

Fire Safety of ETICS with EPS



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Content

- Fire safety of openings (windows)
- Fire tests of ETICS with EPS
- Available fire statistics
- Smoke toxicity of main thermoinsulations for ETICS
- EU framework to ensure fire safe buildings

The safety is certainly very important, but has to be reasonable and acceptable



An increasing number of injuries and tragic deaths of cyclists can be the subject of extensive discussion by security experts.

What can we do to increase the safety of cyclists?



We can mandate the use of an increasing number of safeguards or evaluate the available statistical data, realistically calculate the risks and take appropriate measures corresponding to reasonable safety requirements, taking into account societal interests.

Do we want to live in such buildings?

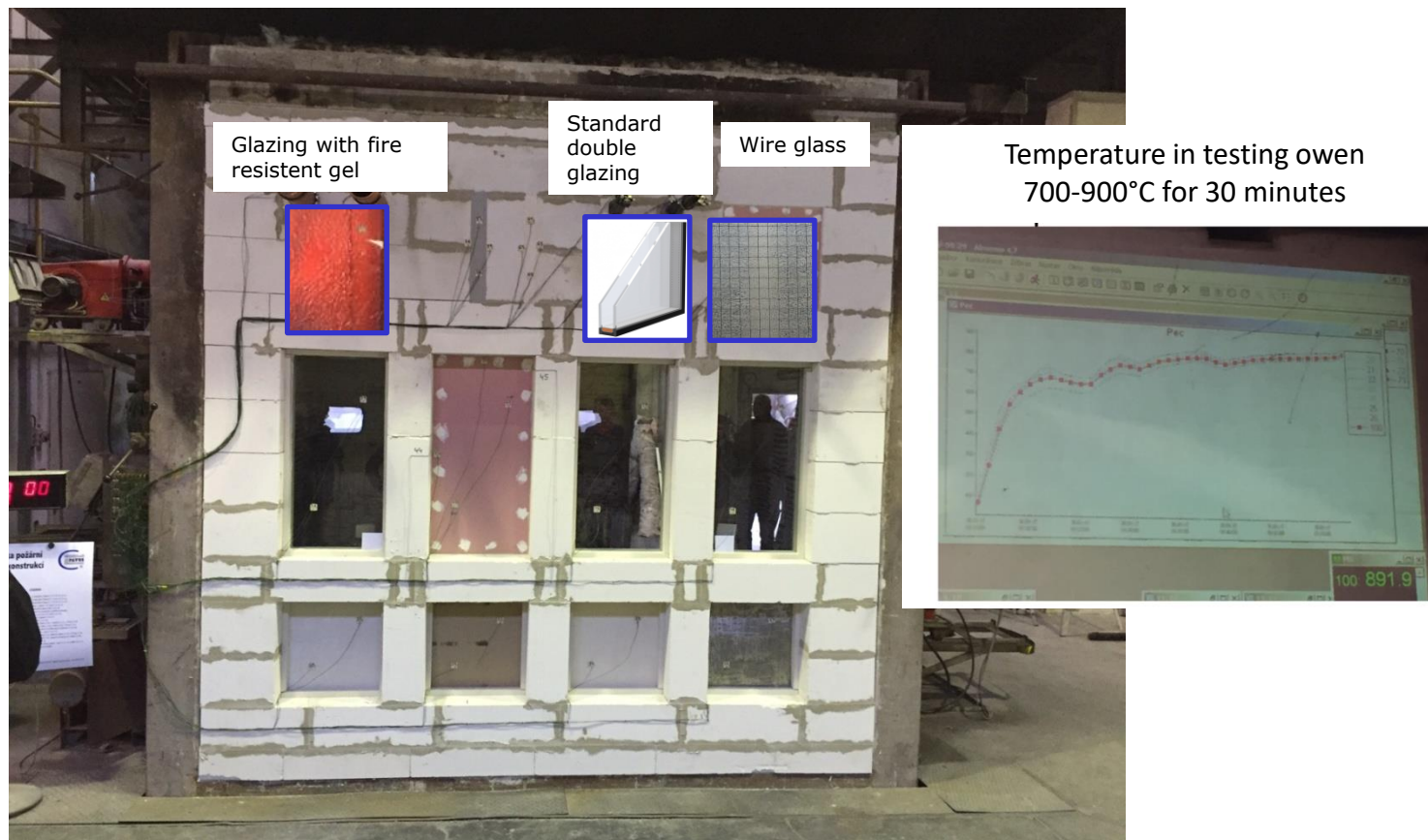
If not, let's talk about the fire safety of insulated buildings without the emotions and based on the facts.



What we already know:
The weakest elements of the walls of the buildings in case of fire are the openings (windows).

Fire resistance of openings?

0. minute: start of the test



Source: PROMAT

3rd minute: All three glazings are intact



Source: PROMAT

5th minute: Standard double glazing cracked



Source: PROMAT

22nd minute: Special fire-proof gel glazing cracked



Source: PROMAT

30th minute: end of the exam - wire-reinforced glass passed the test



Source: PROMAT

Conclusion

- The weakest points of the wall from the fire safe point of view are the opening fillings (windows).
- Standard insulating double glass window cracked in the 5th minute.
- Special fire-proof gel glazing window cracked in the 22nd minute.
- Only the window with the wire reinforcement passed the 30-minute test.

FIRE TESTS OF ETICS WITH EPS

Self-extinguishing properties of expanded polystyrene (EPS) (video)



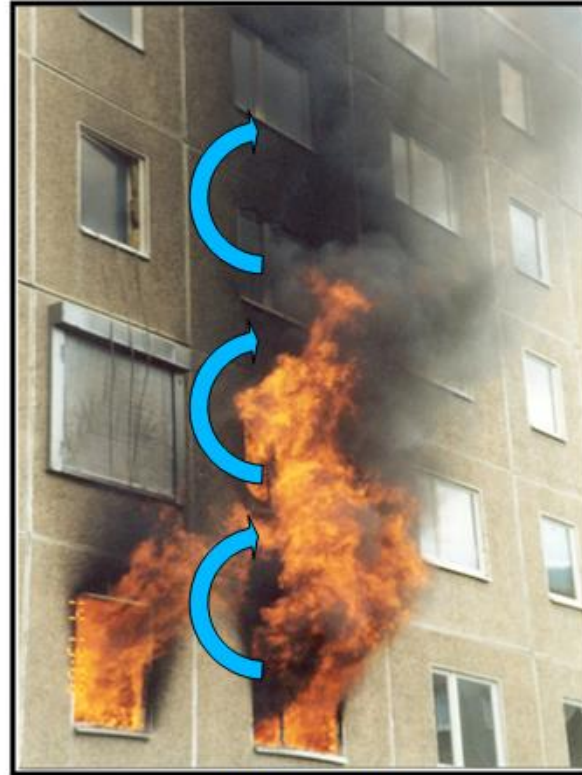


Dipl.- Ing. Ingolf Kotthoff, German fire expert

Controlled fire in an apartment building without thermal insulation (I.Kotthoff)



