

Hazardous Combustion Gases from Insulating Polyurethane Foam. A Case Study

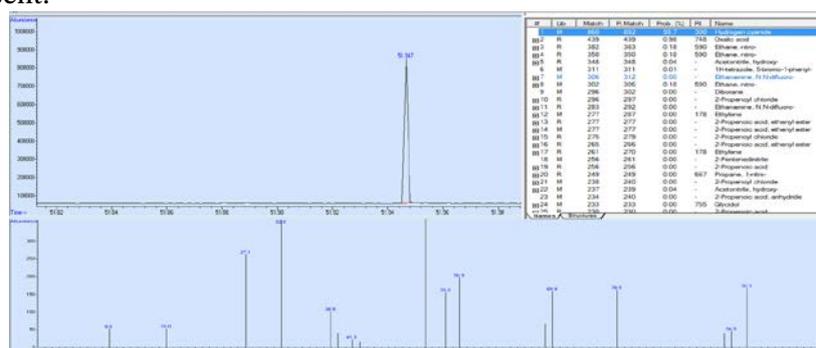
Prof. Dr. Ovidiu Oprea, Faculty of Applied Chemistry and Materials Science, University POLITEHNICA of Bucharest, Romania

Polyurethane (PU) foam with its flexible or rigid type is used in a variety of applications today: as flexible material in furniture or automotive industry, as thermal insulation in freezers or in constructions, as packaging material or as sound insulation liner, to mention just the most important ones, with over 80% consumption among them.

In our day by day activity we are surrounded by objects which contains PU foam. Unfortunately the PU foam is also a combustible material, and a hazardous one, beside good flammability PU forming as we will see a deadly cocktail of gases (mainly carbon monoxide and hydrogen cyanide).

The PU foam may be classified as thermoset, cross-linked polymer, which will decompose on heating. The high number of C-N bonds are primarily responsible for the hydrogen cyanide yields, while high carbon content is responsible for carbon monoxide production [1]. In order to produce a safer material, fire retardants are added in PU. The flame retardants used to protect PU foams are still mainly halogenated and some are associated with a wide range of adverse effects in animal and human health [2]. Such material will not be able to burn by its self, but will still produce large amounts of carbon monoxide and hydrogen cyanide when exposed to fire started from other combustible materials [3]. Because non-flame retardants PU is cheaper, there are still various entities that will use it only based on costs analysis. Such case was the "Colectiv" night club, which was set on fire by sparks from firework candles on 30.10.2015. Most of the victims who died on site were poisoned by the toxic gases released from the burning foam, and were also reported cases in which some survivors died after going back inside to try evacuate more people.

Thermal analysis performed with NETZSCH STA *F3 Jupiter*® TGA/DSC-FT-IR-GC-MS. The samples of PU foam were alike those used inside the club. The results have quickly revealed the unseen killer in the "Colectiv" nightclub. The gases evolved were indeed formed mainly from carbon monoxide and hydrogen cyanide, both of them deadly, even in small doses and also silence killers by impeding the respiratory processes. While at lower temperatures only carbon monoxide is produced, at temperatures over 500°C also hydrogen cyanide is present.



References

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3. Risk Assessment Report on Tris(2-chlor-propyl) Phosphate (TCPP), Scientific Committee on Health and Environmental Risks, Environmental Part, EINECS No. 237-158-7 (2007)