pinfa
Phosphorus, Inorganic & Nitrogen Flame Retardants Association

Your newsletter for non-halogen fire safety solutions n° 162 July-August 2024

PINFA IN ACTION

CAMX webinar: PIN FR technologies

28th August 13h EST (19h CEST Paris). pinfa-NA experts will talk about flame retardant innovation and implementation in composites at CAMX lead-up webinar (free): Roger Avakian (Avakian Polychem Consulting), Jean-Pascal Schroeder (Scott Bader) and Maggie Baumann (Performance Polymers and Additives LLC).

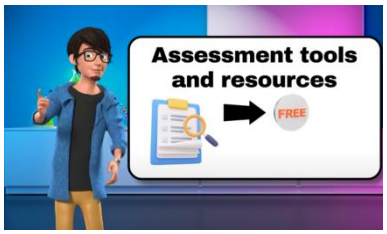
CAMX, the Composites and Advanced Materials Expo, 9-12 September 2024, San Diego, USA https://www.thecamx.org/

Webinar co-organised by pinfa-NA and CAMX, 28th August 13h EST (19h CEST Paris). Registration https://us06web.zoom.us/webinar/register/WN_SeKGsotyR_mPZwy8lQd61g

pinfa-NA free webinar: flame retardant wood

Timm Locke, Marketing Director, Western Wood Preservers Institute, Wed. 25 September, 11:30 EDT (17h30 CEST). Wood is a remarkable and sustainable construction material, with increasing demand. But it is flammable and releases toxic smoke in fire. A range of PIN FR technologies can protect wood from fire, enabling its safe use in modern buildings. This webinar will particularly present pressure impregnation of PIN flame retardants, which can enable durable and sustainable wood fire construction. Timm Locke has three decades of experience in developing wood products for construction, in business companies, quality inspection and timber promotion organisations.

This is pinfa-NA's 12th L&L (lunch and learn) free webinar. Wednesday, September 25, 2024, 11:30am-12:30pm EDT (17h30 CEST). Registration: https://us02web.zoom.us/webinar/register/WN_n9h1T7FJTHSDQdVUt59e4g



pinfa-NA video: chemical hazards and risks

7th pinfa North America 3-minute explainer video discusses tools available to identify safer alternative flame retardants. These resources can help manufacturers and stakeholders find preferable fire safety options for products. The presented tools are based on the hazards of pure chemicals, whereas risk is the combination of hazard and exposure, and a hazardous chemical can be safe if it is held within a product and there is no exposure. The video summarises the EPA Design for the Environment, Green Screen and Chemforward assessment tools.

"Resources for Identifying Safer Alternative Flame Retardant Chemicals", pinfa-NA n°7 explainer video (3 minutes) https://www.pinfa-na.org/learnfrmaterials

pinfa new member: Envalior

Envalior, a global leader in engineering materials with over 4,000 employees worldwide, has joined pinfa. Envalior was established in 2023 through the merger of LanXess Performance Materials and DSM Engineering Materials (who had been a pinfa member). With a long track record of customer-driven innovation, Envalior specialises in developing sustainable and high-performance material solutions. Focus markets include Automotive, New Mobility, Electronics & Electrical, and Consumer goods. "To support our focus markets in the best way, we have studied for many years the flame retardancy behaviour of the plastics in our portfolio, leading to the development of numerous non-halogenated flame retardant grades across all our major product lines and for many applications. These include USB-C connectors, DDR4 connectors and low voltage switch gears. By joining pinfa, we will be able to further understand, in an early stage, the technical and regulatory directions non-halogenated FRs will head towards and so be able to support our customers even better."

