

QUESTION & ANSWER: SMOKE TOXICITY



Center for the
Polyurethanes Industry

General Information on Smoke Toxicity:

What byproducts are found in smoke?

The combustion of products that contain organic materials produce carbon monoxide, carbon dioxide, and water. So, for example, burning common materials like wood will produce these substances. Products that contain nitrogen will also produce certain amounts of hydrogen cyanide and nitrogen oxides. Common products that contain nitrogen include sheep's wool, silk, and composite wood products using polyurethane binders. **Smoke and byproducts from fires are toxic regardless of the source of those fires and what is being burned.**

What is the most abundant toxicant in fires?

Carbon monoxide (CO). In terms of hazard, carbon monoxide (CO) is typically the most abundant toxicant in fires under almost all combustion conditions. CO is also responsible for most deaths in fires.¹

Are there long-term effects when exposed to smoke toxicants?

The nature and frequency of exposures to smoke toxicants will determine any long-term effects. For most people, exposure to fire gases is a single life time event, if ever. When people can escape from a fire or are rescued, they can normally recover fully after a short period of time. This may be different if people already suffer from a special or particular pulmonary disease. Certain populations may encounter fire events more frequently and require special protective devices. For example, firefighters are required to wear breathing protection when in the immediate vicinity of fires. The expectation for firefighters is that their long-term exposure to smoke toxicants is reduced through the use of personal protective equipment (PPE) and safe work practices.

Information Specific to Polyurethane Products:

What are polyurethane products?

Polyurethanes refer to a wide range of products that include flexible foams used in furniture and automobiles, rigid foams used as building insulation, durable coatings, adhesives and sealants, and even certain items of apparel.²

Can polyurethane products burn?

As with other common organic materials, polyurethane foam products are combustible when exposed to a sufficient ignition source. For that reason, to maximize their safety many polyurethane products are flame retarded or protected by a barrier that can delay ignition, retard combustion, reduce surface burning, or otherwise protect the material from fires.

¹ <http://www.nfpa.org/news-and-research/news-and-media/press-room/reporters-guide-to-fire-and-nfpa/consequences-of-fire>

² For more detailed information on polyurethanes, visit: <https://polyurethane.americanchemistry.com/Introduction-to-Polyurethanes/>

Do polyurethane products emit smoke when burning?

Yes. Like any material in a fire, the amount of smoke generated is dependent on a number of factors, including the amount and type of burning material, the amount of oxygen available, and the temperature of the fire.

Do polyurethane products produce a unique toxicity risk in fires?

No. While a range of airborne chemicals may be emitted during fire events involving polyurethane products, all combustible materials produce toxic smoke when burned, including wood. In terms of hazard, carbon monoxide (CO) is typically the most abundant toxicant in fires under almost all combustion conditions. Additional combustion byproducts may include carbon dioxide, nitrogen oxides, hydrogen cyanide, and other potentially hazardous decomposition products. The composition of these chemicals, when emitted, may vary.

Do fires involving polyurethane present a significantly greater health risk than fires involving other synthetic or natural materials?

No. Smoke from a fire that involves polyurethane products does not present a significantly greater health risk than fires resulting from the burning of other synthetic or natural materials. While the combustion of polyurethane products can produce smoke containing hydrogen cyanide (HCN), it is also true that HCN is produced whenever nitrogen-containing materials are burned (e.g., sheep's wool, silk, and wood composites). The hazards created by any burning material are strongly dependent on the fire scenario, which is a complex phenomenon influenced by a range of factors such as room size, temperature, ventilation conditions, exposure time, source, and location of ignition.³

Does the use of polyurethane foam insulation in a home present an increased risk of exposure to smoke toxicants as compared to a home insulated with other organic materials?

No. Research has shown that in a fire event the combustion of products that contain organic materials will produce similar smoke toxicants. For example, the combustion of wood and polyurethane foam insulation will produce carbon monoxide (CO) – CO is the most abundant toxicant in fires under almost all combustion conditions. It is important to remember that building fire safety codes and other protective measures like the use of flame retardants are in place to help prevent fires from starting and to provide building occupants with valuable escape time.

How are polyurethane products protected from fire?

Like other commonly used products, fire safety standards are in place to regulate the use of some polyurethane products such as construction materials, upholstered furniture, and mattresses. Some of these standards require products to pass fire safety tests and also govern how products are used. Manufacturers use a combination of fire safety technologies and product and assembly designs to meet these standards.

³ ISO TS 29761:2015 "Fire safety engineering – Selection of design occupant behavioral scenarios"- § 5.4.