



Spray Polyurethane Foam Insulation

Safe use and handling guidelines for installers

Introduction

Spray polyurethane foam (SPF), which is formed from the combination of A-side (isocyanate) and B-side (polyol blend) chemicals, is becoming increasingly popular for use as perimeter wall, crawlspace, and/or attic insulation in commercial and residential buildings. Bayer MaterialScience LLC (BMS) has prepared this guide to support the safe use, handling, and installation of spray polyurethane foam insulation. However, it should be noted that this guide is for informational purposes only, and BMS makes no representations or warranties regarding the information provided herein.

The typical spray foam system contains an “A” side and a “B” side. The A-side is commonly known as polymeric methylene diphenyl diisocyanate (pMDI), and is typically comprised of approximately 50% methylene diphenyl diisocyanate (MDI), and 50% higher molecular weight oligomers of MDI. The B-side is typically a blend of polyols, catalysts, blowing agent, flame retardant, and surfactant. The Material Safety Data Sheets (MSDS) for the A- and B-side chemicals should be consulted to determine the components present, their approximate percentages, and the available information regarding health, safety, and environmental protection.

How workers can be exposed to spray foam chemicals

Because the chemicals used in spray foam insulation are heated prior to and during application, and sprayed indoors (sometimes with minimal ventilation), both vapor and liquid aerosol are likely to be present. They can present potential inhalation as well as skin and eye contact hazards. When the chemicals discharge from the spray gun, they are a reacting mixture of the A- and B-side components. This could result in inhalation of A- and B-side chemicals that have not yet

completely reacted. In addition, volatile B-side additives such as the blowing agent and catalysts can escape from the reacting foam.

Potential chemical exposure also may result from transferring chemicals between containers, as well as disconnection and draining of piping, hoses, and other equipment that contain spray foam chemicals. The use of solvents for equipment cleaning also may result in direct skin/eye contact or inhalation of vapors.

Overexposure

Various organizations have established occupational exposure limits (OELs) for numerous chemicals including MDI and some blowing agents and catalysts. OELs (e.g. TLVs) are airborne concentrations of chemical substances, and represent conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, over a working lifetime, without adverse health effects. Worker potential exposure levels typically are determined by an industrial hygienist through air sampling and subsequent

laboratory analysis. Inhalation overexposure occurs when the airborne concentrations are above the established OELs. Any amount of direct skin contact with or ingestion of spray foam chemicals can also be considered overexposure, as there currently are no established allowable limits for these routes of exposure.

OELs for some of the components of the BaySystems spray foam systems are listed below. Refer to the MSDS for additional information.

COMPONENT	ORGANIZATION	OEL	COMMENT
MDI	OSHA PEL-C	20 ppb	Should not be exceeded at any time
	ACGIH TLV-TWA	5 ppb	As an average over an 8 hour period
245fa	AIHA WEEL - TWA	300 ppm	As an average over an 8 hour period

- MDI - Methylene Diphenyl Diisocyanate
- 245fa - 1,1,1,3,3-Pentafluoropropane
- OSHA - Occupational Safety and Health Administration
- ACGIH - American Conference of Governmental Industrial Hygienists
- AIHA - American Industrial Hygiene Association
- PEL - Permissible Exposure Limit
- C - Ceiling
- TLV - Threshold Limit Value
- TWA - Time Weighted Average
- WEEL - Workplace Environmental Exposure Level

ppb - parts per billion
ppm - parts per million

Potential health effects of overexposure

A-Side

Inhalation of MDI vapor and/or aerosol, at elevated levels (above OELs), has the potential to cause adverse health effects. Possible effects on the respiratory system can include the following: irritation of the nose, throat, and lungs, causing runny nose, sore throat, coughing, tightness in the chest, and shortness of breath. The development of other respiratory conditions, such as hypersensitivity pneumonitis, also are possible, but uncommon.

Respiratory tract sensitization (i.e., the development of asthma) is also possible as a result of overexposure. Symptoms of sensitization include chest tightness, shortness of breath, coughing, and/or wheezing. These symptoms can be delayed up to several hours after exposure. Sensitization can be permanent,

and extreme asthmatic episodes can be life threatening. Some MDI sensitized individuals can experience asthmatic episodes upon exposure to cold air, dust, or other airborne substances, a condition known as nonspecific bronchial hyperresponsiveness. There is also evidence, though limited, that repeated overexposures to MDI can lead to reduced lung function.

