pinfa
Phosphorus, Inorganic & Nitrogen Flame Retardants Association

Your newsletter for non-halogen fire safety solutions n° 179 February 2026

PINFA IN ACTION

pinfa | sparks
A sector group of Cefic

120 participants for 1st pinfa sparks webinar:

Experts discussed potential, challenges and solutions for recycling PIN flame retardant plastics. Thomas Futterer, pinfa Chairman (Budenheim), presented pinfa, active since 2019, with today 26 members manufacturers and users of PIN flame retardants. He outlined the contribution of flame retardants to fire safety and pinfa's mission to ensure sustainable fire safety and technology progress, including through plastics recycling. Michael Grosshauser, Fraunhofer Institute for Structural Durability and System Reliability LBF, outlined the continuing EU policy push for plastics recycling, but noted that tonnages recycled have stagnated since 2022. Most technical plastics from post-consumer wastes are today incinerated, so also most flame retarded plastics, because of the considerable technical and logistic difficulties to identify and sort heterogeneous post-consumer waste plastics. Post-industrial secondary plastics are easier to recycle (closed loop). Fraunhofer, with pinfa, have carried out trials with a range of PIN FR plastics, showing that multi-cycle ageing – reprocessing recycling is possible with in most cases limited deterioration and fire performance maintained. Issues in recycling are generally because of deterioration of the polymer and of glass fibres, not related to the flame retardant. Performance materials can be reformulated from such mono-material recyclates by use of re-stabilisers, compatibilisers, chain extenders. A further Fraunhofer – pinfa project is now underway looking at upcycling of recyclates which are currently not recycled to performance plastics, with PIN FR compounding and assessment of final performance. Questions in discussion concerned contaminants in recycled plastics, implications for recycling of reactive FRs and the use of recycled PIN FR plastics in timber products.

pinfa 'sparks' webinar: recycling of PIN FR plastics, with Michael Grosshauser, Scientific Expert at Fraunhofer Institute for Structural Durability and System Reliability LBF - Innovation, Transfer and Cooperation, Germany, Thursday 5th February, watch online here. https://youtu.be/mH6uAYmdvis?si=IkMLVKophemJNm25

US SPE National Flame Retardants Week

23 – 25 March 2026. Online. US Society of Plastics Engineers (SPE) with pinfa-NA. Technologies. Regulations. Performance. This SPE educational event targets professionals and organisations involved in development and application of fire safety solutions for plastics. Presentations include specialist flame retardant suppliers, compounders and formulators, industry and science researchers working on innovative flame retardant chemistries and applications. Sessions cover flame retardant technologies, standards, regulations, synergists (drip prevention, smoke suppression, impact modifiers), non-FR fire safety solutions and an FR supplier roundtable.

National Week of Flame Retardants 2026, 23r – 25 March 2026. Online. US Society of Plastics Engineers (SPE) with pinfa-NA.
https://www.4spe.org/i4a/pages/index.cfm?pageid=9898

SPE reduced rate package for companies / customers
https://www.4spe.org/i4a/pages/index.cfm?pageID=9944

Free webinar: PIN FR solutions for polymers

22nd April. Oliver Töpfer, Nabaltec, introduction to Mechanisms, Applications and Test Methods for PIN flame retardants. In today's world, we are surrounded by various polymers, both in expendables and in durable components of e.g. buildings, electrical installations and transportation systems. Fire safety of such plastics is not an option, but a requirement. Regulation drives development and applications towards flame retardants with a reduced toxicological and improved sustainability profile. Phosphorous, Inorganic and Nitrogen-based Flame Retardants (PIN-FRs) provide a wide range of solutions for demanding performance profiles in different polymers. This webinar will present the different PIN-FR product groups and their performance profiles, with a brief introduction to the specific test regimes for flame retarded polymer systems.

