Phosphorus, Inorganic & Nitrogen Flame Retardants Association

Your newsletter for non-halogen fire safety solutions
n° 169 March 2025

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PINFA IN ACTION

Free webinar: polymer fire behaviour

Polymer combustion behaviour and how flame retardants impact heat release and smoke emission. pinfa-NA free webinar, with Alexander Morgan, fire and materials expert at the University of Dayton Research Institute

Polymer combustion behaviour. pinfa-NA's 14th L&L (lunch and learn): Wednesday, 19 March 2025, 11:30am-12:30pm EDT USA (16h30 -17h30 Brussels time). Registration (free) : *https://us02web.zoom.us/webinar/register/WN_-X7NxSAgTMG1kGiJ5PT-mA*

pinfa-NA Members' Meeting

pinfa-NA members discussed activities, conference communications, met sponsored FR research students. The pinfa-NA annual end-of-year members' meeting was held in Cleveland, Ohio, on 11th November, coinciding with pinfa-NA participation at the Compounding World Expo 2024. Members had a chance to communicate, collaborate and plan for 2025 activities. 2024 was an active and productive year for pinfa-NA. Among many activities, we welcomed a new member (Polymer Additives Group), conducted many free webinars, presented at conferences including SPE, CAMX and ACS, provided scholarships and developed a technical paper on Chemistry, Energy Consumption, Green House Gas Emissions of Non-Halogenated Flame Retardants (available to pinfa member companies on request). We also successfully published a series of educational 'explainer videos' for audiences new to the world of flame retardants.

"We had a great annual meeting," noted Carolyn Pressley, the Regional VP Americas at Budenheim USA and pinfa-NA Chairperson. "The highlight was the presentations from Ecotek, showcasing their scientific experiment ideas, which pinfa-NA sponsored. It's important to help the next generation of scientists and pinfa-NA is doing their part. The students from Ecotek were in attendance and both pinfa-NA members and Ecotek students were able to learn and understand each others' needs and contributions."

See pinfa-NA website for more information: https://www.pinfa-na.org/

Photo: pinfa-NA members and Ecotek students and director at pinfa-NA's annual meeting.

REGULATORY

Canada lists DBDPE and DP for action

Canada has listed for priority action the two halogenated flame retardants DBDPE and DP (decabromodiphenyl ethane, Dechlorane Plus*). Both are added to the Canada national List of Toxic Substances (Part2, Schedule 1). Both of these halogenated FRs are used as replacements for the now-banned brominated flame retardant Deca-BDE. The Canada listing publication notes that in Europe ECHA has indicated that, although evaluation is not yet complete, DBDPE appears to be persistent, bio-accumulative and toxic (PBT). DP is identified as very persistent and very bio-accumulative in Europe with proposed restriction and is listed in the Stockholm POPs convention. In Australia both chemicals have been (1, 2) identified to potentially pose unreasonable risk to the environment. Canada's assessment is that DBDPE is toxic, may degrade in the environment to persistent, bio-accumulative and toxic chemical, and that DP is toxic, persistent and bio-accumulative (as defined under Canadian regulations). This formal listing of these two substances does not as such impose regulatory restrictions.

** DBDPE = Benzene, 1,1´ -(1,2-ethanediyl)bis[2,3,4,5,6-pentabromo-. DP = 1,4:7,10-Dimethanodibenzo[a,e]cyclooctene, 1,2,3,4,7,8,9, 10,13,13,14,14- dodecachloro-1,4,4a,5,6,6a,7,10,10a,11,12,12 adodecahydro.*

"Order Adding Toxic Substances to Part 2 of Schedule 1 to the Canadian Environmental Protection Act, 1999: SOR/2025-27", Canada Gazette, Part II, Volume 159, Number 5, 14 February 2025 https://gazette.gc.ca/rp-pr/p2/2025/2025-02-26/html/sor-dors27-eng.html

Further EU regulation of brominated PBDEs

Public consultation to 18th March 2025 on tighter regulation of the POP brominated FRs, PBDEs, in recycled materials. DecBDE and other PBDE brominated flame retardants (tetra- to hepta-) are listed as POPs (persistent organic pollutants) under the global Stockholm Convention. The manufacture, sale and use of these brominated FRs are already prohibited under REACH, and concentrations present in articles as UTC (unintended trace concentrations) are limited. The proposed modifying regulation would reduce the limits allowed as UTC in articles containing recycled materials from 500 mg/kg sum total of all PBDEs on publication to 200 mg/kg end December 2027 (10 mg/kg in articles for children: toys, car seats, mattresses …).

