pinfa
Phosphorus, Inorganic & Nitrogen Flame Retardants Association

Your newsletter for non-halogen fire safety solutions n° 164 October 2024

pinfa in Action 1
15 years: pinfa anniversary Assembly 1
Flame retardants at Fire Safety Week 1
Regulatory 2
Canada consults on priority chemicals 2
Fire safety 3
Fire safety for sustainable wind energy 3
Data centre fires disrupt digital services 3
Netherlands insurers warn on battery fires 4
PolymerAdditives guide to flame retardants 4
50 years fire safety at NIST 4
Innovation 5
PIN FR 3D manufacturing for railways 5
Phosphorus nitrogen PIN FR for epoxy 5
Biobased lignin DNA FRs for poly lactic acid 6
Polymeric PIN FR for V-0 polyamide 6
DOPO triazene PIN FR for PET 7
PIN FRs for wood – plastic composites 7
Publisher information 7

PINFA IN ACTION

15 years: pinfa anniversary Assembly

Some thirty representatives of pinfa member companies joined pinfa's 15th anniversary General Assembly in Rome, 21-22 October 2024. Members discussed the increasing regulatory pressure on chemicals in Europe, with reports from member company and Cefic experts on EU chemicals policy developments, REACH revision, ECHA (European Chemicals Agency) work on flame retardants, EU EcoDesign, Construction Products Regulation as well as global news from China, North America and UN Global Plastics Treaty developments. Members discussed joint projects developing information on upcycling of end-of-life FR plastics, recycling of automotive and electric vehicle FR plastics and leaching potential of FRs from plastics. Increasing regulatory pressure on chemical producers in Europe is posing economic challenges for companies, because chemicals manufactured outside Europe and imported in articles (such as computer, smart phones, car parts …) escape most EU chemical safety restrictions and data requirements. Tightening regulations will however offer long-term opportunities for PIN flame retardants which can ensure fire safety with positive environment and health profiles.

Companies producing, distributing or using flame retardants in Europe (compounders, OEMs) can become members of pinfa, to participate in pinfa's actions and joint projects. Members have access to information and networking at the EU level and globally via pinfa's sister associations in North America and China.

EUROPEAN FIRE SAFETY ALLIANCE

Flame retardants at Fire Safety Week

European Fire Safety Week, 18-21 November: sustainability, electric vehicles, furniture, electrical safety, home fire safety …. pinfa are hosting an in-person (Brussels) and online event (free), Wednesday 20th November, 13h30, on the importance of flame retardants in modern society and their role in reducing fire risks of modern materials.

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The pinfa event at European Fire Safety Week 2024 will cover how fire load has increased in modern buildings, building regulations, fire testing and how flame retardants reduce fire risks in modern materials. With Suzana Draganić, Igor Dzolev, and Mirjana Laban, University of Novi Sad*, Eric Guillaume, Efectis France, Krzysztof Biskup, European Fire Safety Alliance and Thomas Futterer, Budenheim and pinfa.

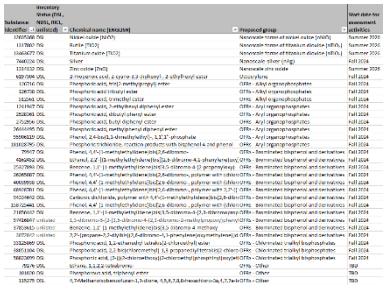
** see "Survey based fire load assessment and impact analysis of fire load increment on fire development in contemporary dwellings", Dzolev, Laban & Draganic, Safety Science 135 (2021) 105094, https://doi.org/10.1016/j.ssci.2020.105094*

18-21 November, European Fire Safety Week 2024
https://www.europeanfiresafetyalliance.org/european-fire-safety-week/

Wednesday 20th November, 13h30 (CET), pinfa event "The importance of flame retardants in modern society" in-person (Brussels) and online
https://www.europeanfiresafetyalliance.org/european-fire-safety-week/edition-2024/european-fire-safety-week-2024-20-11/#session-3b

Registration: https://www.europeanfiresafetyalliance.org/european-fire-safety-week/edition-2024/registration-form-2024/

REGULATORY



Canada consults on priority chemicals

Public consultation, open to 4th December 2024, on list of chemicals to prioritise for assessment under CEPA (Canadian Environmental Protection Act). A proposed list of 33 chemicals / chemical families is proposed including "Organic flame retardants" (OFRs). The accompanying document indicates that some organic FRs have shown evidence of ecological or health risks and that "many … are structurally related" to organic FRs already assessed and concluded to pose health or environmental risk and it is proposed that "OFR substances be considered in structurally similar groups". The consultation includes a 'Work Plan' listing 70 Organic Flame Retardants (in a total of over 500 listed chemicals), identified by CAS number. Twenty-four of these OFRs (of three groups: alkyl organophosphates, brominated bisphenol & derivatives, chlorinated trialkyl bisphosphates) have autumn 2024 indicated as start date for assessment. The others have no defined start date (including chlorinated, brominate and phosphorus compounds).

