EU flammability standards and ENFIRO

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Life Cycle Assessment of Environment-Compatible Flame Retardants: Prototypical Case Study
European regulations and standards

Classification is the same all over Europe
Legislation remains national
Regulation flame retardants and fire safety

• REACH
  – High production flame retardants are assessed for environmental and health and safety

• RoHS (Restriction of the use of certain Hazardous Substances)
  – PBBs and PBDEs restricted under RoHS 2011

• Eco-label
  – No leaching of hazardous compounds

• Fire regulations and standards
Fire regulations and standards in Europe

• European standards (EN) for reaction-to-fire are specified by the European Commission

• CEN, CENELEC, ETSI work out the test standards
  – Technical Committees (TC) are responsible for preparation of the European standards (EN). ISO/TC92 Fire Safety, TC 89 Fire Hazard Testing
  – European system of classification
  – Test methods

• Test laboratories perform the fire tests according to the standards
<table>
<thead>
<tr>
<th>Country</th>
<th>Type of Building</th>
<th>Reference regulations</th>
<th>Type of furniture</th>
<th>Requirement</th>
<th>Test methods</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>Domestic</td>
<td>N°200-164</td>
<td>Bedding</td>
<td>No ignition by cigarette</td>
<td>EN ISO 12952-1 and 2</td>
<td>Pass/ Fail</td>
</tr>
<tr>
<td></td>
<td>Public</td>
<td>U 23 (Health)</td>
<td>Bedding</td>
<td>No ignition by cigarette</td>
<td>EN ISO 12952-1 and 2</td>
<td>Pass/ Fail</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mattress</td>
<td>No ignition by cigarette</td>
<td>EN 597-1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>AM 18 (Spectacle)</td>
<td>Seat</td>
<td>No ignition by 20g paper cushion equivalent burner</td>
<td>EN F 60013</td>
<td>Pass/ Fail</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No ignition of the frame</td>
<td>NF P92501 and NF P92507</td>
<td>M3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>GPEMD1 – 90 (Prisons)</td>
<td>Mattress</td>
<td>No ignition by cigarette</td>
<td>EN 597-1</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No ignition by match</td>
<td>EN 597-2</td>
<td>D</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>No ignition by higher ignition sources</td>
<td>GPEM D1-90 procedure</td>
<td>C,B,A (A the best)</td>
</tr>
<tr>
<td>UK/ Ireland</td>
<td>Domestic</td>
<td>Furniture and furnishing Regulations n°1324</td>
<td>Seat/Mattress Filling</td>
<td>No ignition by cigarette</td>
<td>EN 1021-1 and EN 1021-2 BS 5852</td>
<td>Pass/ Fail</td>
</tr>
<tr>
<td></td>
<td>Public</td>
<td>BS 7176</td>
<td>Seat</td>
<td>No ignition by cigarette</td>
<td>EN 1021-1 and EN 1021-2 BS 5852</td>
<td>Pass/ Fail</td>
</tr>
</tbody>
</table>

[viii] Sainrat A, Regulatory Trends and Standardization towards the Reaction of Fire or the Upholstery Furniture in France and in Europe. Proceedings of Flame retardants 2006
[ix] Troitsch J., Furniture and furnishing, Plastics Flammability Handbook – Principe, regulations, testing and approval, 3rd Edition Hanser
Part 2: Chapter New and potential flammability regulations

J Troitzsch, Fire and Environmental Protection Service, Germany

- Introduction: overview of present fire safety regulations in Europe
- Building
- Fire testing of construction products in the European Union
- Fire safety requirements and tests for electrical engineering and electronics equipment
- Fire safety requirements and tests in transportation for rail vehicles and ships
- Fire safety requirements and tests in furniture
- Future trends
- Sources of further information and advice
- References
Prescriptive regulations and tests considering the toxicity of fire effluents

J Troitzsch, Fire and Environment Protection Service FEPS, Germany
- Introduction
- Mandatory toxicity requirements, classification and tests for products used in transportation and building
- Transportation
- Building
- Future trends
- References

