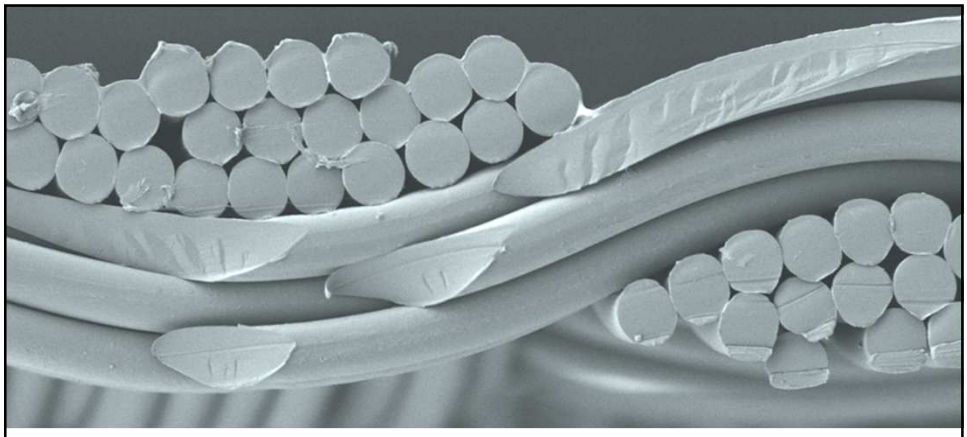


Flame retardants in the textile industry

Cluster Innovatieve coatings 19.02.2019

Conflict

Respons time fire men

8 minutes

past

Start fire — Flash over

17 minutes

now

Start fire — Flash over

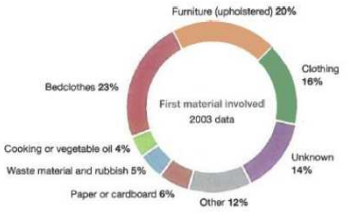
3 minutes

Deadly victims / material damage

3

Figures

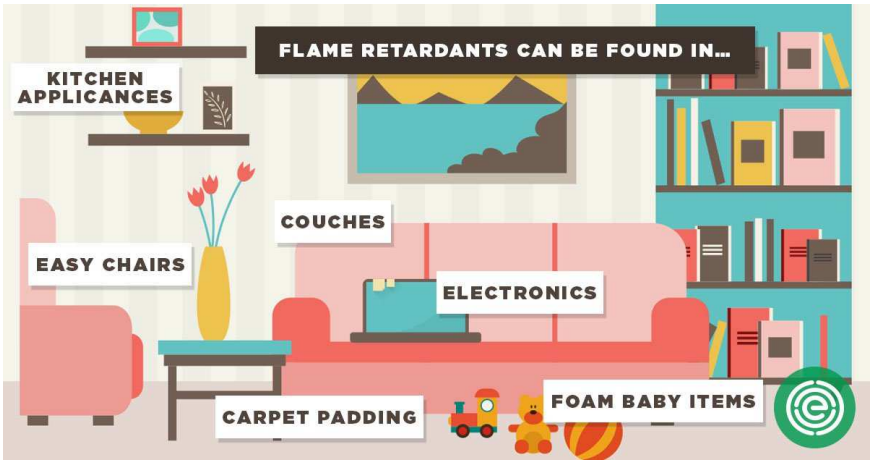
- 2 tot 2,5 millions fires each year in Europe
- 80% deadly victims → domestic fires
- 73% of fatal fires start in living or bedroom



Source: M. Kobes, and K. Groenewegen - Ter Morsche, Consumer fire safety: European statistics and potential fire safety measures, Netherlands Institute for Safety Nibra, January 2008, p. 27.

4

Where?



Goal flame retardants

Delay or inhibit ignition

Once ignited: slow down flame spread
Smoke generation and toxicity!

Flame retardants

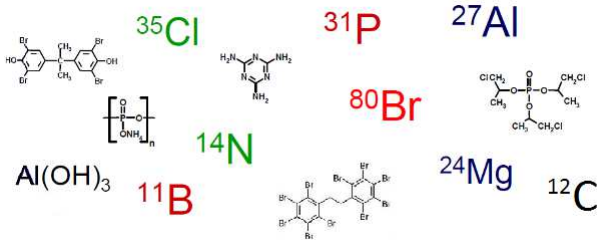
Minimise material damage

Safe lifes

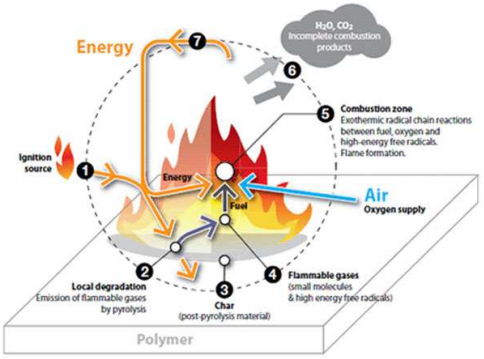
Significant difference

Flame retardancy

- Does refer to a functionality, not a specific chemical
- Big variety of products/chemicals
  - each with specific physico-chemical interaction with fire
  - different physical / chemical properties, environmental fate, toxicology, regulatory status