MDI contact with skin can cause irritation and sensitization effects. The signs of both are similar and include reddening, itching, swelling, and rash. However, in the case of sensitization, these signs can be elicited from only a very small exposure. Furthermore, animal tests and other research indicate that skin contact with isocyanates can play a role in causing isocyanate sensitization and respiratory reaction.

Eye contact with MDI vapor or liquid can cause reddening, tearing, stinging, and/or swelling of the eyes. Conjunctivitis also can occur.

B-Side

The chemicals contained within the B-side typically do not have established OELs; however, contact with these components can potentially produce adverse health effects.

The majority of the B-side is comprised of polyols which, in most cases, present minimal hazard from inhalation or skin contact. Further, while some of the other components of the B-side have greater potential to cause adverse health effects, their ability to cause such effects is diminished, because they are typically present at low percentages in the B-side.

Exposure to elevated airborne levels of blowing agent can result in irritation causing coughing, sore throat, and runny nose. Overexposure can also result in cardiac arrhythmia (irregular heartbeat). Skin contact is only slightly irritating. Eye contact with liquid or mist may result in slight irritation. In addition, if sufficient blowing agent is released into a

given space, air can be displaced, and oxygen deficiency can result.

Exposure to elevated airborne levels of amine catalysts can also result in irritation of the respiratory tract causing cough, sore throat, and runny nose. Some amine catalysts are also capable of causing respiratory tract sensitization. Skin contact can result in irritation, causing reddening, itching, swelling and/or burns. Some catalysts are also capable of causing skin sensitization. Eye contact can result in reddening, tearing, swelling, burns, and conjunctivitis. In some cases, vapor may temporarily cause vision to become foggy or blurry, and halos may appear around bright objects.

Exposure to elevated airborne levels of flame retardants can result in irritation of the respiratory tract causing cough, sore throat, and runny nose. Skin contact can result in slight irritation, while eye contact is generally non-irritating.

Additional information, including first aid procedures for A- and B-side chemicals, can be found in the MSDS.

Reducing exposure

There are several protective measures that can be taken to effectively reduce exposure.

Engineering Controls/Work Practices

Spray foam contractors are encouraged to ventilate the area during and following spraying. For example, windows on opposite sides of a room or structure could be opened to allow outdoor air to enter and inside air to escape. Of course, weather conditions and the circumstances of the job site (e.g., proximity to bystanders/passersby, other buildings, vehicles, possible regulations, etc.) must be taken into consideration.

Air monitoring studies have shown that low levels of airborne A- and B-side chemicals can be present in the truck trailer. Accordingly, it is prudent to ensure that all drums of chemicals are tightly closed, connections between pumps, drums, hoses, etc. are tight, and that any drips/leaks are promptly addressed.

Eating, drinking, smoking, and chewing tobacco or gum should not be conducted in the truck trailer or active work area due to the presence of chemicals. Further, employees should wash their hands well with soap and water after handling any chemicals.

Personal Protective Equipment

Respiratory Protection

Spray Foam Application

Respiratory protection is required for the spray foam applicator and any other SPF contractor employees working in the same area (e.g., on the same floor) as the applicator during spraying, as well as during post-spray activities (e.g., trimming foam, clean-up) in the application area.

The recommended type of NIOSH-approved respiratory protection is a full face or hood-type supplied air respirator operated in positive pressure or continuous flow mode.

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Liquid Chemical Handling

When handling liquid product that has been heated, an air purifying respirator with combination organic vapor/particulate (P100) cartridges is recommended. Per OSHA's respiratory protection standard (29 CFR 1910.134), the cartridges must be equipped with end-of-service life indicators (ESLI) certified by NIOSH; otherwise, a change out schedule must be developed and implemented. The basis for the change out schedule must be described in a written respiratory protection program (29 CFR 1910.134(d)(3)(iii)). The change-out schedule is based on the capacity of the cartridges relative to workplace airborne concentrations. If the wearer notices odors, irritation, or breathing resistance at any time, cartridges should be changed promptly.

General

Per OSHA's Respiratory Protection Standard, a medical evaluation is required prior to use to determine the wearer's fitness for using a respirator (29 CFR 1910.134(e)). Users of respirators with tight-fitting face pieces must pass an annual fit test on the same make, model, and size of respirator that they use to ensure a proper fit (29 CFR 1910.134(f)). Respirator users must not have facial hair that interferes with the face piece seal or inhalation/exhalation valves (29 CFR 1910.134(g)(1)). Respirators should be regularly cleaned and disinfected according to the manufacturer's instructions and must be periodically inspected for damage and deterioration. Deteriorated/defective respirators should be taken out of service (29 CFR 1910.134(h)).

