

PUR / PIR foam's perception

Support of discussion – interim phone meeting

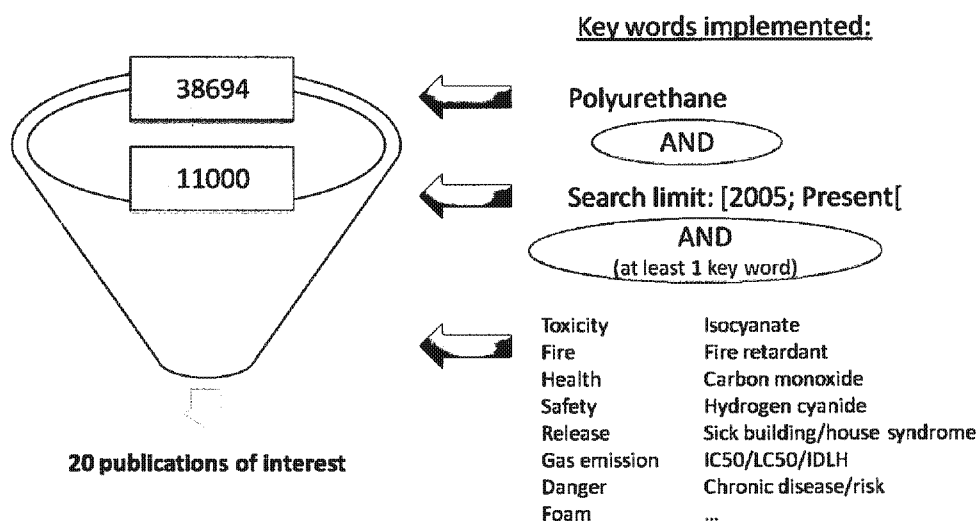
Methodology

As of Monday, 17th January 2011, an in-depth literature research has been performed to identify articles / websites which could potentially raise awareness towards PUR / PIR hazards:

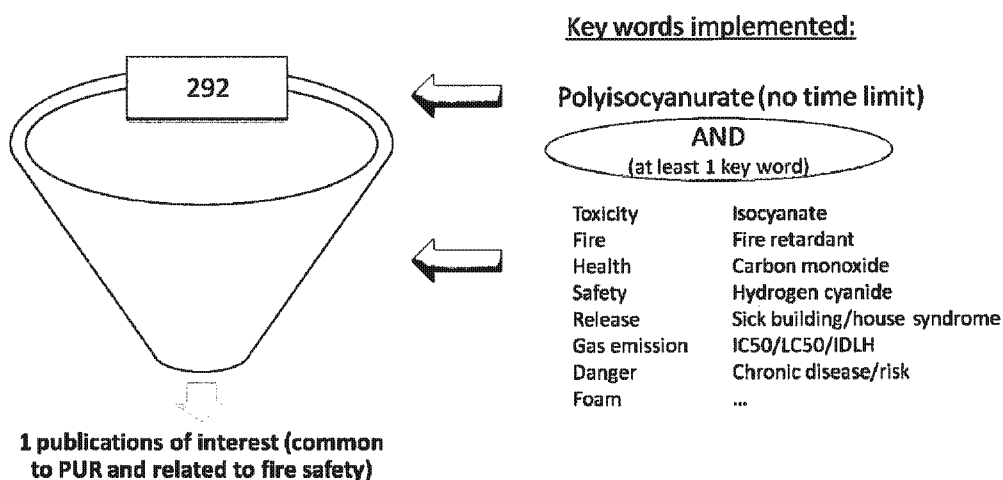
➤ Through SCOPUS:

Please note that the publications selected are not limited to construction and fire risks but are global to any hazards related to PUR use (construction, furniture...).

○ PUR:



○ PIR: only 1 study of interest, specific to PIR use and related hazards, has been found, which has also been selected through the previous research.



➤ Through global Internet-based research

- Similar key words were used
- Country-specific research has been undergone

From the research, it appears that most of the concerns are found in public forums and are directed towards the chronic use of PUR in furniture (e.g. mattresses) and related off-gassing.