12th minute
„flash-over“ 1st floor



20th minute
„flash-over“ 2nd floor



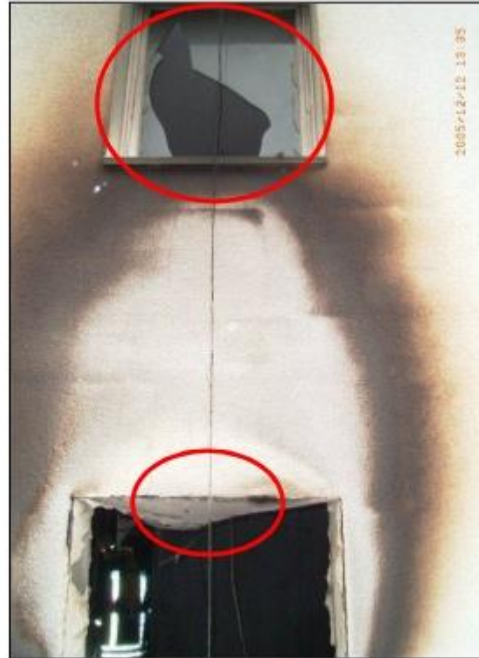
25th minute

The flames from floor to floor also occur when the outside wall is completely non-combustible over the window openings and proceeds without extinguishing attack of the fire brigade continuously upwards!

Controlled fire simulation in an apartment building



The flame from a fully developed residential fire always extends to the upper floor window



Effect of fire on the upper floor window after the test



Heat insulation from EPS after removal of ETICS top layers
No spread of fire through isolation

Testing 200 mm wide fire barriers in Germany (ISO 13 785-2)

3 MW, 30 minutes



11.minute after flash over



after 30 minutes - the flame did not spread the sample



after removing the top layer

ISO 13785-2; Czech Republic 2014



14th minute calibration test and test of ETICS with EPS



After termination of the test – the render system layer uncovered

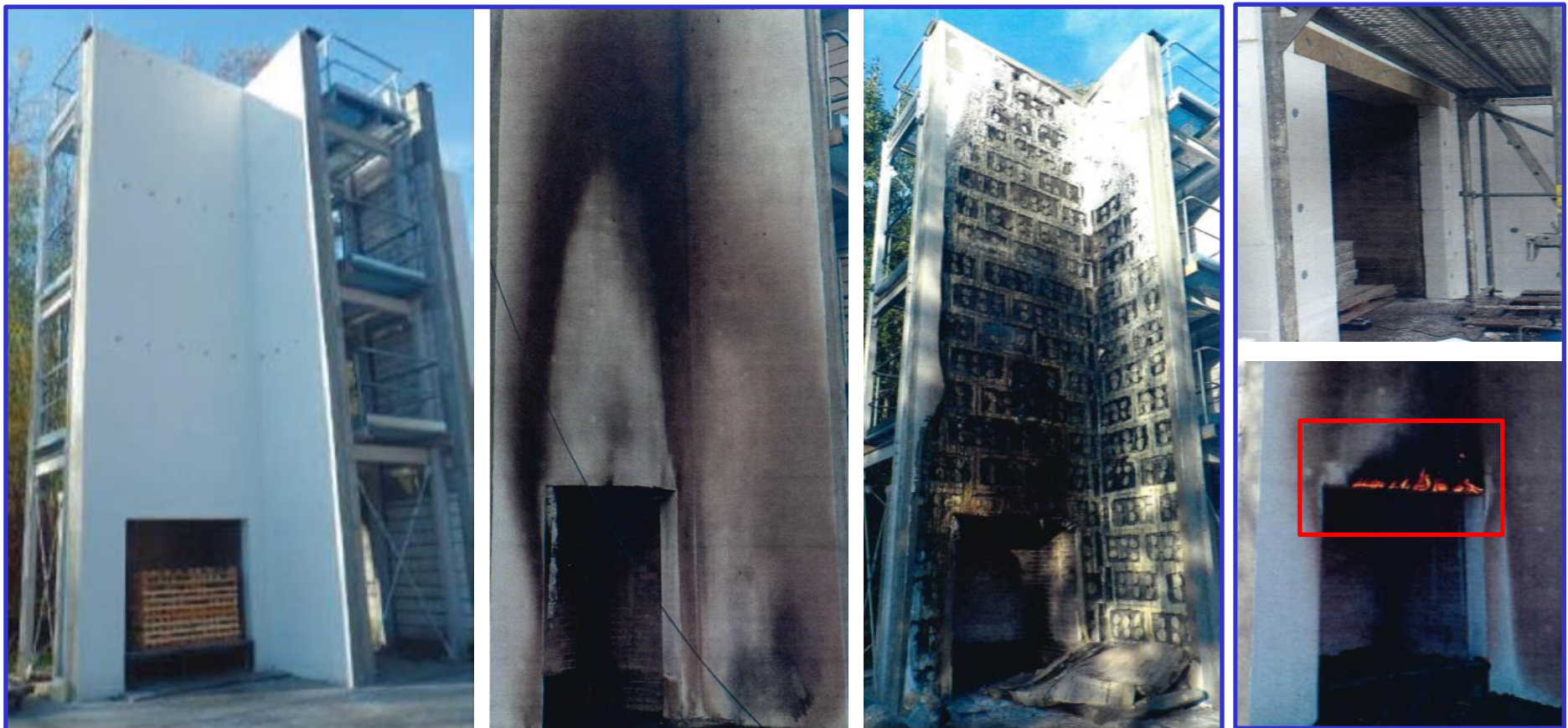
3 MW, 30 minutes

BS 8414-1:2020; Poland 2020

3 MW, 30 minutes

Specimen of ETICS with EPS without fire barrier

Specimen with fire barrier



Source: Stowarzyszenie na rzecz systemów ociepleń

MSZ 14800-6; Hungary 2019



3 MW, 650 kg of pine wood, 45 minutes

ISO 13785-1 (middle scale test) Czech Republic 2016



100 kW, 30 minutes

Draft of new European test Czech Republic 2021

Specimen preparation



Specimen ready to be tested



23rd minute of the test



60th minute of the test



45th minute of the test

Facade fires where EPS was present

Czech Republic, several cases of fire of ETICS with EPS without fire barriers



Facade fires where EPS was not present

Ambar Tower, Madrid 29th August 2020

Ventilated facades with GW + AL panels with PE core



Torre die Moro, Milan, 29th August 2021

ETICS with GW + AL panels with PE core on metal structure



Let's not jump to **conclusions** without **proper investigation**



Conclusion

- The flames of an apartment fire are 3-4 m high and jump to the window of a higher floor regardless of the cladding of the wall.
- The positive contribution of fire barriers is very questionable.
- The MW fire barrier retains the EPS melt, contributing to the fire load above the barrier.