Fire cycle

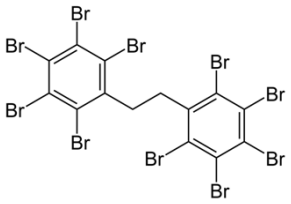


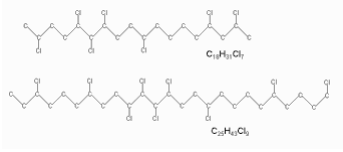
EFRA – Keeping fire in check

Classes

Halogenated (Br, Cl, F)

- Radical quenching in gas phase
  (substitution of high-energy free-radicals by low-energy free-radicals)
- Avoid the fire cycle to establish or to sustain itself
- High efficiency – low loadings (e.g. 12 wt%)
- Bromine more efficient than chlorine
- Mostly used in combination with antimony trioxide as synergist



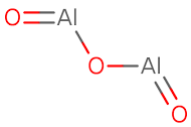


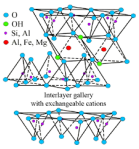
Classes

Minerals (Al, Mg,…)

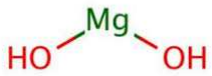
- Endothermic decomposition (energy capture)
- Dilution of combustion zone with inert gases (water)
- Non flammable layer material surface
- Low efficiency – high loadings (60 wt%)

$Mg_3Ca(CO_3)_4$





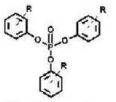
$Mg_5(CO_3)_4(OH)_2{\cdot}4H_2O$



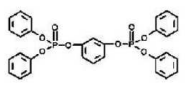
Classes

Phosphorus

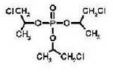
- Powerful char promoter
- Char hinders the passage of flammable gases to the flame
- Char shields polymer from energy (heat) supply
- Often intumescent systems
- Varying efficiency & loadings (10-30%wt)



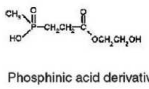
Triaryl phospates



Resorcinol bis(diphenylphosphate) (RDP)

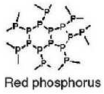


Tris(chlorpropyl)phosphate (TCPP)



Phosphinic acid derivatives

Ammonium polyphosphate (APP)

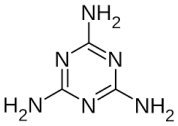


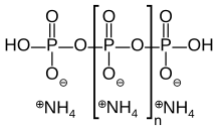
Red phosphorus

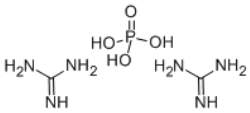
Classes

Nitrogen

- Enhancing formation of cross-linked stable compounds at high temperatures, which inhibits pyrolysis
- Dilution of combustion zone with inert gas (nitrogen)
- Low efficiency alone, good synergist
- Often used in combination with P-based FRs







Concerns

- Findings of certain brominated flame retardants in environment, biota, humans
- Concern about certain phosphate esters in indoor air
- Source of endocrine disruption ?
- Persistence, Bioaccumulation, Toxicity (PBT)

→ Risk assessments
Scientific studies for materials of concern

REACH regulation

Fire retardants in candidate (SVHC) list

- hexabromocyclododecane (HBCDD)
- alkanes, C10-13, chloro (Short Chain Chlorinated Paraffins)
- tris(2-chloroethyl)phosphate (TECP)
- boric acid
- diboron trioxide
- decabromodiphenyl ether (DecaBDE)
- trixylyl phosphate
- dechlorane Plus TM

REACH regulation

- Fire retardants in autorisation list (annex XIV)
  - hexabromocyclododecane (HBCDD)
  - tris(2-chloroethyl)phosphate (TECP)
- Fire retardants in restriction list (annex XVII)
  - penta-BDE
  - octa-BDE
  - deca-BDE
  - TRIS
  - TEPA
  - polybromobiphenyls

Pressure

- Eco-Labels
  - Der Blaue Engel
    - mattresses: no halogenated organic compounds
  - Oeko-Tex®
    - Use of flame retardants limited
    - Only use of FR "white-list"
- Position of consumer organisations and OEM's

Trends

Halogen free solutions

- Halogenated small molecules: Persistent, bioaccumulation and toxic to humans
- Regulation
- Continuous pressure from NGOs on OEMs

Nanomaterials

- Lot of basic research
- Mostly as synergist
- E.g. clays, CNT, graphene, …

Trends

Polymeric flame retardants

- Non-migrating / low fogging
- Considered as safest FR approach by end users and regulatory bodies
- Both halogen containing as halogen-free polymeric FR

Biobased

- Lignin, DNA, proteins, chitosan, …
- Research on production of FR from waste streams e.g. poultry feathers, fish waste, …

Running /starting projects at Centexbel

KaRMA2020 — Poultry feathers as keratin source to synthesize new FRs

FLAREX — Screening of alternative FRs technical/LCA/risks/toxicological

Bio FR LeTex — Use of biobased FRs in leather and textile

Past projects at Centexbel

Technical screening of alternative FRs for coating and extrusion

Desktop study on FRs in plastics

→ Expertise on FRs in coating/extrusion fibres/plastics

Ine De Vilder
ivi@centexbel.be
09 241 86 86