Free pinfa-NA webinar: Wednesday 22nd April 2026, 11:30 - 12:30 EDT (USA) = 17h30-18h30 CEST (Brussels time). pinfa-NA's 22nd Lunch and Learn (L&L) webinar. Registration
https://us02web.zoom.us/webinar/register/WN_6aMuZy1rRICCMK2-rlqPjg

Watch previous pinfa-NA L&L webinars: https://www.pinfa-na.org/

REGULATION

Call for evidence: aromatic BrFRs

ECHA is calling for input to support a restriction proposal on certain non-polymeric aromatic brominated flame retardants (BrFRs). Open for public input until 18th March 2026. The call concerns proposed restriction of three aromatic brominated flame retardants identified as SVHC (Substances of Very High Concern) because vPvB (very Persistent very Bioaccumulative):

DBDPE, TBPH and BTBPE and two substances containing these. This follows a European Commission mandate of 10th November 2025. ECHA indicates that the call for evidence also concerns 19 other non-polymeric aromatic brominated flame retardants currently undergoing PBT/vPvB (Persistent Bioaccumulative Toxic / very Persistent very Bioaccumulative) assessment, because the Commission's mandate to prepare restriction dossiers may be expanded (see table listing these 19 further brominated FRs here). The call for evidence requests information on economic impacts of possible restriction, alternatives (technical and economic feasibility) and issues such as trade, employment, production processes and quality. The call targets all interested parties, including private companies, such as polymer compounders for the electrical and electronic sector (EEE), formulators of mixtures for the coating of textiles, manufacturers of construction products, suppliers of flame retardants, importers of articles containing flame retardants, etc., and also sector associations, laboratories, scientific organisations, NGOs and other stakeholders

DBDPE = 1,1'-(ethane-1,2-diyl)bis[pentabromobenzene]
TBPH = Bis(2-ethylhexyl) tetrabromophthalate
BTBPE = 1,1'-[ethane-1,2- diylbisoxy]bis[2,4,6- tribromobenzene]

See "ECHA report on Aromatic Brominated Flame Retardants (ABFRs)" in pinfa Newsletter n°166

"Call for evidence to support the preparation of a restriction proposal on certain non-polymeric aromatic brominated flame retardants", ECHA call for evidence open to 18th March 2026 https://echa.europa.eu/calls-for-comments-and-evidence/-/substance-rev/81001/term

Proposed POPs listing for TBPH

The European Commission proposes to include the brominated flame retardant TBPH under the Stockholm POPs Convention (Persistent Organic Pollutants). TBPH (tris(2-ethylhexyl) 3,4,5,6-tetrabromophthalate), a brominated flame retardant and plasticizer, is on the EU CoRAP Candidate List of Substances of Very High Concern as vPvB (very Persistent and very bioaccumulative) since 2023. The European Commission has now proposed to Member States (Council) to file for its listing on Annex A or B of the Stockholm Convention on POPs. The Commission decision states that TBPH is both subject to long range transport and toxic (see also e.g. Xing et al. 2025). The Commission considers that submission to the Stockholm Convention is coherent with EU policy development in that the Commission has given the mandate to the European Chemical Agency (ECHA) to prepare a REACH Annex XV restriction proposal on certain non-polymeric aromatic brominated flame retardants (ABFRs), one of which is TBPH (see above). This follows the ECHA report on Aromatic Brominated Flame Retardants (see pinfa Newsletter n°166).

European Commission "Proposal for a Council Decision on the submission, on behalf of the European Union, of a proposal for the listing of TBPH in Annex A or Annex B to the Stockholm Convention on Persistent Organic Pollutants", COM(2026)51, 4th February 2026 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52026PC0051

FIRE SAFETY

Maybe 80 000 fire deaths per year worldwide

CTIF statistics show 17 400 fire deaths annually in surveyed countries representing one fifth of the world population (2023) and over 3 million fire service calls. CTIF is the International Association of Fire and Rescue Services' Center for Fire Statistics. CTIF's 30th report includes data from 46 surveyed countries, including many richer countries which likely have better fire standards. If the numbers are extrapolated to the world population, this means over 80 000 fire deaths worldwide each year. Around one third to half of reported fires are in buildings, mostly homes, and over 10% in transport. Numbers are estimates as different countries have different reporting criteria and systems. The data suggest probably a reduction by around one half of the number of fire deaths per 1000 population per year (from over 2.5 to around 1.2), 1993 – 2023, with a smaller drop in the number of deaths per fire (from around 0.8 deaths per hundred fires, to around 0.6).

"Word fire statistics", report n°30, CTIF, International Association of Fire and Rescue Services, Center for Fire Statistics, www.ctif.org

Korea: tents not achieving fire safety

Korea Consumer Agency says tents advertised as "flame-retardant" may not offer the claimed level of fire protection. KCA tested 15 tents advertised as having flame-retardant performance and found that 13 of these did not meet fire safety standards. Korean national flame-retardant performance standards (n°2022-29) which specifies requirements for after ignition burn and glow time, charred area and length. Tents failed the standard often for several of these criteria. Also, 7 products melted when exposed to flame. 9 of the tested tests did not meet fire-prevention labelling obligations, with no label, too small label or inadequate warning phrases.