FIRE STATISTICS

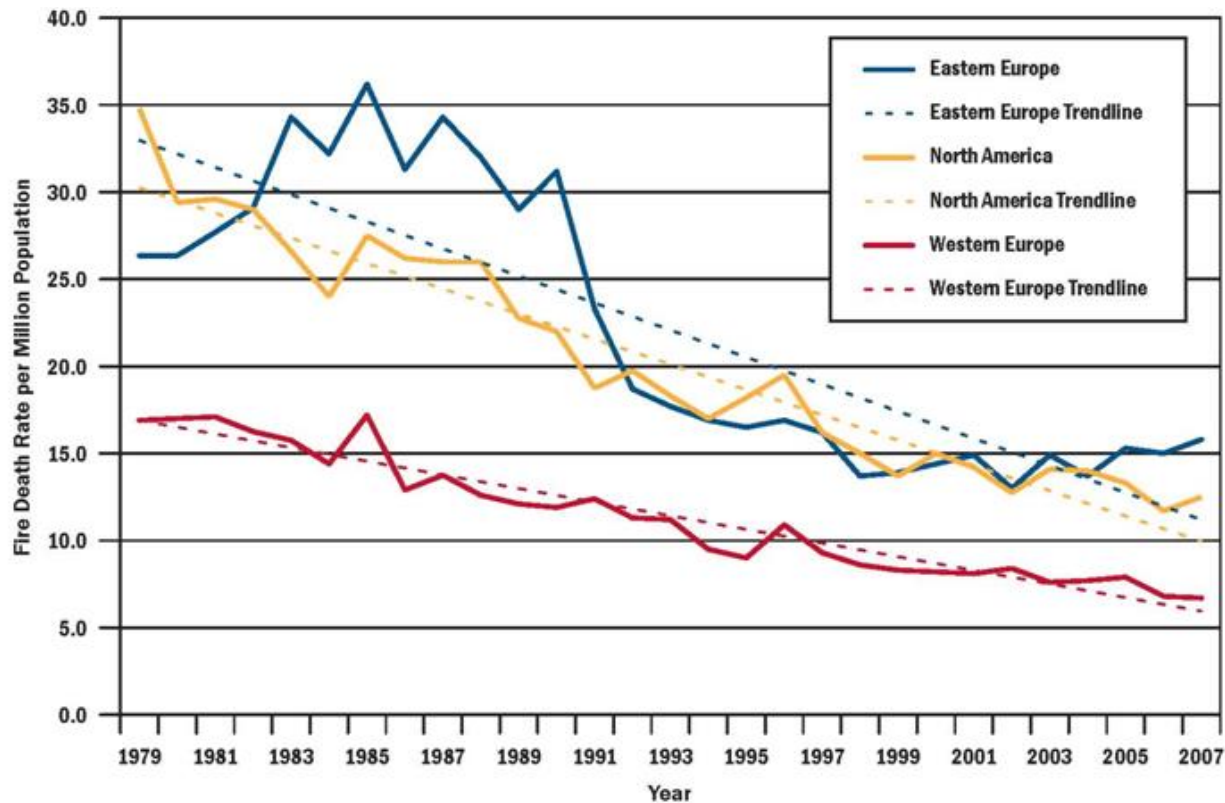
Fire statistics in general

- **For the 16 EU countries for which CTIF statistics are available:**
The direct and indirect damage caused by fire in the period 2006-2010 ranges from 0.08 - 0.229% of GDP.

Country	2006 - 2008	2008 - 2010
Czech republic	0,085	0,07
France	0,21	0,20
Germany	0,146	0,134
Italy	0,184	0,20
Finland	0,18	0,181
The Netherlands	0,187	0,15
Poland	0,09	0,09
Spain	0,08	0,08
UK	0,14	0,138

Fire statistics in general

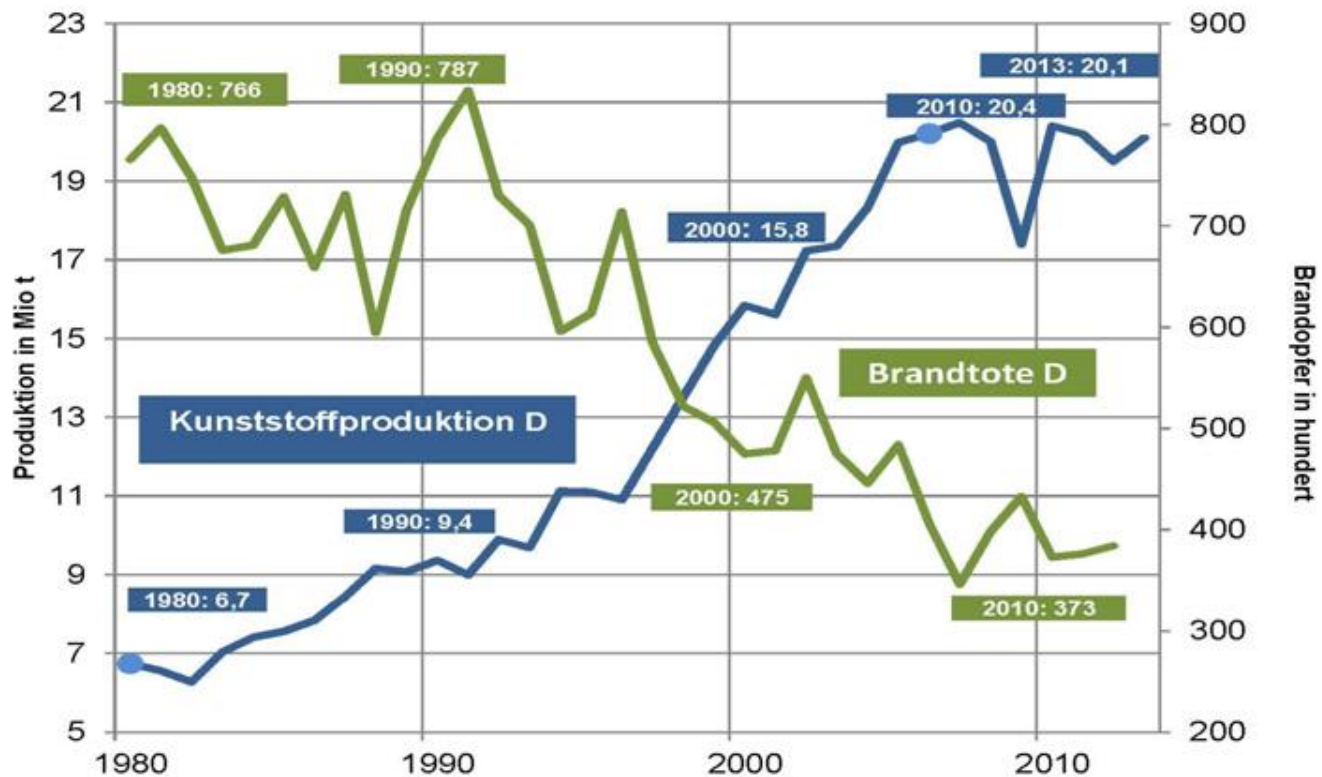
Number of deaths per year by fires per million inhabitants