First insights

Scopus

- Globally, very few publications are related to our direct scope, which was as follows:
 - PUR/PIR foam use as construction insulators **AND**
 - Associated hazards due to: important fire **OR** fire of small amplitude (which could slightly degrade the foams and release toxic compounds) **OR** chronic use (e.g. volatile compounds, ageing...)

From the identified publications:

- 8 publications are related to building insulation (or refer to it), among which:
 - All relate to PUR, of which 1 of them also refers to PIR
 - **5 are related to fire toxicity¹**: none seem to take into account small levels of fires. **Carbon monoxide** and **hydrogen cyanide** are considered to be the main toxic combustion products released by urethane foams, the evolution of which depends on the oxygen concentration in the combustion environment (Singh 2009)
 - **3 are related to chronic risks²** (e.g. contact with water, semi-volatile dibasic esters originating from PUR floor component, potential exposure to isocyanates during spray foam application)

¹ **Stec 2010** Assessment of the fire toxicity of building insulation materials Energy and Buildings, Article in Press
Konecki 2009. Simple fire model for comparative studies of critical conditions during combustion of chosen polymer materials. Journal of Civil Engineering and Management, 15 (3), pp. 247-257.

Singh 2009. Ignition, combustion, toxicity, and fire retardancy of polyurethane foams: A comprehensive review (2009) Journal of Applied Polymer Science, 111 (2), pp. 1115-1143

Liang 2007. Toxicity characteristics of commercially manufactured insulation materials for building applications in Taiwan. Construction and Building Materials, 21 (6), pp. 1254-1261 → *Japanese only*.

Hirschler 2008. Polyurethane foam and fire safety. Polymers for Advanced Technologies, 19 (6), pp. 521-529.

² **Lithner 2009**. Leachates from plastic consumer products - Screening for toxicity with Daphnia magna (2009) Chemosphere, 74 (9), pp. 1195-1200.

- 13 do not relate to building insulation (or do not specify applications of use):
 - 4 relate to toxicity emitted from PUR linked to fire³
 - 3 relate to chronic hazards⁴. In particular in Chester 2005: case report on "Asthma death after spraying polyurethane truck bedliner", partly due to the volatile isocyanates emitted by the spray.
 - 6 are not in our direct scope, as they describe isocyanates potential risk in workplace. Such papers, even though not specific to PUR, have been kept as they might also impact on the perception of PUR/PIR foams' use, since they are present in these.

The publications that have been selected show no tendency towards an interest from a specific country (Canada, Sweden, USA, Japan, UK, India, Taiwan, Belgium...). Though for isocyanates, half of the publications of interest were USA-related.

Examples of institutes/universities involved:

- Greater Manchester Fire Service (UK)
- Centre for Fire and Hazard Science, University of Central Lancashire, UK
- CERtech (Centre de ressources technologiques en chimie), Belgium
- Institut de Recherche Robert-Sauvé en Santé et en Sécurité du Travail, Montreal, Quebec, Canada
- Architecture and Building Research Institute, Ministry of the Interior, Taiwan
- Exposure, Epidemiology and Risk Program, Harvard School of Public Health, Boston, Massachusetts, USA
- Institut National de Recherche et de Sécurité, France

Chronic risks
Fire in non-bldgs applicat.
Chronic hazard in non bldg applicat.