Envalior: https://www.envalior.com/en-us/home.html and materials advisor: https://envalior.com/en-us/material-advisor.html

POLICY

New EU EcoDesign enters into force

Reinforced and updated Regulation introduces new "chemicals of concern" and product "Digital Passports". The EU EcoDesign Regulation provides the framework for mandatory product criteria. It is under this Regulation that the EU banned halogenated flame retardants in TV and monitor cases (see pinfa Newsletter n°108). The new Ecodesign for Sustainable Products Regulation (2024/1781), entering into force 18th July 2024, centres on energy use, product lifetime and repairability, recycling, lifetime carbon and environmental footprint, green public purchasing and substances of concern.

"Substances of concern" is a new definition (art. 1, §27), covering a wide list of health and environmental hazard classifications already included in current EU chemical regulations but adding also any substance that "negatively affects the reuse and recycling of materials …". Future product EcoDesign criteria will require (art. 7.5) information about "substances of concern" present in products (identification of substances, range of concentrations …) provided through the Digital Passport.

The European chemicals industry, Cefic (of which pinfa is a sector group), has indicated its support for communication on substances in products to improve circularity. However, it is today unclear how companies will identify whether or not a substance is "of concern" in that the new definition does not rely on existing hazard classifications nor REACH dossier information. It is expected that the European Commission will declare product-specific lists of "substances of concern" when establishing product EcoDesign criteria (art. 7.6).

European Commission: "Ecodesign for Sustainable Products Regulation" https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/sustainable-products/ecodesign-sustainable-products-regulation_en and EcoDesign regulation implementation website https://green-business.ec.europa.eu/implementing-ecodesign-sustainable-products-regulation_en

Ecodesign for Sustainable Products Regulation 2024/1871 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32024R1781

Cefic position, 27th May 2023 https://cefic.org/policy-matters/innovation/ecodesign-for-sustainable-products-initiative/

FLAME RETARDANTS

Benefits and perspectives of PIN FRs

Review paper says PIN flame retardants can combine polymer fire safety, performance and sustainability. Based on over 100 references, this review presents advances in PIN FRs and their integration into innovative composite materials, in particular in electronics, transport and aerospace, and new research areas. PIN FRs are identified as effective in reducing flammability and also in reducing smoke generation, but with challenges of processing and materials performance. The range of PIN FRs available ensures widespread applicability and potential to contribute significantly to fire safety and sustainability in various industries. Developments include improving polymer compatibility, improving heat resistance and thermal stability (for processing, recycling). Focuses are provided on new polymer composites and on applications to ensure fire safety in electronics and transport.

"Advancements in halogen-free polymers: exploring flame retardancy, mechanical properties, sustainability, and applications", M. Sabet, Polymer-Plastics Technology and Materials 2024, https://doi.org/10.1080/25740881.2024.2359633

Balancing safety and sustainability

World Resources Forum (WRF) think piece on combining safe use of flame retardants with human health and environment. Adrien Specker, WRF, underlines the fire and smoke risks posed by plastics and the need for flame retardants (FRs) to reduce their ignitability. This poses a dual challenge of ensuring that FRs used are compatible with recycling and plastics end-of-life management, and are also safe. Some brominated and chlorinated FRs, used in the past, are listed as POPs (persistent organic pollutants) by the Stockholm Convention. The EU's Regulatory Strategy on Flame Retardants (see pinfa Newsletter 147) aims to ensure "the safe use of flame retardants while upholding human health and environmental protection standards". At the same time, effective end-of-life management practices for plastics are essential. The article concludes that a combination of flame retardant innovation, responsible management and regulation can ensure a future where plastics are both fire-safe and sustainable.

"Plastics and Flame Retardants: Balancing Safety and Sustainability", A. Specker, World Resources Forum (WRF), 14th May 2024, https://www.wrforum.org/think-piece/plastics-and-flame-retardants-balancing-safety-and-sustainability/

FIRE SAFETY

Consumers concerned about EV batteries

Deloitte study shows that one third of consumers are concerned about battery safety in electric vehicles. 29% – 32% of consumers expressed concern about battery safety in the US, Germany, Japan, compared to 38% - 45% in China, Asia and India. In Germany the most expressed concern (55%) was driving distance, and in the other countries/regions it was charging time (40% - 50%). Key findings of the Deloitte survey are a slowing of demand for EVs, driven probably by price concerns, increasing tendency for consumers to switch brands, again mainly for price, connectivity services not translating into sales and younger consumers looking to rent a car when needed rather than owning.