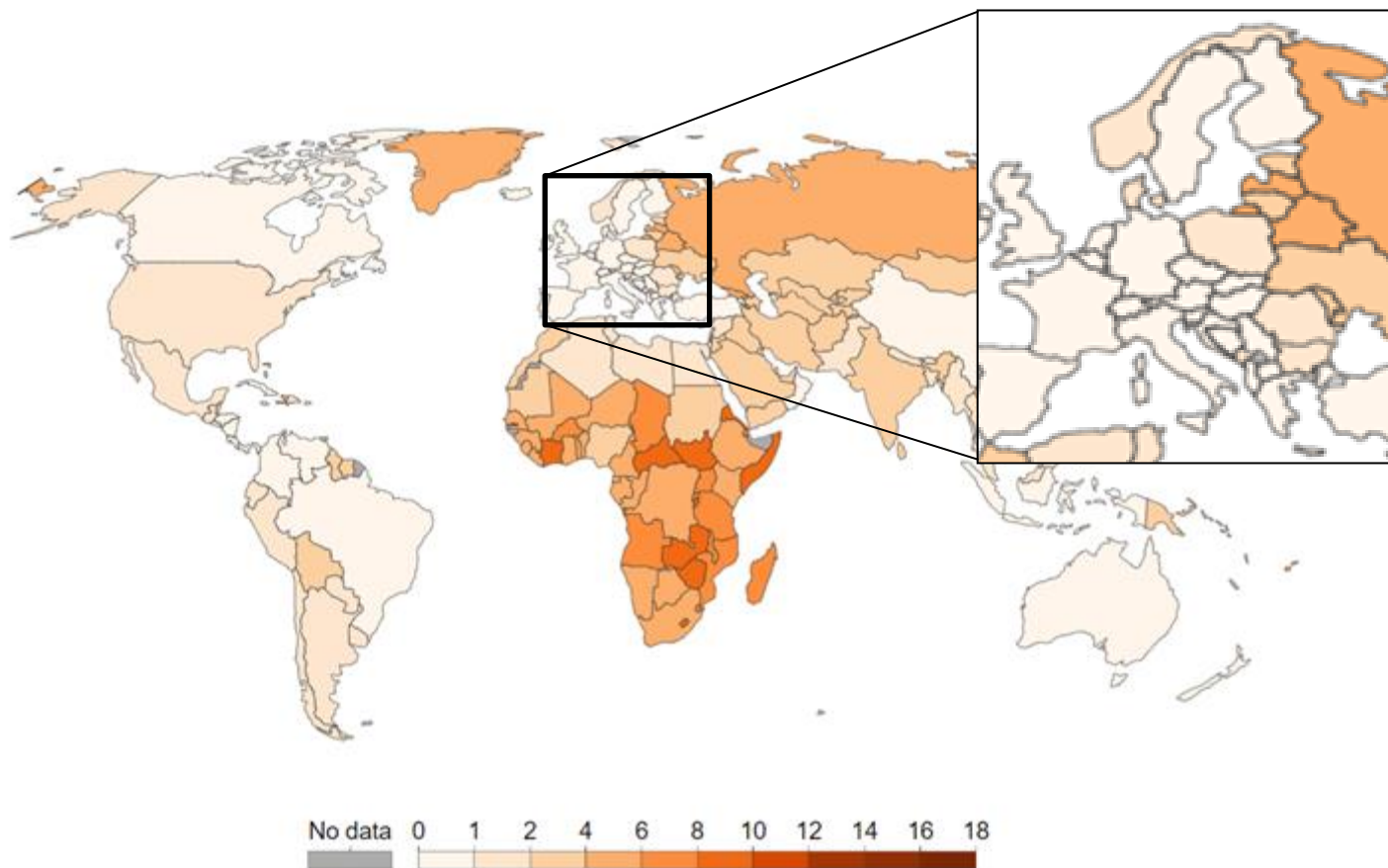
Source: www.ufsa.fema.gov/statistics

Fire statistics in general

Plastics production vs. victims of fires in Germany

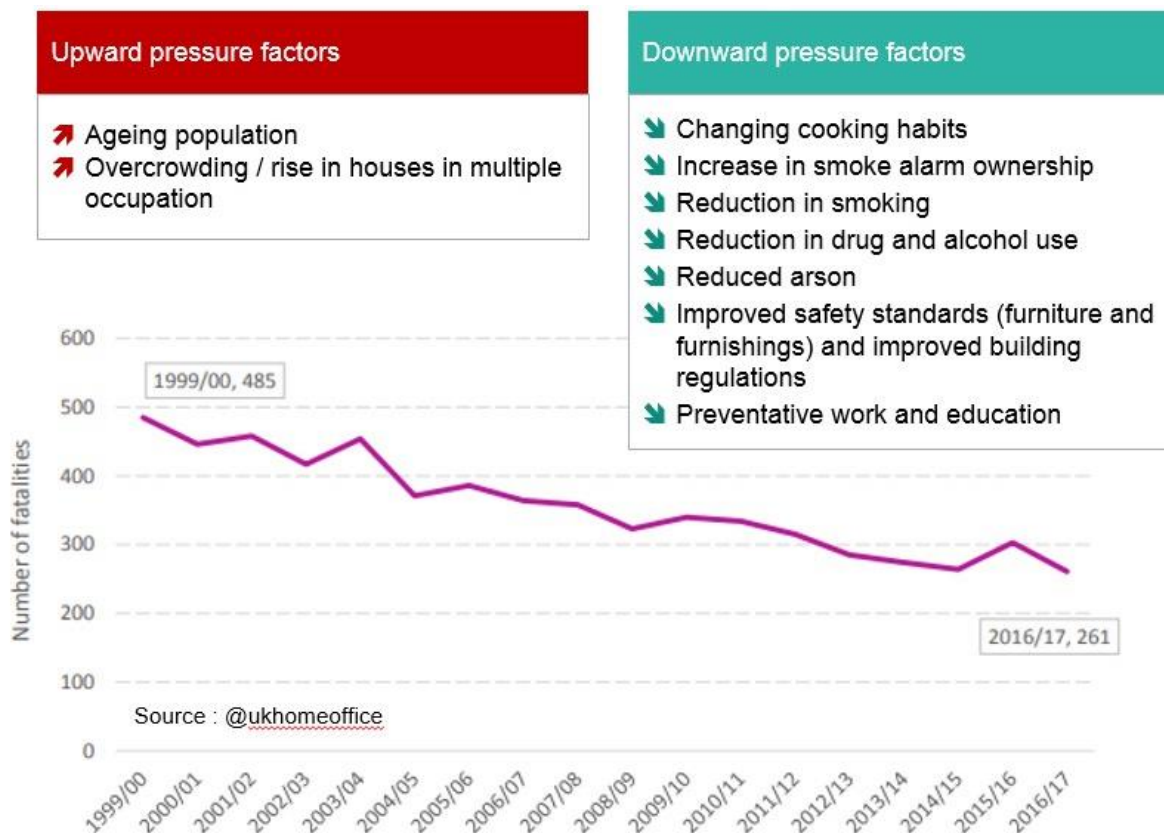


Number of deaths per 100,000 inhabitants due to fire



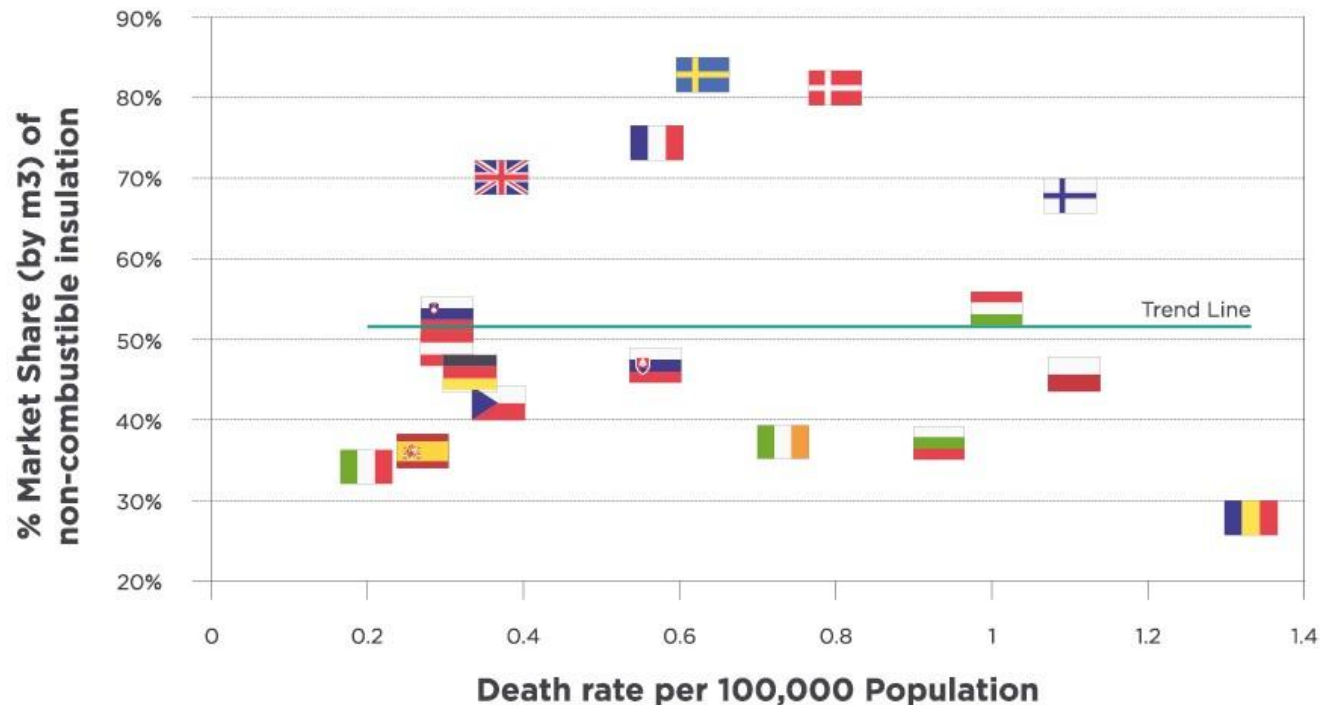
Source: IHME, Global Burden of Disease (GBD)

Fire safety facts: influencing factors, the case of England



Source: @ukhomeoffice