"Proposed Plan of Priorities under the Canadian Environmental Protection Act, 1999", ***public consultation to 4th December 2024***
https://www.canada.ca/en/environment-climate-change/services/canadian-environmental-protection-act-registry/implementing-modernized-cepa/plan-of-priorities-landing-page.html

FIRE SAFETY

Fire safety for sustainable wind energy

Access difficulties and importance for renewable energy production make fire safety critial for offshore wind farms. Article in 'WindpowerEngineering' reports over 200 incidents in the UK offshore wind sector in 2022, increasing yearly. Offshore wind farms are often some way from shore and unmanned, making emergency response difficult and slow. Transformer platforms are a particular fire risk: they house vital equipment, serve a number of turbines, and fire can lead to electrical failure and loss of controls. Fire intervention for fires in electrical equipment in the marine environment requires specific expertise and equipment. Fire safety of wind farms is key to protect the infrastructure and to ensure ongoing supply of energy and grid stability.

"Fireproofing offshore wind for a sustainable future", S. White, Blaze Manufacturing Solutions, in Wind Power Engineering, 15th October 2024
https://www.windpowerengineering.com/fireproofing-offshore-wind-for-a-sustainable-future/

Data centre fires disrupt digital services

Real estate company JLL says fire safety in data centres is under scrutiny following several more disrupting fires. A fire at Digital Reality's Loyang Way data centre, Singapore, in September, impacted clients including Alibaba Cloud, Lazada, Bytedance. The fire started in a lithium ion battery. A fire at a data centre in India in September caused an outage for users of Reliance Jio, India's leading telcon provider. JLL says that despite the risk of and impact of such fires, there is today no global regulatory standard for data centre fire safety. Some countries have national regulations or guidelines, but most operate under general industrial building regulations. Partitioning of UPS (power back up) systems containing lithium ion batteries is important, as is maintenance of these (the lithium ion batteries have only 15 years guarantee).

"Recent data center fires raise serious concerns about the adequacy of current fire safety measures", JLL, 14th October 2024
https://www.us.jll.com/en/trends-and-insights/workplace/will-data-center-fires-spark-tighter-safety-rules

"Data Centers 2024 Global Outlook", JLL report, January 2024
https://www.us.jll.com/en/trends-and-insights/research/data-center-outlook

"Fire at Loyang data centre, SCDF operations still ongoing after a day", CAN, 10th September 2024
https://www.channelnewsasia.com/singapore/fire-loyang-digital-realty-data-centre-scdf-operation-4599316

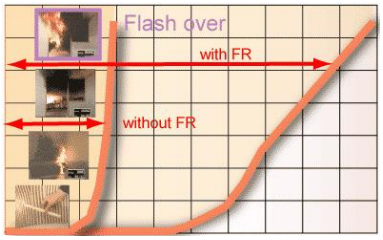
"Fire at data centre causes India-wide outage for Reliance Jio users", Reuters, 17th September 2024
https://www.reuters.com/world/india/reliance-jio-users-report-network-outage-across-india-downdetector-shows-2024-09-17/

See "Data centre fires a 'significant threat'" in pinfa Newsletter n°152.

Netherlands insurers warn on battery fires

The Dutch federation of insurers says batteries caused one in twenty house fires, significantly increasing year on year. Whereas the total number of house fires seems to be slowly decreasing (52 000 insurance claims in The Netherlands in 2023, versus 54 000 in 2022) the number of fires suspected to be caused by batteries increased in number and in percentage (from 3% to 5%). Insurers and the National Burns Foundation, participating in the Netherlands Fire Prevention Week, underlined the risks of battery fires from e-bikes, e-scooters and other equipment.

"House fires more often caused by burning batterie", Dutch Association of Insurers (Verbond van Verzekeraars), 23rd October 2024
https://www.verzekeraars.nl/publicaties/actueel/ruim-52000-woningbrandclaims-bij-verzekeraars-in-2023



PolymerAdditives guide to flame retardants

SpecialChem website updates detailed information pages on flame retardants and their selection for different polymers. The pages cover fire mechanisms and how FRs act to reduce fire risks, fire safety benefits of flame retardants, different types of flame retardant and selection criteria for different types of FR and for different families. Selection criteria covered include impacts on polymer mechanical performance and appearance, processing, UV stability, environmental aspects. A number of diagrams, illustrations and infographics are included.