Korea Consumer Agency (KCA) https://www.kca.go.kr/eng/

"Flame-Retardant Performance...8 Out of 10Tents Fail to Meet Standards", Asia Business Dail, 12th February 2026
https://cm.asiae.co.kr/en/article/2026021122511171884

Photo is not a concerned tent, Shutterstock.

EU FUNDING FOR FLAME RETARDANTS INNOVATION

EU R&D projects target PIN FRs

A number of EU-funded R&D projects underway are looking at PIN flame retardant developments and solutions.

Biosafire looks at functionalising lignin and tannin to develop industrially applicable biobased PIN flame retardants, targeting naval, rail, household goods and wood coating applications. The project aims to test and validate the EU JRC framework for "Safe and Sustainable by Design" for flame retardants.

Thermofire will research use of bio-based PIN flame retardants in biobased thermoplastic composites. The project includes development by Arkema of additive PIN FRs for polyamide PA11 by incorporating phosphorus-containing monomers. Avanzare are developing PIN FR solutions for natural fibres based on graphene and wood derived molecules.

FireDesign aims to use machine-learning and genetic algorithms to design new phosphorus PIN FRs for epoxy resins, then synthetise and test the modelled molecules.

PLANETS, with pinfa Members as partners, will particularly look for Safe and Sustainable by Design (SSbD) PIN flame retardants for polyurethane foams (see pinfa Newsletter n°170).

DESIDERATA is also looking at SSbD flame retardants, plasticisers and surfactants, in particular for construction materials, 3D-printing and injection molding of plastics components.

Alchemissts is a third project SSbD flame retardants, plasticisers and surfactants, in particular for lubricants and metalworking fluids, insulation foams, paints, battery cases and sports mats.

FireSpace is looking at fire safety in space exploration, in particular the development of flame-retardant materials and their performance in spacecraft and zero-gravity.

Micro-Insert aims to use fungi to biologically mineralise wood, by generating calcium carbonate, to mineralise wood and so improve fire resistance.

BioPhenom will research functionalised bio-based isolated biophenols as intumescent flame retardants for wood, thermoset and thermoplastic materials.

Biosafire: "Development and manufacture of new, more sustainable and safer materials using biobased functionalised additives based on lignin and tannins to improve fire resistance", EU Horizon Europe, 2024-2028 https://www.biosafire.eu/

Thermofire: "Bio-based fire-retardant thermoplastic composites reinforced with natural fibres", EU Circular Bio-based Europe Joint Undertaking, 2023-2027 https://www.thermofire-project.eu/

FireDesign: "New generation advanced phosphorus-containing flame retardants designed via machine learning and genetic algorithm", EU Horizon Marie-Curie, 2025-2027 https://materials.imdea.org/projects/firedesign-new-generation-advanced-phosphorus-containing-flame-retardants-designed-via-machine-learning-and-genetic-algorithm/

PLANETS: "Plasticizers, flame-retardants and surfactANts: new alternatives validating the safE and susTainable by deSign approach", EU Horizon Europe 2024-2028 https://www.project-planets.eu/

DESIDERATA: "Integrated Pathways: Advancing Safe and Sustainable by Design Material Innovation through Collaborative Wisdom", Horizon Europe 2025-2028 https://www.desiderata-project.eu/

Alchemissts: "Alternative Chemicals and Materials integrating Safety, Sustainability, new Production technologies and Socio-economic aspects", EU Horizon Europe 2024-2028 https://www.alchemissts-project.eu/

FireSpace "Fire safety in space exploration", EU Horizon Europe – ERC -European Research Council), 2026-2032 https://research.ugent.be/web/result/project/3d7b87b1-cd5d-4727-ab94-4c681900b457/details/en#

Micro-Insert "Microbially Induced Mineralisation of Wood for Improved Fire Resistance", EU Horizon Europe, 2025-2029 https://innorenew.eu/project/microbially-induced-mineralisation-wood-improved-fire-resistance-micro-insert/

BioPhenom: "Multifunctional biophenols for safe and recyclable materials", EU Horizon Europe, 2024-2028 https://cris.vtt.fi/en/projects/multifunctional-biophenols-for-safe-and-recyclable-materials/

RESEARCH AND INNOVATION

3D-printing and low-smoke PIN FR projects

DTNW will develop acrylate-based PIN FRs for 3D-printing and improved PIN smoke suppression for natural fibres.