Correlation between the market share of non-combustible insulation materials and the fire death rates in Europe



Source: WHO, IAL consultants et USFA

Conclusion

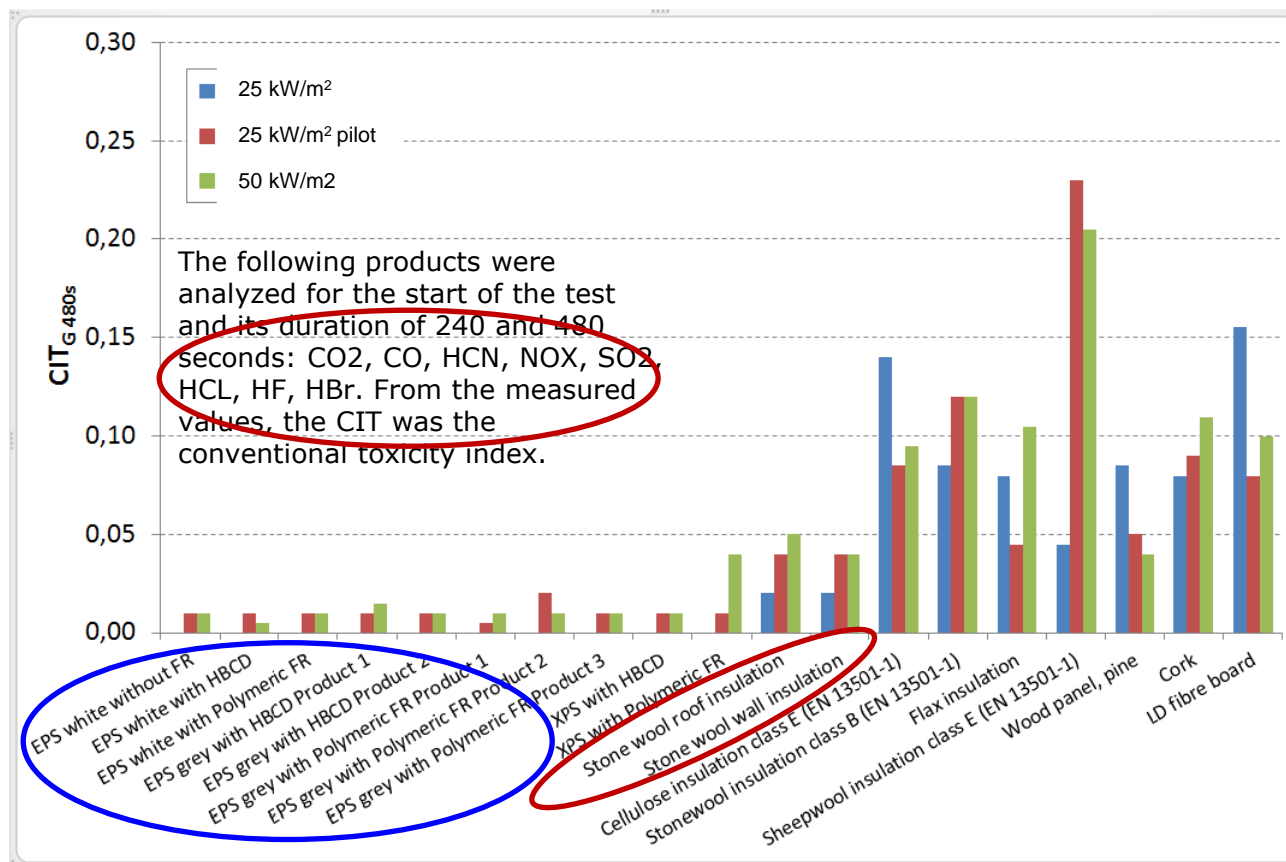
- The number of victims of fires in buildings has been steadily decreasing despite the growing amount of plastics in the construction industry.
- Prevention, the increasing use of smoke alarms and the rapid intervention of firefighters are of great importance in this respect.

