shows polyurethane foam that has been used to seal an opening around pipes and cables to separate two parts of a crawl space under a building.



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Photo 3 shows polyurethane foam that has been applied as insulation and vapor barrier inside a steel stud exterior wall.



Photo 4 shows polyurethane foam that has been applied as insulation and vapor barrier inside a wood stud exterior wall.



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Photo 5 shows polyurethane foam insulation that has been injected into the cores of an exterior concrete block wall.



Photo 6 shows polyurethane foam that has been applied to the underside of a steel roof deck as insulation and vapor barrier.

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The chemical properties of isocyanates and di-isocyanates are hazardous enough that the Occupational Safety and Health Administration has a National Emphasis Program on its use including the application of sprayed foam insulation. Aspects and characteristics of these chemicals include the following:

- They are skin, eye, and respiratory system irritants.
- They are respiratory system sensitizers; an initial exposure can sensitize a person so that a second exposure can cause a more severe reaction including flu-like symptoms, life-threatening asthma, and permanently diminished lung function.
- They require a written respiratory protection plan to protect the workers.
- They require preplacement and periodic medical evaluations of persons who are regularly or accidentally exposed to them.
- Require use of disposable coveralls, shoe covers, head coverings, and gloves for workers who apply or handle the chemicals.
- Require use of eye protection at all times.
- Require use of respiratory protection during chemical handling and foam application.
  - For chemical handling and foam application outdoors, a half-mask respirator with organic vapor cartridges may provide sufficient protection.
  - For foam application indoors, a full-face piece supplied-air respirator is required.
- They require training by the employer before use
- They require removal of all ignition sources before application begins and until the foam is cured.
- Their use requires a copy of the material safety data sheet (MSDS) or safety data sheet (SDS) to be present on the job site.

During outdoor application, the work area must be isolated with barricades or barrier tape so that no one who is not a spray foam worker in proper personal protective equipment (PPE) can be within 50 feet of or downwind from the work area. This includes sealing nearby windows and doors; shutting down heating, ventilation, and air-conditioning (HVAC) systems; and sealing air intakes.

During indoor application, the work area must be isolated, and no one without training and proper PPE can be permitted in the area and for 24 hours after application, with continuous ventilation. This includes shutting down HVAC systems and sealing air intakes for areas of the building where the insulation is not being applied.

First aid for the short-term effects of isocyanates depends on the mixture of chemicals used in the foam components. See the MSDS or SDS for the products in use at the job site.

Once a person has been diagnosed as sensitized to isocyanates or di-isocyanates, no further chemical exposure can be permitted.

Most polyurethane foam insulation is thermoset plastic; it retains its shape when heated after curing and will ignite when it gets hot enough. The foam may have a fire retardant chemical added, which will increase its ignition temperature and make it self-extinguishing, which will then increase the amount of smoke that it produces when burned.

When polyurethane foam, adhesives, and sealants burn, the intermediate products of combustion include acrolein, formaldehyde, acetaldehyde, propionaldehyde, and butyraldehyde. The final products of combustion include carbon (soot) (C), carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), water vapor (H<sub>2</sub>O), hydrogen cyanide (HCN), and nitrogen oxides (NO<sub>x</sub>). Phosgene (COCl<sub>2</sub>) or hydrogen chloride (HCl) may also be produced if chlorine is present during combustion.

Burning polyurethane foam, adhesives, and sealants will generate a lot of smoke, and it can be cooled and extinguished with water if it is a thermoset form of the plastic. If it is a thermoplastic melting and burning, water fog will cool it, cause the melted plastic to solidify, and extinguish the fire.

Buildings with polyurethane foam insulation, adhesives, and sealants have a large quantity of this material, with toxic and irritating products of combustion, which require use of self-contained breathing apparatus (SCBA) and full turnouts. This PPE needs gross decontamination before any parts of the PPE are removed outside the building and complete decontamination and laundering before storage or reuse. Firefighters who have been exposed also need to shower and change their clothing in addition to decontaminating their PPE and laundering their uniforms or street clothing.

In addition, because of their potential exposure to carcinogens and other toxic chemicals, firefighters need regularly scheduled physical exams including cardiac and pulmonary function tests as well as cancer screening. PPE must be stored away from sleeping, dining, and rest areas in fire stations and should not be stored in personal vehicles or at home where children can play with it.



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