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- Lesage 2007**, Airborne methylene diphenyl diisocyanate (MDI) concentrations associated with the application of polyurethane spray foam in residential construction. Journal of occupational and environmental hygiene
- Heinzow 2009**, Dibasic esters as new and relevant indoor air contaminants [Raumluftbelastung mit Dicarbonsäuredimethylestern] Gefahrstoffe Reinhaltung der Luft, 69 (4), pp. 159-164.
- ³ **Miyahara 2009**, Study of the combustion product gases of polyurethane and other polymers and their safety Zairyo/Journal of the Society of Materials Science, Japan, 58 (9), pp. 747-752
- Graham 2009**, B. Furniture thoughts. Fire Risk Management, (SEPTEMBER), pp. 28-31
- Kotresh 2009**, Heat release and burning behaviour of foam and foam/Basofil fabric combination. Polymer Testing, 28 (5), pp. 511-520
- ⁴ **Chester 2005**, Asthma death after spraying polyurethane truck bedliner. American Journal of Industrial Medicine, 48 (1), pp. 78-84.
- Hillier 2009**, Study of odours coming out of polyurethane flexible foam mattresses. Cellular Polymers, 28 (2), pp. 113-144.
- Hoffmann 2009**, Evaluation of consumer risk resulting from exposure against diphenylmethane-4,4'-diisocyanate (MDI) from polyurethane foam .EXCLI Journal, 8, pp. 58-65

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Global internet search

- When related to PUR/PIR foam use in construction, an article from ELEA, a Belgian non-profit organization⁵, dated of 2007, shows high concerns regarding such use. It is stated that PUR and PIR use is "subject to controversy" regarding environment and health: PUR and PIR foams are considered to release isocyanates, "which are carcinogen and might induce asthma". Such insulating foams would likely be outcast from construction material once a substitution material exists.

→ As it is in our direct scope, it will be interesting to contact this organization to understand what is the status of PUR/PIR use in construction in Belgium today. How are PUR/PIR considered today? Will such use be prohibited in the near future?

- Similarly, in the USA, the Healthy House Institute, which provides consumers information "to make their home healthier", states⁶ that after a PUR fire:
 - "A group of firemen, who were exposed to isocyanates, reported numerous neurological symptoms such as: euphoria, headache, difficulty concentrating, poor memory, and confusion."
 - Though, as for chronic risk, they do not present any warning: "polyurethane and polyisocyanurate insulations are fairly inert once treated."
- Even though solid scientific publications, associated with PUR/PIR risks, are not numerous, people are concerned about PUR use and tend to discuss the potential health harm of such material through more accessible websites (US-related):

"Polyurethane is a petroleum-based product that emits fumes into the air. Personal accounts of people who are sensitive to the smell of petroleum-based chemicals or flame-retardant fumes indicate that they have become ill from repeated and continuous exposure to even low levels of the fumes, which they inhale while sleeping."⁷

"After my wife and I both became ill (dizziness, headaches) shortly after beginning to sleep on the mattress, which is 100% polyurethane, we conducted a series of experiments that eliminated other sources of toxins, such as carbon monoxide, mold in the air, etc. I have also learned that the off-gassing of polyurethane (VOCs) can in fact be very detrimental to health. Does anyone have any experience with this type of problem or have any scientific evidence that polyurethane in mattresses could cause dizziness or headaches?"⁸

"My son, who shares a bed with me, has had asthma since he was 9 months old (he will be three in one month) and I recently had asthma symptoms for the first time in my life."

⁵ <http://www.lanaturemamaison.be/fiches/fiche29b.pdf>

⁶ http://www.healthyhouseinstitute.com/hhip_505-Polyurethane_and_polyisocyanurate

⁷ http://www.ehow.com/facts_5845942_illness-polyurethane-foam-odor.html

⁸ <http://www.curezone.org/forums/am.asp?i=427994>

- Regarding the 2 recent fires in Shanghai and Dijon:
 - Dijon⁹: ~~PUR~~ ^{Now! EPS} was stated not to be the only cause of such disaster, even though it participated in the propagation of the fire and has emitted extremely toxic gas.
 - Shanghai¹⁰: very high content of PUR was used during renovation of the building, which might be an important element for controversy.

Next steps

- Complete global internet research
- Contact the authors of the selected publications
- Identify the contacts in the centers potentially involved in the decision process
- Identify and contact the regulatory authorities of the 4 targeted countries
- Assess their reaction towards the South Korean example

⁹ <http://incendie-securite.fr/2010/11/page/2/>

¹⁰ http://www.lepoint.fr/monde/chine-53-morts-dans-l-incendie-de-shanghai-quatre-interpellations-16-11-2010-1262698_24.php