Additional Personal Protective Equipment Spray Foam Application

The following are recommended for the spray foam applicator:

- Disposable coveralls with long sleeves and attached hood that provides protection against aerosols and sprays/

drips of reacting foam (e.g., Tyvek®, Kleenguard®, etc.)

- Disposable over-boots
- For protection against sprays/drips of reacting foam, gloves made of fabric coated with nitrile, neoprene, butyl, or PVC.

Similar protective equipment is recommended for employees working in the same area as the applicator. However, if the employees are not working in close proximity to the applicator, over-boots may not be necessary.

Liquid Chemical Handling

The following are recommended:

- Chemical safety goggles
- Nitrile, neoprene, butyl or PVC gloves
- If potential for splash to the body, impermeable clothing (e.g. PVC, polyethylene).

The personal protective equipment needed when using solvents to clean equipment is dependent upon the solvent used. Consult the solvent manufacturer's MSDS for guidance.



Monitoring employees for adverse health effects caused by overexposure

Implementing a medical surveillance program is recommended. The purpose of such a program is to: (1) establish a medical baseline and assess an employee's fitness to work with isocyanates prior to assignment, and to (2) promptly identify adverse health effects that may be associated with chemical exposure.

Prior to assignment to a work area where isocyanates are used, employees should undergo a medical evaluation by a qualified occupational physician. The evaluation should consist of a review of the employee's medical and occupational history and a physical examination, including a skin inspection, examination of the heart and lungs, and a baseline pulmonary function test (PFT). The initial evaluation should be followed up with

PFTs at two weeks and then again at six months, following the start of work where isocyanates are used. Subsequently, annual evaluations should be conducted that include abbreviated health questionnaires and PFTs.

The accurate diagnosis of occupational asthma is complicated and typically requires the physician to use several tests; however, **once a worker has been diagnosed as sensitized to isocyanates, no further exposure can be permitted.**

Bayer MaterialScience has developed a document titled *Medical Surveillance Guidelines for Users of Isocyanates* that provides additional details. It is available at the BayCare® website referenced at the end of this brochure.

Potential additional safety hazards and work site precautions

Under certain conditions, cured spray polyurethane foam will burn. Thermally degrading foam can generate toxic and irritating gases and vapors including isocyanates, carbon monoxide, carbon dioxide, nitrogen oxides, and hydrogen cyanide, among other compounds. Therefore, smoking, torch cutting, and welding should not be permitted near installed foam.

Further, the reaction of A- and B-side chemicals, when sprayed to form foam, releases heat (i.e., it is an exothermic reaction). Thus, spraying foam too thickly in a single lift, or not allowing sufficient time between lifts, can result in excessive heat generation to the point where the foam may char, smolder, or burn. Fire extinguishers should be readily available at the job site, and employees should be trained on their use.

The use of space heaters during spraying should be avoided. Spray foam aerosol coming into contact with the heating elements may produce toxic and irritating gases/vapors.

Pressurized equipment that is damaged or improperly tightened can result in injury and/or chemical exposure, including injection of chemicals into the body. Pressurized components should be inspected before each use to identify damage

and to confirm that all connections are tight.

The flow of liquids and air through equipment and hoses can generate static electricity that can result in sparking and shocks to workers. Therefore, all equipment should be grounded to reduce this potential. In addition, all electrical equipment should be properly grounded to prevent workers from being shocked or electrocuted should an electrical short develop. Electrical equipment that will be operated near water should be equipped with ground fault circuit interrupters.

No other contractors or building occupants should be in the structure during spray polyurethane foam application. Re-entry by others should not be permitted until the structure has been adequately ventilated. Contact Bayer for guidance.

Material Safety Data Sheets (MSDS) for each chemical used in the spray foam application should be available at the worksite. MSDS for Bayer MaterialScience products are available online at the BayCare® website or by calling the Bayer MaterialScience Product Safety & Regulatory Affairs department, both of which are referenced at the end of this brochure.

Spill and leak procedures

General

Only trained personnel should respond to a release. Outside assistance may be necessary for large spills.

A-side

Require personnel who will not be involved in spill clean-up to leave the area. Isolate the area and prevent access. Remove ignition sources. Notify management. Put on appropriate personal protective equipment. The need for respiratory protection must be evaluated on a case-by-case basis; consideration should be given to the amount of material spilled, temperature of material, volume of space where spilled, etc. Control the source of the leak. Ventilate the area. Contain the spill to prevent spreading.