*"Persistent organic pollutants (POPs) – polybrominated diphenyl ethers (PBDEs)", **EU public consultation open to 18th March 2025** https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13215-Persistent-organic-pollutants-POPs-polybrominated-diphenyl-ethers-PBDEs-_en*

UK confirms furniture regulations recast

The new UK Government has confirmed it will rewrite the UK 1988 Furniture Fire Safety Regulations to modernise safety. The Government reaffirms that the Regulations have contributed significantly to protecting the public but need updating, in particular to enable innovation and the circular economy, and that it is working on the basis of the proposals published for consultation in 2023 (analysis in pinfa Newsletter n°152). Aims include to reduce volumes of flame retardants used. Aspects which will be considered include second-hand furniture refurbishing, ensuring fire safety of natural materials used in furniture, information and traceability of chemicals (to support end-of-life management), furniture labelling, implementation and enforcement, exclusion from the Regulations of smaller items and of baby and children's products. Ongoing assessment will include a possible "flame retardant technology hierarchy": pinfa understands that the initial proposal (see summary in pinfa Newsletter n°152) will be reconsidered because of possible legal contradictions with chemical regulations. The exclusion of products for babies and children's products, and labelling and technical legal modifications, will be implemented in coming months by amendment of the existing 1988 Regulation. Other proposals will be developed in dialogue with stakeholders before the end of 2025.

The BSI (British Standards Institution) Committee FW/6 is working on proposals for 'final item testing' which is part of the Government proposals, but this is complex and progress is slow, and small-scale composite testing will also be necessary.

"Progress update issued on review of furniture fire safety regulations", UK Government, 27 January 2025 https://www.fsmatters.com/Progress-update-issued-on-furniture-regs-review

BSI (British Standards Institution) FW/6 (Flammability performance and fire tests for furniture) https://standardsdevelopment.bsigroup.com/committees/50001727

COMMUNICATION

Journal de-listed after FR polemic

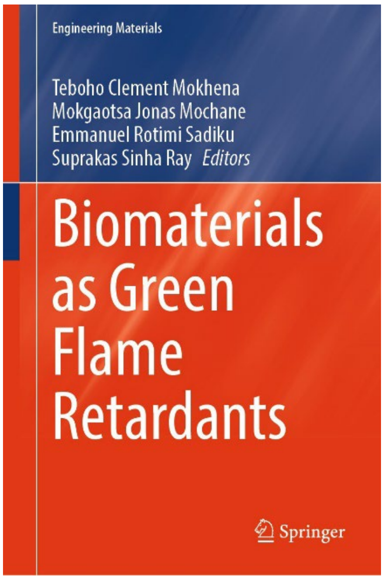
Chemosphere removed from science list after media-grabbing article wrongly calculated flame retardant "contamination". The journal Chemosphere (Elsevier) published September 2024 an article by authors from the NGO Toxic Free Future and the Amsterdam Free University showing analysis of flame retardants in 203 black plastic consumer items (food and kitchenware, hair utensils, toys), finding detectable levels of around ten FRs in a majority of items, including of now-restricted brominated FRs. The presence of these legacy brominated FRs is presumed to be via recycled plastics. The authors then calculated that users would have an FR intake higher than estimated intakes from dust or diet (which are of the order of ng/kg body weight/day = 1 per trillion) and higher than the "reference dose" for the brominated flame retardant BDE-209 (Deca-BDE). This led to significant media coverage. However, there was a 10x calculation error (in the "reference dose" per body weight), and a correction is now published stating that the corrected estimated exposure is in fact an order of magnitude lower than this "reference dose". This has led to de-listing of Chemosphere on Clarivate's Web-of-Science platform, a key index for scientific journals.

"From e-waste to living space: Flame retardants contaminating household items add to concern about plastic recycling", M. Liu et al., Chemosphere 365 (2024) 143319 https://doi.org/10.1016/j.chemosphere.2024.143319

Corrigendum, Chemosphere 370 (2025) 143903 https://doi.org/10.1016/j.chemosphere.2024.143903

"Journal that published faulty black plastic study removed from science index", Retraction Watch https://arstechnica.com/health/2024/12/journal-that-published-faulty-black-plastic-study-removed-from-science-index/

Book



Biomaterial flame retardants

380 pages, 15 chapters, research updates on bio-based materials as flame retardant components. The book is misleadingly titled “Biomaterials as Green Flame Retardants” whereas it is largely about (partly) bio-based flame retardants (biomaterials that have been chemically modified, e.g. by reaction with a phosphorus or nitrogen compound). There is also a chapter on phosphazenes, whereas these are not intrinsically biobased (can be synthesised partially using plant derived organic carbon, as can most organic chemicals), and indeed this chapter does not particularly address bio-based phosphazenes.

