

Polyurethanes & Thermal Degradation

Polyurethane is a material that can be found in many of the products that we use in our daily lives. Incidental heating of polyurethanes or polyurethane containing articles may be necessary during some product applications or operations. When overheated, polyurethanes and other polymers may breakdown and produce smoke and/or vapors that contain various chemicals. This breakdown is often referred to as thermal degradation.

Definition of Thermal Degradation

The chemical breakdown of materials when heat is applied.

Thermal degradation can take place when the material is burning (i.e., flaming mode) or when it is exposed to elevated temperatures without burning (i.e., non-flaming mode). All combustible materials, whether synthetic or man-made, generally produce toxic products when burned. This document highlights toxic products that may be of concern when polyurethanes are thermally degraded, the risks of working in proximity to those toxic products and some worker safety and health precautions to consider.

Examples of Hot Work

Hot work performed on or near polyurethanes, such as paints, lacquers or insulation, may be done through a variety of different processes. Some examples of these methods are listed below.

- **Welding**
- **Heating of polyurethane foam while working on pipes**
- **Heating MDI-based glues**
- **Soldering**
- **Treatment with a heat gun**
- **Cutting with torches or hot wire**
- **Hot scissors**
- **Grinding**
- **Sawing**

The Risks

It has been estimated that non-flaming thermal degradation of some polyurethane products may begin as low as about 150°C (300°F). However, it is important to note that the temperature at which thermal degradation starts can vary due to the many different heating processes and with the various types of polyurethanes used. When polyurethanes undergo thermal degradation some toxic chemicals may be emitted. This may or may not be seen as smoke or vapors. The importance of being aware of this type of degradation, in part, is because of the lack of visible warning signs of the chemicals that may be released during these processes. For the most part, non-flaming decomposition occurs during industrial work processes that may lead to worker exposure issues. Use of some control measures (e.g., local exhaust ventilation and proper personal protective equipment) may reduce the risk of exposure to smoke or vapors from the thermal degradation of polyurethanes. Additional information regarding ventilation and personal protective equipment is available through the Center for the Polyurethanes Industry's website at www.polyurethane.org or possibly through your material suppliers.

Health Effects

A range of airborne thermal degradation chemicals may be emitted during combustion of polyurethane products. These chemicals may include carbon dioxide, carbon monoxide, nitrogen oxides, hydrogen cyanide, isocyanates and amines. The composition of these chemicals, when emitted in the form of smoke or vapors, may vary. Exposure to such chemicals may cause irritation of the eyes and respiratory tract with symptoms of running nose, watering eyes, coughing, headaches, dizziness, nausea and breathlessness. Isocyanates and amines can also cause allergic reactions (sensitization) of the skin and lungs. Workers

exposed to thermal degradation of polyurethanes may experience effects as the exposure occurs or days after exposure has occurred. Medical attention should be obtained if any symptoms occur.

Prevention & Precautions

To help minimize the potential risks of exposure, when performing hot work on or around polyurethanes, keep these safety precautions in mind.

- Personal protective equipment and ventilation should be in good working order and used correctly.
- Carefully read and follow safety precautions listed on the product label and Material Safety Data Sheets (MSDS).
- As applicable, comply with training and OSHA Hazardous Communication Standard requirements (29 CFR 1910.1200).
- If you experience any symptoms of exposure, stop work immediately and see a doctor to determine if your health is at risk.
- Be aware that there may be other federal, state and local regulations that apply to the operations at your worksite beyond those mentioned in this document.
- When possible, remove polyurethanes before performing hot work processes (e.g., pipe insulation should be removed and isolated when welding is carried out).
- Where applicable and safe, consider replacement of hot wire cutting with other cutting devices such as band saws, oscillating saws and high pressure water jets, from which levels of emission breakdown is usually extremely low.

Conclusion

Performing hot work, on or around polyurethanes, may be done safely if workers understand the potential risks associated with this type of job and consider appropriate safety precautions. Workers should inquire about their company's internal product stewardship program for more safety information about working with polyurethanes or visit www.polyurethane.org.

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