Today, 50% or more of German manufacturing companies use 3D printing. Stereolithography (SLA) and digital light processing (DLP) are 3D printing technologies that operate based on photopolymerization methods. Acrylate-based resins containing a photoinitiator are typically used, and a laser or projector serves as the light source in the printer, curing the resin with UV light. This technology can produce high-quality objects with resolutions down to 10 µm and a smooth surface. However, there are few compatible flame-retardant solutions because of the challenges of incorporating FRs into the printing polymer. DTNW (Deutsches Textilforschungszentrum Nord-West), together with SKZ KFE gGmbH, aims to integrate PIN FR components into acrylates to address this challenge and to develop an environmentally friendly PIN FR solution for SLA and DLP printing.

In a second project, with EU funding, DTNW aims to develop low-toxicity boron-based synergists to further reduce smoke in PIN FR systems for natural fibre composites. Boron is an effective smoke suppressant by creating a glassy surface char and by catalysing char formation from organic compounds released in a fire. Compounds with lower toxicity risks than boric acid will be tested, including boronates, boron-carbon compounds, and boron-nitrogen compounds. The aim is to achieve railway smoke standards (EN 45545-2).

Contact: Thomas Mayer-Gall mayer-gall@dtnw.de - Wael Ali ali@dtnw.de – photo: DTNW.

PIN FR long-fibre polyketone (PKE)

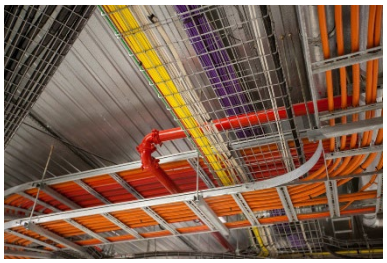
Avient (pinfa member) proposes "non-PFAS" long glass-fibre reinforced PKE achieving UL 94 V-0 (1.5 mm), that is without intentionally added PFAS-based raw materials The material is available in 30% and 40% fibre loading, black or natural, and offers durability, high impact performance, chemical resistance, low moisture uptake and dimensional stability, adapted for applications such as battery housings for power tools and industrial applications. The carbon footprint of the polyketone thermoplastic is lower than for polyamide and has been certified at 2.2 kg CO_2 equivalent per kg product by TÜV Rheinland using ISO-14067:2018 standards.

"Non-PFAS, Flame-Retardant Formulations Expand Avient's Complēt™ Long Fiber Polyketone Portfolio" Photo: Avient
https://www.avient.com/news/non-pfas-flame-retardant-formulations-expand-avient-s-compl-t-long-fiber-polyketone-portfolio

Recycled textiles with PIN fire safety

Indorama Ventures and Jiaren Chemical Recycling launch 50% recycled Trevira® CS phosphorus-based FR fabric. The fibres and yarns contain 50% recycled material, made from polyester textile waste both post-industry and post-consumer. Trevira CS is made inherently PIN flame resistant by embedding phosphorus into the molecular structure, which is polyester based, enabling durability (the fire resistance is completely wash durable), longevity and recyclability. Indorama started PET recycling in 2011, in particular post-consumer bottles to textiles, and is today one of the world's largest PET producers and recyclers, with capacity in Europe, Thailand and worldwide.

"Circular progress: Trevira® CS Eco fabrics can now be made using textile-recycled, permanently flame-retardant fibers and yarns", 21 January 2026 https://beta.indoramaventures.com/news/circular-progress-trevira-cs-eco-fabrics-can-now-be-made-using-textile-recycled-permanently-flame-retardant-fibers-and-yarns



Inorganic PIN FRs for cable sheathing

Three different aluminium and magnesium hydroxides were tested in EVA//LLDME/MA polyolefin cable sheath compound at 60% loading. The PIN FRs tested were synthetic (precipitated) aluminium and magnesium hydroxides and a milled mined mineral magnesium hydroxide (ATH, MDH). They were tested in a polyolefin compound consisting of EVA (ethylene vinyl acetate), LLDPE (linear low density polyethylene) and maleic acid grafted LLDPE, with an antioxidant (pentaerythritol tetracid) and a silicone lubricant. All three PIN FRs provided effective fire performance (reduction of peak heat release rate pHHR of more than 80%) and reduced smoke emission (50 – 70% lower). The metal hydroxides also slightly reduced UV deterioration of the polymer. The different mineral composition, fire performance parameters and processing behaviours of the three inorganic PIN FRs are analysed.