Toxicity of the different thermal-insulation materials

CONVENTIONAL INDEX OF TOXICITY (CIT)



Conventional Index of Toxicity (480 s)



Source: Plastics Europe - Tests were carried out in laboratories in Sweden according to EN 45545-2: 2013 in a test chamber according to EN ISO 5659-2 with a thermal load of 25 and 50 kW / m².

Measuring apparatus



Source: MV - GR HZS CR, Technical Institute of Fire Protection Testing Laboratory TUPO

Smoke toxicity of EPS and MW for ETICS (2020)

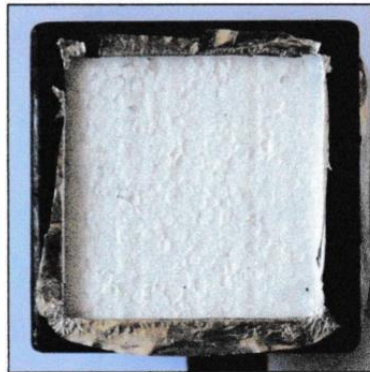


Fig.1: Sample No. 1a before test

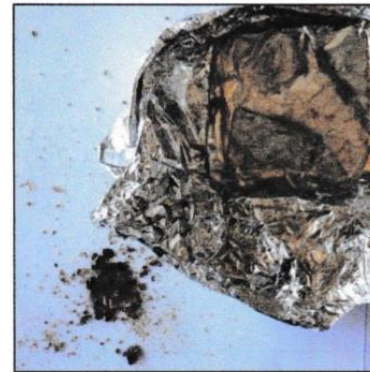


Fig.2: Sample No. 1a after test

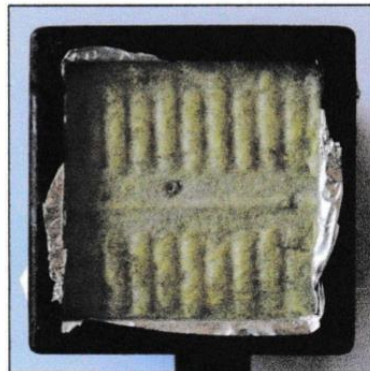


Fig.3: Sample No.2a before test

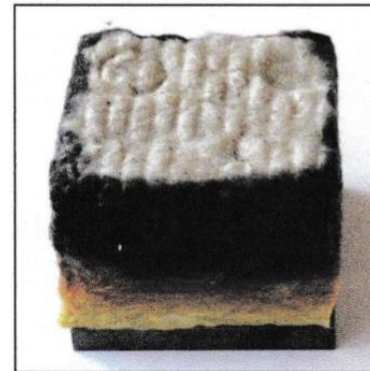


Fig.4: Sample No. 2a after test

Smoke toxicity of EPS and MW for ETICS (2020)

Sample:	Conditions	CIT _{4min}	CIT _{8min}	FED _{30min}	LC _{50total}
No.1 - EPS 70F	50 kW/m ²	0,029 ± 0,009 6x	0,042 ± 0,013 5x	0,037 ± 0,011 5x	142,068 ± 42,620 13x
No. 2 - TR10	50 kW/m ²	0,181 ± 0,054	0,216 ± 0,065	0,197 ± 0,059	11,015 ± 3,304

CIT is the conventional toxicity index (dimensionless unit).

Lower number means lower toxicity.

MW > EPS

FED is the total fractional effective dose (dimensionless unit).

Lower number means lower toxicity.