"2024 Global Automotive Consumer Study", Deloitte, 26 pages
https://www.deloitte.com/global/en/Industries/automotive/perspectives/global-automotive-consumer-study.html

Fire safety of roof photovoltaic panels

Experts say PV panel fires will increase with installation and underline need to mitigate ignition and fire spread. 30-page building institute guidance document explains fire risks of solar PV panels on flat roofs and identifies actions to reduce these risks. Ong et al. 2022 (see pinfa Newsletter 143) estimated occurrence of fires in PV panels at around 3 fires per year per 100 MWh capacity installed. The report from ZAG FRISSBE Solvenia (Grunde Jonaas et al.) underlines the need to reduce the risk of fire starting in the

solar panels (ignition) and to reduce risk of the fire spreading to roofing and building materials, in particular insulation. pinfa notes that flame retardants are key to preventing ignition of polymers used in PV cables, electronics and connectors, backing membranes and insulation.

"Photovoltaic fire safety: Comprehensive measures to mitigate fire risks", International Fire Safety Journal, 26 June 2024, https://internationalfireandsafetyjournal.com/photovoltaic-fire-safety-comprehensive-measures-to-mitigate-fire-risks/

"Publication of Building Applied Photovoltaics (BAPV) Fire Safety Guideline", FRISSBE (Fire Safe Sustainable Built Environment, EU Horizon 2020 project), Slovenian National Building and Civil Engineering Institute (ZAG), 7th May 2024, https://www.frissbe.eu/news/publication-of-building-applied-photovoltaics-bapv-fire-safety-guideline and report https://www.frissbe.eu/upload/files/FRISSBE-ZAG%20BAPV%20Fire%20Safety%20Guideline%20May%202024%20v3.pdf

PIN FRs for a safer electric grid

1 000 wildfires/year are ignited by electricity distribution cables in the US. PIN flame retardant cable insulation can cut risk, reduce energy losses and enable underground transmission infrastructure, which offers aesthetic benefits and avoids damage and outages in storms. Online article by Dow underlines that wildfire risks from non-insulated T&D (electrical transmission & distribution) cables are increasing with climate change, and with grid infrastructure ageing. PIN FR polymers enable performance insulation of both overhead and underground cables, ensuring fire safety and without using halogenated materials. PIN FR materials show low levels of smoke, corrosivity and gas toxicity in case of fire.

"Advances In Materials Science Reduce Risks", P. Brigandi, Dow Packaging and Specialty Plastics, TDWorld, 4th June 2024, https://www.tdworld.com/vegetation-management/article/55056062/advances-in-materials-science-reduce-risks

Fire risks of hybrid, EV and ICE cars

Data suggests that hybrid cars are more than twice as likely catch fire as gasoline engine cars, whereas fully electric vehicles show a much lower risk of fire. The information published by is based on US data for 2020 and 2021 from the National Transportation Safety Board (NTSB), the Bureau of Transportation Statistics (BTS) and from recalls.gov. Number of fires per 100 000 cars sold is estimated at around 3 500 for hybrid vehicles, 1 500 for gasoline engine cars and only 25 for fully electric vehicles. The hybrid car fires tended to be related to battery problems. This report does not address the severity and specific fire fighting problems of EV fires. pinfa notes that lower fire incidence in EVs may result from higher fire resistance requirements specified by manufacturers. A summary of European data by The Guardian also suggests that EVs have lower fire risk than internal combustion engines. A report from Sweden identifying EV from ICE vehicle fires shows that hybrid and EV fires make up less than 2% of car fires. Car fire risk is strongly

related to vehicle age, so EV fire frequency may increase with the average age of EVs on roads. The US National Fire Protection Association estimates that over 500 000 vehicle fires in the USA caused over 500 deaths, 1 500 civilian injuries and nearly 2 billion US$ direct property damage (2018), that is a car fire every 5 minutes.