SpecialChem pages "Flame Retardants of Plastic - Mechanism, Types, & Applications" https://polymer-additives.specialchem.com/selection-guide/flame-retardants

Illustration: "Flash Over Time vs. Fire Retardant Use" from SpecialChem (time in seconds / heat flux KWm/2)

50 years fire safety at NIST

Over 50 years, US fire deaths per capita have decreased -80% and serious injuries by -97%. The US Federal Fire Prevention and Control Act 1974 initiated fire research at NIST (US National Institute of Standards and Technology). 50 years on, NIST has published a list of key fire safety advances over this period, including cigarette resistant furnishings, methods for testing fire size and smoke toxicity, smoke alarm criteria, mattress flammability test method, actions on building construction safety in fire.

"A Legacy of Fire Safety: NIST Marks 50 Years of the Federal Fire Prevention and Control Act of 1974", NIST Special Publication SP 1325, July 2024 https://doi.org/10.6028/NIST.SP.1325 Photo: NIST.

INNOVATION

PIN FR 3D manufacturing for railways

Tiger Coatings is using 3D additive printing to produce spare parts for Austrian Railways ÖBB, achieving EN 45545. One example is retrofit safety rings to ensure that baby carriages do not open doors unintentionally. The rings have to be produced in small series, to specific specifications, conform to railway fire and smoke standards EN 45545. Tiger Coatings TIGITAL are 3D-print compounds for SLS - CBAM 3D-printing (Selective Laser Sintering - composite-based additive manufacturing) and can achieve UL 94-V0 (2 mm), UN ECE 118 Annex 6-7-8 and EN 45545 (HL 1-2-3) with UV resistance, chemical resistance (DBL 5404), notch impact and tensile strength performance, >70% reuse of printer compound, low print temperatures (65-67°C), no pre-drying and non-halogenated PIN flame retardant. The compound is compatible with all open SLS print machines, including Farsoon, Prodways, Weirather, Nexa3D, Sinterit.

"TIGER Coatings Manufactures Spare Parts With Flame-Retardant Materials for Austrian National Railway Trains", 3Dnatives, 10th July 2024 *https://www.3dnatives.com/en/tiger-coatings-flame-retardant-materials-austrian-national-railway-trains/*

"Property Design & Material Qualification of 3D-Thermoset SLS powders. Public transport & Rail applications", T. Auinger, Forum France Addive July 2023 *https://www.tigital-3dprint.com/fileadmin/user_upload/downloads_new/tigital/tigital-3d-print/presentations/20230706_TIGITAL_3D-Set_France_Additive.pdf*

Photo: Tiger Coatings

Phosphorus nitrogen PIN FR for epoxy

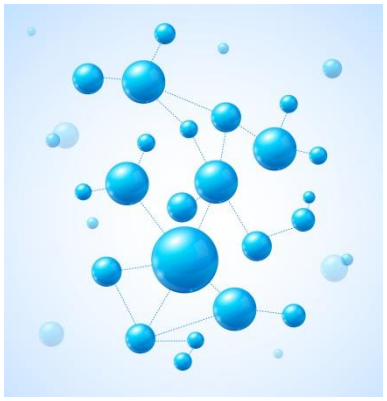
Research shows PIN flame retardant can achieve UL 94 V-0 (3 mm) and 65% smoke reduction at 4% loading in epoxy. The PIN FR was synthetised by reacting furfurylamine (containing N) with Thiophene-2-carbaldehyde (containing S) then DOPO (9,10-dihydro-9-oxa-10-phosphaphenanthrene-10-oxide, containing P) then included into DGEBA epoxy resin at 0, 2 or 4 % w/w loading. This resulted (at 4%) in contents of 0.3% P, 2.82% N and 0.31% S. At 4% loading, the peak heat release rate was reduced by 20% and total smoke production by 60%, achieving UL 94 V-0 (no dripping) and V-1 at 2%. Volatile, hydrocarbon and aromatic compounds in smoke were almost the same between pure epoxy and the PIN FR epoxy. Mechanical performance of the epoxy was improved with the PIN FR addition and optical properties were not deteriorated.

"A P/N/S containing flame retardant for epoxy resins with excellent optical, mechanical and flame retardant properties", Z. Jiang et al., Polymer Degradation and Stability 225 (2024) 110783
https://doi.org/10.1016/j.polymdegradstab.2024.110783

Biobased lignin DNA FRs for poly lactic acid

DNA encapsulated in nano-scale lignin was tested as a PIN flame retardant in the bio-based polymer poly lactic acid (PLA). DNA (deoxyribonucleic acid = biological genetic material, laboratory purified to >98%, from fish sperm) was encapsulated in nano-scale lignin (using laboratory pure lignosulphate), then grafted to OH-funcitonalised PLA to improve compatibility with PLA polymer. The resulting DNA-lignin-PLA was tested in PLA and in production of PLA foams at 0 – 20 % loading (that is, up to 1.1 %P – 1.7%N). Peak heat release rate was reduced by around one third and LOI (Limiting Oxygen Index) increased by around one half with 20% loading. Also, nucleation of foaming was improved (even at 1% loading) resulting in smaller foam cells and lighter foams.