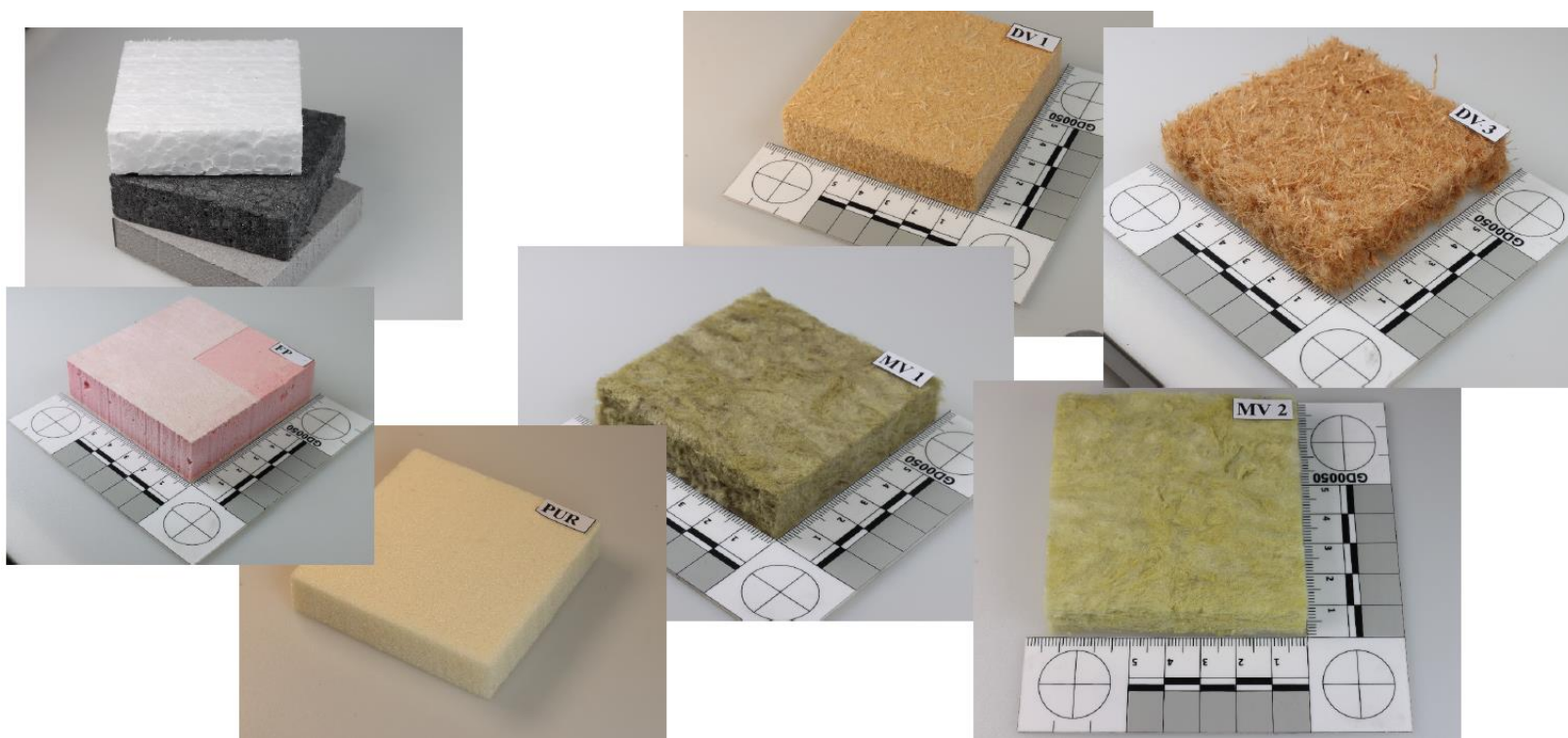
MW > EPS

The LD50 is defined as the lethal dose at which 50% of the population is killed in a given period of time; an LC50 is the lethal concentration required to kill 50% of the population (g/m³).

Lower number means higher toxicity.

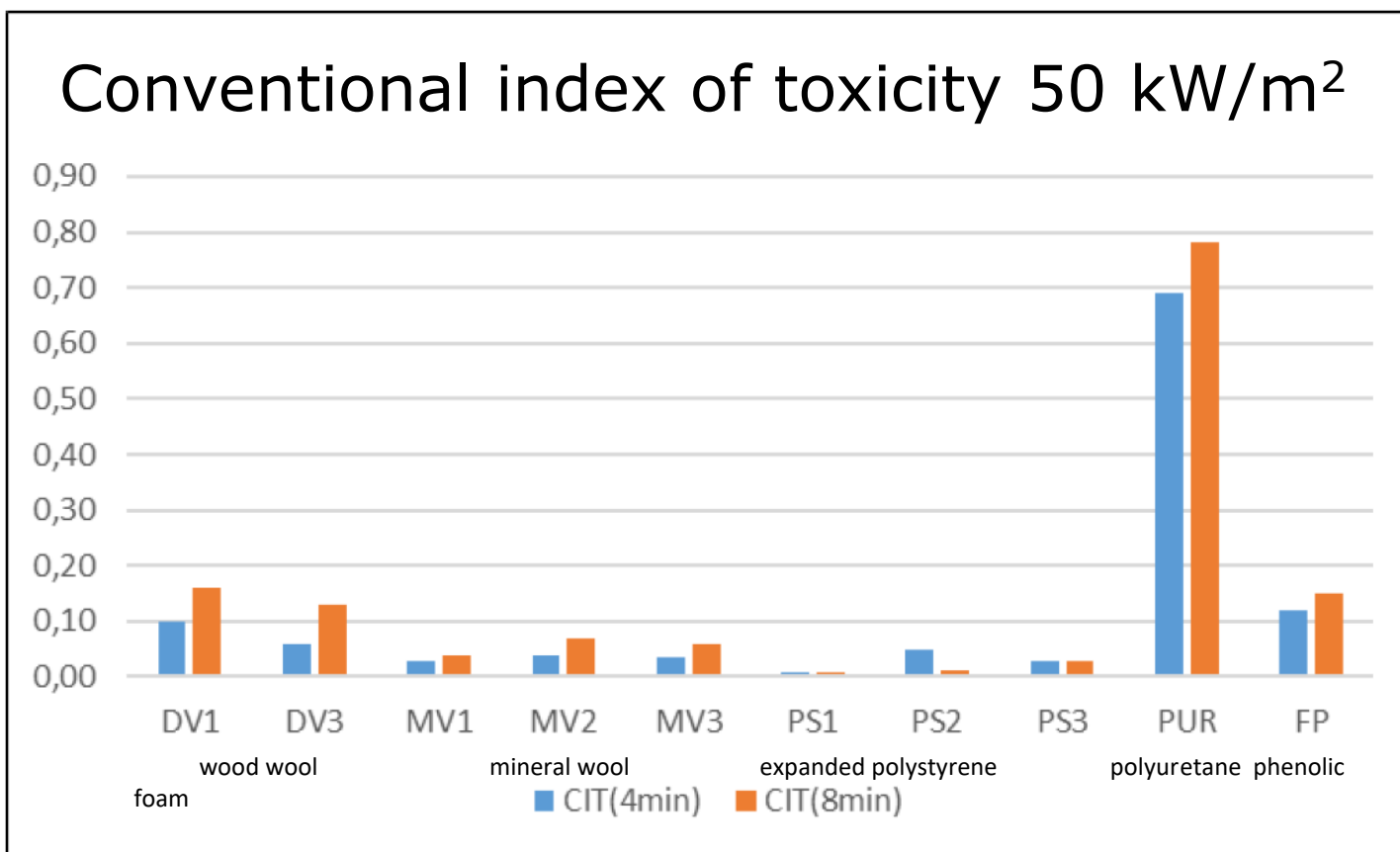
EPS > MW

Specimens of insulation materials intended for use in the ETICS (2022)



Source: MV - GŘ HZS ČR, Technical Institute of Fire Protection Testing Laboratory TÚPO, Ing. Jan Karl, 2022

Smoke toxicity of insulation materials intended for use in the ETICS (2022)



Source: MV - GŘ HZS ČR, Technical Institute of Fire Protection Testing Laboratory TÚPO, Ing. Jan Karl, 2022

The Total Concentration of Isocyanates ($\mu\text{g}/\text{m}^3$)

