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](http://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).
- 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.

**LEGAL NOTICE**

This Technical Bulletin was prepared by the American Chemistry Council's Center for the Polyurethanes Industry. It is intended to provide general information to persons working in close proximity to polyurethane hot work. It is not intended to serve as a substitute for in-depth training or specific handling requirements, nor is it designed or intended to define or create legal rights or obligations. It is not intended to be a "how-to" manual, nor is it a prescriptive guide. All persons working in close proximity to polyurethane hot work have an independent obligation to ascertain that their actions are in compliance with current federal, state and local laws and regulations and should consult with their suppliers or legal counsel concerning such matters. This Technical Bulletin is necessarily general in nature and individual companies may vary their approach with respect to particular practices based on specific factual circumstance, the practicality and effectiveness of particular actions, and economic and technological feasibility.

Neither the American Chemistry Council, nor the individual member companies of the Center for the Polyurethanes Industry, makes any warranty or representation, either express or implied, with respect to the accuracy or completeness of the information contained in this Technical Bulletin; nor do the American Chemistry Council or any member companies of the Center for the Polyurethanes Industry assume any liability or responsibility for any use or misuse, or the results of such use or misuse, of any information, procedure, conclusion, opinion, product, or process disclosed in this Technical Bulletin. NO WARRANTIES ARE GIVEN; ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE ARE EXPRESSLY EXCLUDED.

This work is protected by copyright. The American Chemistry Council, which is the owner of the copyright, hereby grants a nonexclusive royalty-free license to reproduce and distribute this Technical Bulletin, subject to the following limitations: (1) the must be reproduced in its entirety, without alterations; (2) all copies of the work must bear a notice on the first page noting the American Chemistry Council's notice of copyright; and (3) copies of the work may not be sold.
Center for the Polyurethanes Industry of the American Chemistry Council promotes the sustainable growth of the polyurethane industry by identifying and managing issues that could impact the industry, in cooperation with user groups. Its members are U.S. producers or distributors of chemicals and equipment used to make polyurethane or are manufacturers of polyurethane products.

The American Chemistry Council (ACC) represents the leading companies engaged in the business of chemistry. ACC members apply the science of chemistry to make innovative products and services that make people’s lives better, healthier and safer. ACC is committed to improved environmental, health and safety performance through Responsible Care®, common sense advocacy designed to address major public policy issues, and health and environmental research and product testing. The business of chemistry is a $635 billion enterprise and a key element of the nation’s economy. It is one of the nation's largest exporters, accounting for ten cents out of every dollar in U.S. exports. Chemistry companies are among the largest investors in research and development. Safety and security have always been primary concerns of ACC members, and they have intensified their efforts, working closely with government agencies to improve security and to defend against any threat to the nation’s critical infrastructure.

© Copyright 2008 American Chemistry Council (ACC). All rights reserved.