An international standardised framework for prediction of fire gas toxicity

T R Hull and A A Stec, University of Central Lancashire, UK
- Introduction
- The workings of the international organisation for standardisation (ISO) technical committee on fire safety (TC 92)
- Fire threat to people and the environment TC92 SC3
- Overview of assessment of hazards to life
- Current international organisation for standardisation (ISO) standards covering fire threat to people and the environment
- Proposed international organisation for standardisation (ISO) standards for fire toxicity
- Future standard development in fire toxicity and fire safety engineering: “the matrix”
- Proposed standards on the harmful effects of fire effluents on the environment
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FR regulations

• Building
• Aircraft
• Ships
• Electrical engineering
• Furniture and furnishing
• ....
E&E

• Enclosures:
  – EU standard since July 2010
  – Standard UL 94 (V-1 or higher) in order to access the EU market

• Connectors
  – UL94 V-1 or V-0
  – IEC standards 60695- 2-11 to 13 (GWFI and GWIT)
  – IEC 60335 and 62368 specifications
Furniture & Textile

• In many parts of Europe, not stringent fire safety regulations as for the **UK and Ireland**
  – ‘Furniture and Furnishings (Fire) (Safety) Regulations’ 1988 (No. 1324 Regulation 6)
  – All upholstered furniture (textiles, foams and fabrics) sold in UK BS 5852 and EN 1021-1 and 1021-2

• Many countries use EN standards
  – e.g. EN 1021 and 597 (ignitability of furniture by cigarette or match)

• National regulations and standards in Europe
ENFIRO project

• To study the substitution options for some BFRs
  • DecaBDE, TBBP-A, brominated polystyrene

• European project, 12 partners, 3-years

• Alternative flame retardants selected:
  • 15 Halogen free flame retardants (HFFR)
  • Commercial available HFFRs
ENFIRO: Life Cycle Assessment of Environmentally Compatible Flame Retardants
Selected polymers/materials

• E&E
  – Epoxy resins
  – Polystyrene blends: PC/ABS, PPE/HIPS
  – Polyamide 6,6
  – Polybutylene therephthalate (PBT)
  – Ethylene vinyl acetate (EVA)
  – Epoxy (encapsulants)
• Textile polymers (e.g. thermoplastics PUR)
• Intumescent Coatings (paints)
FIRE performance tests ENFIRO

• UL94
• LOI
• Cone calorimeter
• Smoke yield
• Toxic gases
• Char formation
UL-94 Testing
UL94 classification

**HB:** slow burning on a horizontal specimen; burning rate <76 mm/min for thickness < 3 mm

**V2:** burning stops within 30 seconds on a vertical specimen; drips of flaming particles are allowed

**V1:** burning stops within 30 seconds on a vertical specimen; drips of particles allowed as long as they are not inflamed

**V0:** burning stops within 10 seconds on a vertical specimen; drips of particles allowed as long as they are not inflamed

**5VB:** burning stops within 60 seconds on a vertical specimen; no drips allowed; plaque specimens may develop a hole

**5VA:** burning stops within 60 seconds on a vertical specimen; no drips allowed; plaque specimens may not develop a hole
UL-94 limited use

- To prioritize alternative flame retardants as all FR/material were V0
- It provides information on the performance of the material and therefore,
- Does not give information on “real world” fire
Cone Calorimeter

- Flammability testing of the polymer/flame retardant material
- Fire risk factors (e.g. heat release rate, ignition time and efficiency)
- Quantifies fire hazards (CO, CO$_2$, smoke)

Polymer + FR → Combustion
Cone Calorimeter → FTIR analysis → Char formation
Fire Performance BFRs - HFFRS

![Graph showing fire performance and smoke production for different materials.](image-url)
Main conclusions

• In general, HFFRs had improved smoke suppression

• HFFRs had similar fire performance characteristics (heat release rates, ignition time and efficiency) as BFRs in polymers, except for polymer blends

• More sophisticated fire tests were needed to prioritize and select the most viable alternative FRs
Thank you for your attention

Acknowledgements
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Dioxin2012

Thursday Room 5&6 Flame retardant alternatives

• 13.00 Outcomes of ENFIRO
• 13.20 ENFIRO film

Poster Monday Indoor Environments

• Leaching of HFFRs and BFRs from polymers
Burning questions

A workshop on alternative flame retardants looking at flammability, applications, toxicity, exposure to life cycle assessment

7-8 November 2012, Brussels, Belgium

Deadline early registration October 15th, 2012