"US Study Shows Hybrid Cars Burst Into Flames More Often Than Electric and Gas-powered Vehicles", 1st February 2022
https://www.autoworldnews.com/articles/39969/20220201/study-shows-hybrid-cars-burst-flames-more-electric-gas-powered.htm

"Gas vs. Electric Car Fires [2024 Findings]"
https://www.autoinsuranceez.com/gas-vs-electric-car-fires/

"Do electric cars pose a greater fire risk than petrol or diesel vehicles?", The Guardian, 20th November 2023
https://www.theguardian.com/business/2023/nov/20/do-electric-cars-pose-a-greater-fire-risk-than-petrol-or-diesel-vehicles

"You're Wrong About EV Fires", 11th July 2023
https://www.motortrend.com/features/you-are-wrong-about-ev-fires/

"Sammanställning av bränder i elfordon och eltransportmedel år 2018–2023", Myndigheten förSamhällsskydd och Beredskap (MSB) - Authority for Social Protection and Preparedness", 20th May 2023, report n° 2020–02136 https://rib.msb.se/filer/pdf/29438.pdf

US NFPA vehicle fire statistics https://www.nfpa.org/education-and-research/research/nfpa-research/fire-statistical-reports/vehicle-fires

INNOVATION

Recycling of End-of-Life Vehicle plastics

Review of physical and solvent recycling of automotive plastics underlines complexity of sorting and technical challenges. An average car today in 2019 contained already c. 160 kg of plastics (nearly 9% of its weight), of which around 50% in the car interior, nearly 30% under the hood and electrics and 20% vehicle exterior. The EU End-of-Life Vehicle (ELV) Regulation sets a recycling target of 85% of vehicle weight. Sorting of ELV plastics is complicated because a range of polymers are used, parts are often bonded to other materials, and composites contain fibres and different additives (stabilisers, antioxidants, antistatics, colours, fillers, flame retardants). Current automatic sorting methods only enable separation into groups of similar materials and manual sorting is prohibitively expensive. Pre-treatment before recycling also involves shredding to small particle sizes and washing to remove contaminants (dirt, fuels and fluids). Physical recycling is discussed, noting that mechanical properties tend to deteriorate with breakage of the polymer molecules and fibres. Examples of solvent recycling are presented, noting that to date these tend to target recovery of carbon fibres rather than plastics.

"A mini-review of the physical recycling methods for plastic parts in end-of-life vehicles", V. Martinez Sanz et al., Waste Management & Research 2022, Vol. 40(12) 1757–1765,
https://dx.doi.org/10.1177/0734242X221094917

PIN FR from magnesium recovery

Magnesium dihydroxide (MDH) recovered from seawater salt production wastewater tested as PIN flame retardant in epoxy. China alone generates some 30 million m^3/year of 'bittern', the wastewater from salt production from seawater. Over three quarters of this is currently not valorised and discharge can cause environmental problems. In this lab study, sodium hydroxide and MDH seed crystals were added to synthetic bittern, resulting in precipitation of MDH. This was separated by filtration, then heated (80°C) to generate a 40-60 µm hexagonal MDH nanosheet, which was then functionalised with sodium stearate. The resulting PIN flame retardant, at 9% loading in epoxy, reduced heat release rate by over 60% and smoke by around 40%.