"Sustainable and efficient metal hydroxides as halogen-free flame-retardant additives in polyolefin-based composites for cable sheathing applications", G. Infurna et al., J. Physics and Chemistry of Solids 211 (2026) 113458 https://doi.org/10.1016/j.jpcs.2025.113458

Sulphur phosphorus FR for aircraft seats

Several sulfone-bridged phosphorus PIN FR showed effective fire safety in back-coating of polyamide aircraft seat textiles. Four different research S-P PIN FR molecules were synthetised and tested. They were compounded into a polyurethane-based binder at 5%P loading (15 – 34% FR loading) which was applied to the back of polyamide seat textile (470 g/m^2) by manual scraper spreading, aiming for 150 g/m^2. The back-coated textiles were then fire performance tested using the US Federal Aviation Administration vertical burn test (FAR 25.853). Two of the tested S-P molecules

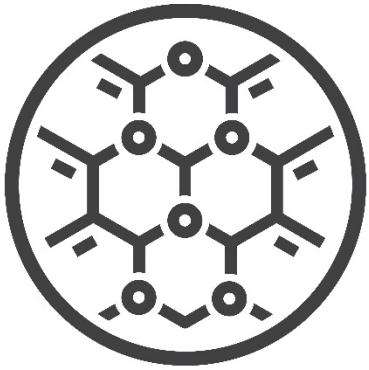
showed predominantly solid phase action (char formation), ineffective for fire performance in back coating. Of the two showing predominantly gas phase action, one passed the FAR test. Preliminary in vitro testing using human lung epithelial and macrophage cells indicated no cytotoxic effects.

"Non-toxic sulfone-bridged phosphorus flame retardants for fire-safe back-coated aircraft seat textiles", M. Özer, S. Gaan et al., Progress in Organic Coatings, 211, 2026, 109833,
https://doi.org/10.1016/j.porgcoat.2025.109833

P- N synergies for wood fire safety

Bio-based PIN FRs, APP and melamine derivative improved fire safety of wood. Bio-based PIN FRs (sodium lignosulfonate and chitosan) were used with ammonium polyphosphate (APP) at 1% - 3% in a melamine-modified urea-formaldehyde resin, applied as a 0.3 mm coating to wood. UL94, LOI and cone calorimeter were used to evaluate fire performance. Compared to untreated wood, peak heat release rate was reduced by nearly -80% and carbon monoxide emission was reduced by two thirds. Analysis showed that the PIN FR coating caused the formation of a dense char layer in fire. The authors conclude that the effectiveness of the PIN FR combination is due to synergy between nitrogen (chitosan, melamine-derivative), phosphorus and lignin-based compounds.

"A Phosphorus–Nitrogen Synergistic Flame Retardant System for Wood Coatings: Enhanced Fire Resistance and Smoke Suppression", M. Lv et al., ChemistrySelect , 2026, 11:e05212,
https://doi.org/10.1002/slct.202505212



Reactive P-N PIN FR for polyester

A 1-vinylimidazole phosphite salt, reacted into unsaturated polyester resin @ 15% achieved UL 94 V-0 (3.2 mm), and over 60% reductions in peak heat release rate and smoke production. 1-vinylimidazole was reacted with phosphorus acid at a 2:1 ratio in ethanol to produce the phosphite salt. This was then reacted into unsaturated polyester resin during curing at 10%, 15% and 20% loadings. The phosphite salt covalently reacts into and cross-links the polyester resin. With 15% phosphite salt loading, UL 94 V-0 (3.2 mm) is achieved, limiting oxygen index (LOI) is increased by around -50% (compared to neat polyester) and peak heat release rate (PHRR) and smoke production are both reduced by more than -60%. This loading of the phosphite salt did not significantly deteriorate the polyester mechanical performance (bending strength -10%, bending modulus not significantly changed, impact strength improved.

"Flame retardancy and smoke suppression of unsaturated polyester resins enabled by 1-vinylimidazole phosphite salts", W-L Mu et al., Polymer Degradation and Stability 238, 2025, 111353,
https://doi.org/10.1016/j.polymdegradstab.2025.111353

PUBLISHER INFORMATION

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