"Biobased Flame-Retardant Polylactic Acid Foams through Lignin- Based Nanocarriers Encapsulating Deoxyribonucleic Acid", H. Ridard, T. Mayer-Gall et al., ACS Sustainable Chemistry Engineering 2024
https://doi.org/10.1021/acssuschemeng.4c05886

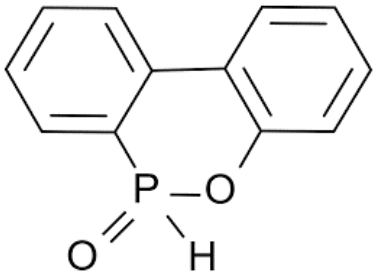


Polymeric PIN FR for V-0 polyamide

Polymeric phosphorus – nitrogen PIN FR achieved UL 94 V-0 (3.2 mm) at 0.3 % P. The experimental polymeric PIN FR was synthesised by reacting DDP (9,10-Dihydro-10-(2,3-dicarboxypropyl)-9-oxa-10-phosphaphenanthrene 10-oxide) with decamethylene diamine and caprolactam (both nitrogen containing) resulting in a nitrogen-containing DOPO-derivative polymer*. This polymer was then blended into polyamide (PA6) to achieve phosphorus contents of 0.3 – 0.5 %. At 0.3% P, UL 94 V-0 was achieved (V-2 for neat PA6) and LOI (limiting oxygen increase) was increased to nearly 26% (below 22% for neat PA6). However, smoke and carbon monoxide release were considerably increased and mechanical properties were significantly deteriorated compared to neat PA6. The flame retardant action was identified as principally gas phase, with low char formation. The authors note that the PIN FR obtained in this study had a relatively low molecular weight (5 9000 – 7 5000 g/mol) and that polymerisation method improvement could enable higher molecular weights to be achieved, possibly leading to less deterioration in PA6 mechanical properties. The authors cite previous studies showing that other PIN FRs can achieve UL 94 V-0 in PA6, e.g. AlPi (aluminium diethylphosphinate) at 15% loading.

"Polymer-type flame retardants based on a DOPO derivative for improving the flame retardancy of polyamide 6: Preparation, properties and flame retardancy mode of action", B. Liang et al., Polymer Degradation and Stability 225 (2024) 110807,
https://doi.org/10.1016/j.polymdegradstab.2024.110807

DOPO = 9,10-Dihydro-9-oxa-10-phosphaphenanthrene-10-oxide



DOPO triazene PIN FR for PET

(3-DOPO-propyl)-triazine trione (TAD) achieved UL 94 V-1 and one third reduction in peak heat release in PET at 5% loading. The experimental PIN FR contains three phosphorus atoms (10.3% P w/w) and three nitrogen atoms. It was blended into PET (polyethylene terephthalate) by extrusion at 1 – 5 % w/w, with 0.6% antioxidants and 0.4% anti-drip PTFE (a fluorinated PFAS). At 5% loading, UL 94 v-1 (3.2 mm) was achieved, peak heat release rate was reduced by a third (compared to neat PET) and LOI was increased to 30.2 (from 23.8 neat PET). Mechanical properties of the PET were generally deteriorated by the TAD addition at 5%, but at 1 – 3 % loading were in some cases improved. The fire safety action of TAD was considered to be a combination of gas phase, with phosphorus radicals inhibiting burning, and protective char production.

"The behavior and mechanism of tris-(3-dopo-propyl)-triazine trione flame retardant polyethylene terephthalate", H-Y. Liu et al., J Appl Polym Sci. 2023;140:e54069, https://doi.org/10.1002/app.54069

PIN FRs for wood – plastic composites

PIN flame retardants were effective for fire safety of wood – polyethylene composites, remaining effective after weathering. Addition of wood flour to polyethylene (PE) increases mechanical performance and also reduces flammability for uses such as exterior decking and siding. Analysis of previous studies showed that ammonium polyphosphate (APP) and magnesium hydroxide (MDH) were effective flame retardants when compounded into the PE – wood particles blend (35% polyethylene, 50% wood fibre, 10% flame retardant compared to control 35% / 60% / zero FR). 60% wood reduced peak heat release rate by 76% compared to neat polyethylene, and 50% wood – 10% MDH by 84%. MDH and APP were identified as the most effective flame retardants for the polymer – wood composite tested, compared to a brominated FR, with limited impact of weathering.

"Durability and performance of wood flour/polyethylene composites containing fire retardants after weathering via ASTM D2565", M. Dietenberger et al., J. Fire Sciences 2024
https://doi.org/10.1177/07349041241237536

PUBLISHER INFORMATION

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