Major spill/leak (standing liquid) – Released material may be pumped into closed, but not sealed, metal containers for disposal.

Minor spill/leak (wet surface) – Cover spill area with suitable absorbent material (e.g., Kitty Litter, Oil-Dri®, etc.). Saturate absorbent material with neutralization solution (see next paragraph) and mix. Wait 15 minutes. Collect material in open-head metal containers. Repeat applications of decontamination solution, with scrubbing, followed by absorbent until the surface is decontaminated. Apply lid loosely and allow container to vent for 72 hours to let carbon dioxide escape. Commercially available Swype® test kits may be helpful in detecting the presence of residual surface contamination.

Neutralization solutions include:

- 1) Colormetric Laboratories Inc. decontamination solution;

- 2) a mixture of 75% water, 20% non-ionic surfactant (e.g., Plurafac SL-62, Tergitol TMN-10), and 5% n-propanol;

- 3) a mixture of 80% water and 20% non-ionic surfactant;

- 4) a mixture of 90% water, 3-8% ammonium hydroxide or concentrated ammonia, and 2% liquid detergent.

Note that Bayer requires that CHEMTREC be immediately notified (800-424-9300) when this product is unintentionally released from its container during its course of distribution, regardless of the amount released. Distribution includes transportation, storage incidental to transportation, loading, and unloading. Such notification must be immediate and made by the person having knowledge of the release. Refer to the Accidental Release Measures section of the MSDS for more details.

Note that other agencies (e.g., United States Environmental Protection Agency, state/local agencies, etc.) may need to be notified, depending on the quantity of material spilled. Refer to the Regulatory Information section of the MSDS for more details.

B-side

Require personnel who will not be involved in spill clean-up to leave the area. Isolate the area and prevent access. Remove ignition sources. Put on appropriate personal protective equipment. Control the source of the leak. Ventilate the area. Contain the spill to prevent spreading. Cover spill area with suitable absorbent material (e.g., dry sand or earth) and collect for proper disposal.

Handling drums and waste

Moving drums of chemicals can result in injuries to feet, hands, and back. Steel toe shoes or boots and leather gloves are advisable. Also, drum dollies and lift gates should be used to assist with transporting drums.

Note that care must be taken with containers of A-side where the product has come into contact with water or water vapor. Such containers should not be tightly closed,

because the reaction of MDI with water/water vapor will slowly produce carbon dioxide. The accumulation of carbon dioxide may deform or rupture a closed container.

Containers of B-side that contain blowing agent must be kept cool to prevent vaporization of the liquid blowing agent. Heating and vaporization can result in excessive pressure that may deform or rupture the container.

Waste chemicals should be disposed of in accordance with federal, state, and local regulations. Wastes are typically "hazardous" by virtue of being listed as such by regulatory agencies, or because they display certain characteristics with respect to toxicity, ignitability, reactivity, and corrosivity. Although the BaySystems A- and B-side chemicals, as purchased, are not listed as hazardous wastes by the US Environmental Protection Agency (EPA) and do not exhibit the characteristics of hazardous waste, state and local regulations must be consulted, as they may differ from EPA regulations. Even wastes that are not

"hazardous" by EPA definition are typically subject to some form of disposal requirement. Again, state and local regulations must be consulted.

Empty drums should be drip dry, meaning nothing drains out of the drum when overturned. Empty drums may be sent to a qualified drum re-conditioner, drum recycling facility, or a landfill permitted to accept used drums. Drums should not be torch cut. Torch cutting may generate irritating and toxic gases and vapors from residual chemicals or cured product present in the drums.

For More Information

The following resources contain valuable information on health, safety, and environmental protection with respect to polyurethane chemicals.

Bayer MaterialScience's Product Stewardship Program, BayCare®, is available online at www.baycareonline.com. This website offers important information on the safe handling of Bayer MaterialScience products. First time users must register at the website. Select "Health & Safety." Then "BaySystems SPF."

Material Safety Data Sheets for the A- and B-side chemicals are available from Bayer MaterialScience online at www.baycareonline.com or by calling the Bayer MaterialScience Product Safety & Regulatory Affairs department at 412-777-2835.

Center for the Polyurethanes Industry (CPI) website www.polyurethane.org. Select "Environment," "Safety," or "Health."

Spray Polyurethane Foam Alliance (SPFA) website www.sprayfoam.org. Select "Health & Safety" or "Energy & the Environment."

Consultation with the Bayer MaterialScience Product Safety & Regulatory Affairs department is available by calling 412-777-2835.

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