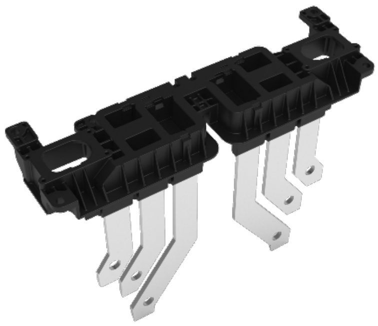
The book’s editors’ preface suggests that biomaterials are “poised to replace a majority of traditional FRs” but the book chapters’ authors are research scientists not representing industry or users. Indeed, the first chapter (overview) concludes “Biomaterials … may provide some fire resistance, however they are ineffective compared to synthetic flame retardants … they frequently require modification with other flame retardant chemical compounds” and underlines fundamental application problems including long-term stability (durability), impacts on treated material properties and difficulties of incorporation, possible moisture uptake.

The book’s concluding chapter on Trends addresses principally research questions and also identifies important challenges to industrial implementation: availability and cost, scalability and stability of production processes polymer compatibility, durability, regulation and standards.

Chapters cover research developments and challenges for use of different biological molecules as flame retardants, either as such or after processing or chemical modification: alginate, phytate, tannic acid, chitin, (micro)cellulose, lignin, proteins, DNA. There is a lack of distinction between biological organic polymers, which can be a carbon source in intumescent systems but are not as such flame retardants, or which can be chemically modified to produce (partly) bio-based flame retardants (e.g. lignin, cellulose, tannic acid) and biological molecules which themselves have flame-retardant effects because of P and/or N content (phytate, chitin, alginate, DNA).

“Biomaterials as Green Flame Retardants”, Springer, ed. T. Mokhena, M. Mochane, E. Sadiku, S. Ray, 2024 ISBN 978-981-97-6870-7
https://doi.org/10.1007/978-981-97-6871-4

INNOVATION

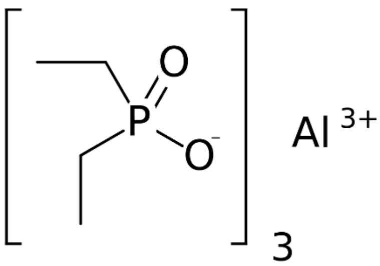


PIN FR PPA for EV wiring safety

New non-halogenated flame retardant polyphthalamide from BASF (pinfa member) for electrical vehicle terminal blocks. The PPA compound can replace non fire-safe plastics, ensuring high performance electrical insulation and durability in demanding temperatures, in EV motors, inverters and high-voltage wiring connecters, terminals and busbars. In addition to dielectric performance at high temperatures and in humid conditions, the PIN FR material offers thermal shock resistance (-40°C to +150°C, 1000 cycles), strength, stability, stiffness and low-corrosion processing, with wide and vivid colour options. The non-halogenated flame retardant formulation ensures low metal corrosion (essential in wiring, connectors and electronics).

"BASF launches innovative Ultramid® T6000 grade for electric vehicle applications", BASF, 13 January 2025
https://www.basf.com/cn/en/media/news-releases/asia-pacific/2025/01/apac-25-03

"Bridging the gap between PA and PPA for E&E applications Ultramid® T6000", BASF
https://download.basf.com/p1/8a8082587fd4b608017fda6c319a7986/en/Ultramid%253Csup%253E%25C2%25AE%253Csup%253E_T6000



DEPAL synergists in TPE cable sheaths

Aluminium diethylphosphinate with synergists achieves UL-94 V0 (3 mm) and reduced smoke in thermoplastic elastomer. The phosphorus PIN FR aluminium diethylphosphinate (DEPAL), from Clariant (pinfa member), was tested in thermoplastic elastomer (TPE: 60% SEBS, 20% POE, 20% PPO), at 0 – 30% phr DEPAL loading and at 25% DEPAL with 5% of three different synergists: zinc borate, melamine cyanurate and organic montmorillonite (OMMT). 30% DEPAL increased LOI from 18.5 (neat TPE) to 25.2, reduced PHRR peak heat release rate by over 50% and achieved UL-94 V-2 (3 mm). With 25% DEPAL and 5% zinc borate or 5% OMMT, UL-94 V-0 (3 mm) was achieved, LOI further increased to >28 and PHHR further reduced to <40% compared to neat TPE. On its own, DEPAL increased smoke density compared to neat TPE, but this effect was mitigated by zinc borate, and with OMMT the smoke density was significantly lower than for neat TPE. Tensile strength and elongation at break were not significantly deteriorated. The authors conclude that these PIN synergists with DEPAL can achieve high fire performance in TPE cable materials and reduce dangers from reduce smoke emission.