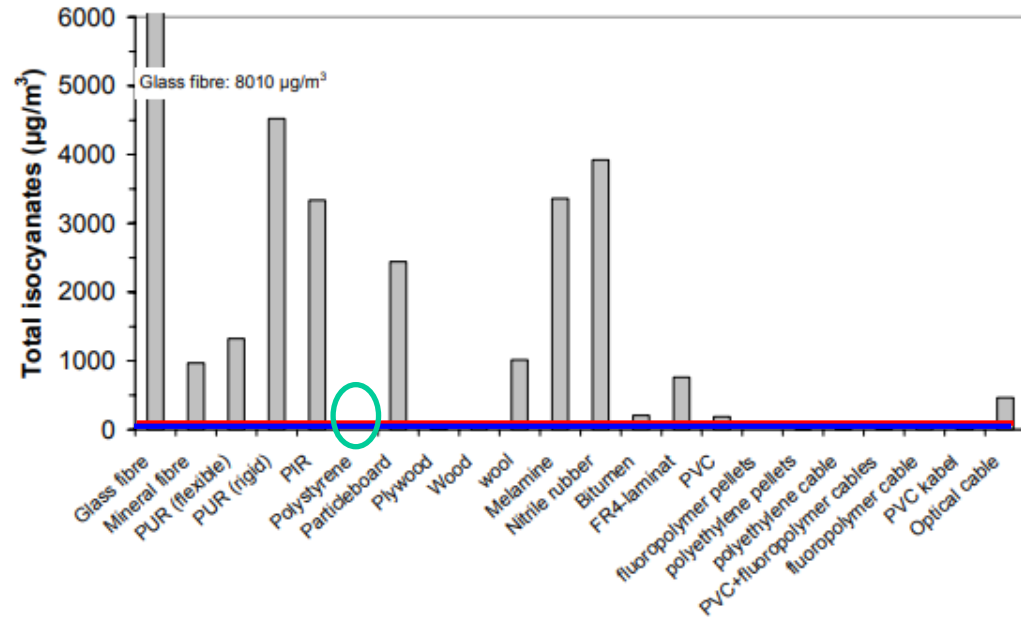
In this project, isocyanates were found in the smoke gases from all nitrogen-containing material tested.

The total concentration (gas phase and particle bound) of isocyanates for all tests conducted in Cone calorimeter is on picture.

The only insulation material that did not produce any isocyanates was the polystyrene.

Substance	PEL ($\mu\text{g}/\text{m}^3$)	NPK-P ($\mu\text{g}/\text{m}^3$)
Difenylnmethan-4,4-diisocyanat	50	100
Hexamethylen-1,6-diisocyanat	35	70
2,4-Toluendiisocyanat	50	100
2,6-Toluendiisocyanat	50	100

PEL: Acceptable exposure limit (long term)
NPK-P: Permissible exposure limit (short term)



Disease from isocyanates

Isocyanates are strongly irritating and allergenic. Even at low concentrations they can trigger asthma attacks.

Conclusions

- Fire safety require special attention, but it should be balanced and proportionate to the real level of the risk.
- The weakest elements of the wall are the windows and up to now there are almost no fire requirements on them compared to ETICS.
- Numerous medium- and large-scale fire tests on ETICS with EPS show that the insulation material is not a source of fire spread.
- Analyses of available statistics shows that there is no need for a significant increase in fire requirements of ETICS.
- EPS does not pose a higher risk in terms of smoke toxicity than so-called non-flammable materials such as MW.
- **A holistic approach to fire safety in buildings is necessary.**

EU framework to ensure fire safe buildings

The EU Fire Information Exchange Platform (FIEP) has been set-up by the EU Commission following Grenfell fire, and identified 5 key priorities for which working groups have been established :

1. Common terminology and fire statistics.
2. The application of fire prevention principles.
3. The regulatory approach for new products, including high-rise buildings.
4. Exchange of experience from fire accidents.
5. Fire engineering approach in building regulations.

EU framework to ensure fire safe buildings

WHICH REGULATORY FRAMEWORK TO ENSURE TO ALL EU CITIZENS FIRE SAFE BUILDINGS?

If the 7 layers of fire safety in buildings are covered by the Building, Installation and Organisational Requirements, it ensures to all EU citizens fire safe buildings.

NATIONAL BUILDING CODES AND REGULATIONS

Should consider the following 3 requirements in regards with the building type



EU PRODUCT STANDARDS



STRONG ENFORCEMENT

B BUILDING REQUIREMENTS

- EVACUATION ROUTES
- FIRE & SMOKE COMPARTMENTATION
- RESISTANCE TO FIRE
- FACADES
- ACCESS TO FIREFIGHTERS
- FIRE SAFETY ENGINEERING

I INSTALLATIONS

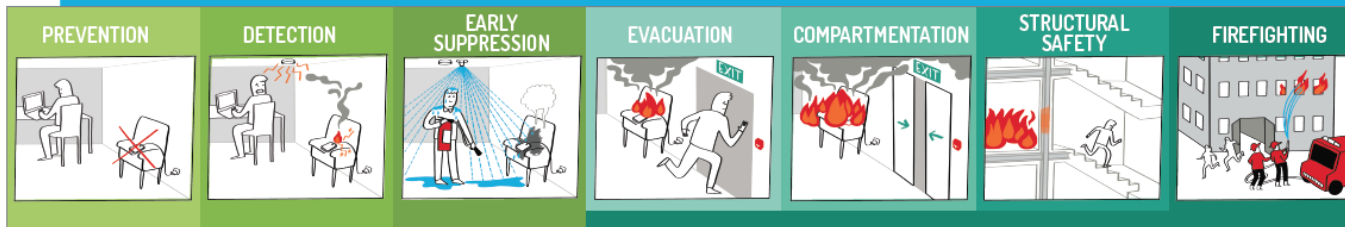
Recommended items to guarantee safety

- DETECTION SYSTEMS
- ADEQUATE ALARMS SYSTEMS
- FIRE SUPPRESSION SYSTEMS (eg SPRINKLERS)
- FIRE & SMOKE DAMPERS
- SMOKE VENTILATION
- SPECIFIC FIREFIGHTING FACILITIES (WATER SUPPLY, DEDICATED LIFTS...)

O ORGANISATIONAL REQUIREMENTS

Adequate means and clear roles and responsibilities for:

- PLANNING
- CONSTRUCTION
- MAINTENANCE & INSPECTIONS
- MARKET SURVEILLANCE
- USER INFORMATION & PREVENTION
- FIRE SERVICES (WELL TRAINED AND EQUIPED FIREFIGHTERS...)



7 LAYERS OF FIRE SAFETY IN BUILDINGS Also requires fire safe behaviour and content (appliances, furniture...)

EU framework - video



Thank you for your attention.



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