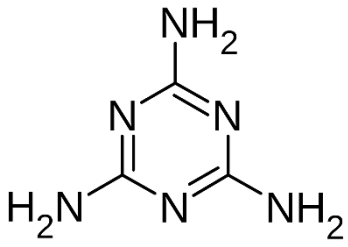
"Fast and complete recovery of magnesium from sea bittern to synthesize magnesium hydroxide hexagonal nanosheet for enhanced flame retardancy and mechanical properties of epoxy resin", B. Sun et al., Desalination 583 (2024) 117716
https://doi.org/10.1016/j.desal.2024.117716

Review of FRs for lithium-ion batteries

Research review discusses flame retardants for electrolytes in current and possible future battery technologies. Current lithium ion battery technologies use liquid organic electrolytes, which are flammable and can react with cathodes, as well as polymer separator membranes. PIN flame retardants can improve fire safety. Various phosphorus (e.g. PBMP, ADP = AlPi, DMMP, TMP, TEP, vinyl benzyl phosphonates, …), nitrogen (e.g. PBI, adiponitrile), nitrogen-phosphorus (e.g. HT) and inorganic PIN FRs are discussed, and also fluorinated phosphorus FRs (e.g. TFEP, fluorinated cyclic phosphates) because current electrolytes are generally organo-fluoride based). Auxiliary solvents can be used to avoid reactions between the graphite anode and phosphorus FRs in the electrolyte (e.g. vinylene carbonate VC or fluoroethylene carbonate FEC). PIN compounds are also being researched to produce flame retardant solid electrolytes.

PBMP = poly(bis(4-phenoxyl)propane methylphosphonate)
ADP = AlPi = aluminium (Al) diethyl hypophosphite
DMMP = dimethyl methyl phosphonate
TMP = trimethyl phosphate
TEP = triethyl phosphate
TFEP = tris(2,2,2-trifluoromethyl) phosphate
PBI = polybenzimidazole
HT = hexaphenoxycyclotriphosphazene

"Glory of Fire Retardants in Li-Ion Batteries: Could They Be Intrinsically Safer?", R. Mishra et al., Adv. Sustainable Syst. 2024, 2400273
https://doi.org/110.1002/adsu.202400273



Melamine - inorganic PIN FR polyurethane

Reacted melamine in polyurethane, with metals and graphite, for fire safety and reduced smoke emission. Melamine was not used as such but was reacted into the polyol. This melamine derived polyol was combined into rigid polyurethane foam at 30 %w/w, with 0 – 5 % w/w of a copper – sulphur – molybdenum compound and 0 or 15% expanded graphite. Fire performance was considerably improved at the highest PIN FR loadings: LOI increased by c. 100% and peak heat release rate reduced by nearly 80%, smoke production rate reduced by over 60% and reduced carbon monoxide emission. The expanded graphite showed the strongest fire protection effects. The inclusion of the melamine polyol considerably deteriorates foam mechanical properties (compressive strength, cell structure) but this deterioration was mitigated by the addition of expanded graphite and the metals compound.

"Tri-phase flame retardant system towards advanced energy-saving building materials with highly efficient fire and smoke toxicity reductions", Y. Yuan et al. Construction and Building Materials 433 (2024) 136719
https://doi.org/10.1016/j.conbuildmat.2024.136719

PIN FR for railway fire safety

Intumescent PIN flame retardant reduces fire risk and smoke in polyurethane seats achieving railway safety standards. The Adeka PIN FR at 0 – 60% loading in resin inserts in foam seat material was compared to magnesium and bromine based flame retardants and to neat resin. For the resin insert, the magnesium and intumescent (both PIN) considerably reduced smoke emission. The intumescent PIN FR offered the best fire performance in the resin, reducing peak heat release rate and smoke emission by nearly 90% at 40% loading. The insertion of the PIN FR resin layer into the seating foam (below 20 mm depth of foam) was effective in suppressing foam combustion because of the intumescent and char forming effect.

"Improvement of Flame Retardancy of Seat Cushion Materials for Railway Vehicles Using Intumescent Flame Retardant", T. Toyohara, S. Yamanaka, QR of RTRI vol.65, n°2, May 2024
https://www.jstage.jst.go.jp/article/rtriqr/65/2/65_83/_pdf

PUBLISHER INFORMATION

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