"Study on the flame retardancy of thermoplastic elastomers composites applied for cable sheath", L. Wang et al., Progress in Rubber, Plastics and Recycling Technology 2025, https://doi.org/10.1177/14777606241313075
Image: Wikipedia Edgar181

Transparent fire safety coating for wood

Guangzhou SIO launches non-halogenated flame retardant protective coating for wood, transparent and durable. The silicone-based coating is delivered as a water-based, paint-on viscous liquid, not containing halogenated flame retardants nor solvents. It can cross-link with other resins at room temperature, to deliver wear and weather durability. After application it is odourless and transparent, conform to indoor air requirements, with formaldehyde emissions < 0.1 mg/m³. Fire protection is ensured by intumescence and charring, achieving B1 fire resistance classification.

"Breakthrough in Fire Safety: SIOResin's WRS-1002 Water-Based Intumescent Resin Delivers Exceptional Expansion & Clarity", 11 February 2025 https://www.einpresswire.com/article/784622085/breakthrough-in-fire-safety-sioresin-s-wrs-1002-water-based-intumescent-resin-delivers-exceptional-expansion-clarity *and "WRS-1002 Fire Retardant Resin For Wood Fireproof Paint"* https://www.sioresin.com/other-resins/wrs-1002-fire-retardant-resin-for-wood-fireproof-paint.html

Encapsulated water as a flame retardant

Lab study tests encapsulating water into polystyrene foam show UL-94 V-0 (4 mm) with 30% water content. Gel emulsions were prepared by high-speed mixing of water with styrene, hydrophobic silicon dioxide and cross linkers/initiators (EGDMA, TMPTMA, AIBN). This emulsion was then polymerised at up to 85°C for several hours, resulting in a cross-linked polystyrene containing trapped water in pores, with final water content of 7 – 70% water by weight. With 30% water, peak heat release was reduced by over 55%, smoke was considerably reduced and UL-94 V-0 (4 mm) was achieved. Based on theoretical modelling of water evaporation from polymers, the authors estimate that by coating the polymer and adding salts to the water, a useful life of 8 years could be achieved. pinfa notes that this inadequate for durable products (EcoDesign), even assuming that it is not reduced by e.g. wear or temperature variations. The impacts of including water into polystyrene, on weight, electrical and insulation properties and corrosion risks in case of any water release, are unfortunately not addressed in the article.

"Encapsulated Water Imparts Unprecedented Flame Retardancy to Cross-Linked Polystyrene Foams", C. Zhang et al., ACS Appl. Mater. Interfaces 2025, 17, 9971−9980, https://doi.org/10.1021/acsami.4c22309

Ageing of FR HDPE and fire performance

Thermal ageing of PIN FR polyethylene for railway applications shows required fire performance lost after 59 days @ 120°C.The tested fibre-filled bio-based (>94% of carbon content) high density polyethylene (HDPE copolymer-1- butene) used a PIN FR package (intumescent, smoke suppressor, synergists) to achieve HL2-R1 under the EU railway fire standard. Until 59 days of thermal aging, the char structure generated by the material in fire tests was not significantly modified, but from 59 days the char showed larger pores, then progressively also showed cracks and became hollow. The material showed significantly deteriorated mass loss calorimeter (MLC) and peak heat release results from 59 days of thermal aging, resulting in failure of HL2-R1, a slight increase in smoke density, but no significant change in lateral flame spread nor smoke toxicity. The authors suggest that this failure of fire performance after nearly two months of high-temperature aging is probably related to oxidation of the polymer matrix which starts to occur at 43 days.

"Thermal ageing of flame-retardant high-density polyethylene designed for railway application", R. Baron et al., Polymer Degradation and Stability 234 (2025) 111202
https://doi.org/10.1016/j.polymdegradstab.2025.111202

PIN FRs for recycled PET

Combining P and N PIN FRs for fire and mechanical performance in foamed recycled polyethylene - terephthalate (rPET). Ammonium polyphosphate (APP), aluminium diethylphosphinate and melamine polyphosphate (MPP) were tested. 20% OP achieved UL-94 V-0 (4 mm) and fire performance was further improved with 15% loading OP plus 5% MPP, self-extinguishing in around 5 seconds without dripping. The authors suggest that this is because of synergy between the charring effect of the OP PIN FR and the swelling effect of MPP. The combination of OP and MPP only slightly deteriorated mechanical properties of rPET and the authors suggest that this is a viable solution for ensuring fire-safe industrial applications of recycled PET foams.

"Use of Hybrid Flame Retardants in Chemically Foamed rPET Blends", V. Szabó et al., Crystals 2025, 15, 80. https://doi.org/10.3390/cryst15010080

PUBLISHER INFORMATION

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