pinfa
Phosphorus, Inorganic & Nitrogen Flame Retardants Association

# Your newsletter for non-halogen fire safety solutions n° 114 June 2020



## REGULATORY AND STANDARDS


### EU new EU Circular Economy Action Plan

**Five of the seven targeted product value chains in the new Plan concern flame retardants and fire safety**: electronics and information and communication technology (ICT), batteries and vehicles, plastics, textiles (EU strategy for 2021) and construction. Proposals include: extending the Ecodesign Directive (pinfa note: which for screens and electronic displays will exclude brominated flame retardants) and for 2021 reviewing RoHS (Restriction of Hazardous Substances in E&E). Mandatory recycled content requirements and plastic waste reduction measures are announced for 2021-2022 for construction materials (within the revision of the Construction Product Regulation) and for vehicles. pinfa also notes that the proposed "*Digital logbooks for buildings*" should offer a significant opportunity to ensure follow-up of fire safety through renovations ("Renovation Wave" initiative in the Green Deal).

*COM(2020)98 "A new Circular Economy Action Plan" 11th March 2020*

An Roinn Gnó, Fiontar agus Nuálaíochta
Department of Business, Enterprise and Innovation

**Review of the Furniture Fire Regulations**
Public Consultation

### pinfa response furniture consultation

**pinfa input to the Ireland furniture fire safety consultation underlines that PIN FRs are available which are recognised as safe by labels such as ÖkoTex, TCO or ZDHC** (Zero Discharge of Hazardous Chemicals coalition). pinfa supported maintaining the current high fire safety requirements of the Ireland furniture regulations, which are essentially the same as the UK furniture fire safety requirements. pinfa refuted the suggestion in the consultation document that all organophosphorus chemicals are potentially harmful (some organophosphates are essential biological molecules e.g. DNA, cell membranes, ATP, in our bodies) and provided a list of organophosphorus FR chemicals

which are ecolabel accepted and have no health or environment classification. pinfa also provided a list of other PIN FR chemicals with no identified risk as used in furniture, including inorganic phosphates, nitrogen and melamine compounds, mineral PIN FRs and smoke suppressants, clays, expandable graphite and non-halogenated polymeric FRs. pinfa recommends to "rely on objective assessments, such as excluding all chemicals (including flame retardants) which are substances of very high concern (SVHC) under REACH or which have certain health or environment Classifications (unless they are durably reacted into the treated material and are no longer present at significant levels) or to limit to chemicals which have achieved Benchmark 2 or higher under GreenScreen."

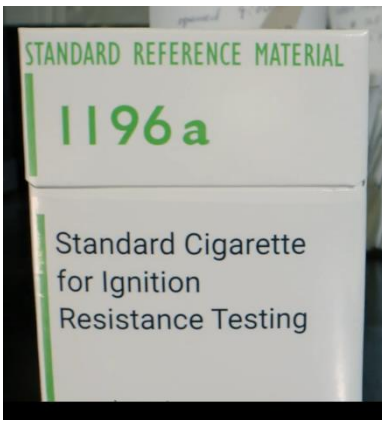
*Ireland national government Furniture Fire Regulations Consultation (closed) https://dbei.gov.ie/en/Consultations/Furniture-Fire-Regulations-Consultation.html pinfa response online here https://www.pinfa.eu/flame-retardants/position-papers/*


## pinfa input to EU textile BREF update

**pinfa has proposed, through Cefic, improvements to the textile industry BREF including integration of PIN FRs into fibres and updates on alternative assessments.** pinfa comments include correcting information on phosphorus in wastewaters, corrections on decomposition of aluminium hydroxide (ATH), updates of chemical information (with reference to ECHA and REACH), correction of information about melamine and melamine compounds and intumescents and clarifications on wash durability.

*Best Available Techniques (BAT) Reference Document for the Textiles Industry, draft December 2019: https://eippcb.jrc.ec.europa.eu/reference/textiles-industry*

# REGULATORY AND STANDARDS




## NIST relaunches standard testing cigarette

**The original 2010 production of SRM 1196 testing cigarettes lasted less long than expected because of increasing demand for fire testing**. NIST, the US National Institute of Standards and Technology, has produced a new supply of the testing cigarette (1196a), designed to be the same. It differs from commercial cigarettes in order to provide a stronger and more stable ignition source for testing. NIST also provides SRM 1082 to support manufacturers of self-extinguishing cigarettes. NIST underline that one in thirty-one smoking-related home fires results in death.

*"NIST Releases a New Standard Cigarette for Testing the Flammability of Mattresses and Furniture", NIST 19 February 2020*
*https://www.nist.gov/news-events/news/2020/02/nist-releases-new-standard-cigarette-testing-flammability-mattresses-and*

## US ICC standards process questioned

**A vote on amendments to the International Construction Code reversing positions in committee and hearings is casting doubt on the standards process.** Most standards organisations function by a combination of technical consensus between industry and stakeholders and governments. This is also the case for ICC ("International Construction Code", which in fact concerns the USA). Twenty amendments to ICC, relating to energy not to fire safety, proposed and promoted by a coalition of stakeholders promoting energy savings (EECC) were rejected by ICC committees and at hearings, but then approved by the final vote, in which any registered public official can vote. Following complaints, the vote has been investigated and found to have been accurate. This suggests that advocacy may have had more influence than technical knowledge of the proposals.

*New Buildings Institute, 20th December 2020 https://newbuildings.org/local-governments-vote-resoundingly-for-improved-national-energy-codes/*

# FIRE SAFETY

## Grenfell Tower inquiry report published

**The rapid spread of the tragic fire from its start in a fridge-freezer was allowed by windows, and by cladding which was not conform to fire safety regulations.** The public inquiry into the Grenfell Tower fire, London, 2017, in which 72 people were killed, has published the report on its first phase (860 pages), investigating the course of events during the fire. This concludes that the fire spread because hot smoke or flames from the initial fire, which started in a Whirlpool Hotpoint fridge-freezer, caused a uPVC window to deform so enabling fire to reach the external cladding "*the principal reason why the flames spread so rapidly up, down and around the building was the presence of the aluminium composite material (ACM) rainscreen panels with polyethylene cores*" and burning drips from these "*the presence of polyisocyanurate (PIR) and phenolic foam insulation boards behind the ACM panels, and perhaps components of the window surrounds, contributed to the rate and extent of vertical flame spread*". It is indicated that there is compelling evidence that the cladding panels, installed in a 2015-2016 refurbishment, did not comply with the fire safety requirements of the UK Building Regulations. Phase 2 of the inquiry will try to establish responsibility for this decision between the architects Studio E, the fire consultants Exova who were supposed to verify conformity, the cladding manufacturer Celotex, and the UK Building Regulations.

*Grenfell Tower Inquiry, Phase 1 Report https://www.grenfelltowerinquiry.org.uk/phase-1-report*

*"Grenfell Inquiry: Aesthetics v safety v money", BBC 13th March 2020 https://www.bbc.com/news/uk-51859272*

## Furniture regulations increase escape time

**Full scale fire tests on 34 sofas purchased in different EU countries show that strict national furniture fire safety regulations mean increased escape time**. Firstly, fire tests were carried out on one sofa purchased from each EU Member State. Then furnished room tests were carried out on six further sofas. Only the UK and Ireland were identified as having stringent furniture fire safety regulations (cigarette and small flame resistance) and the two regulation-conform sofas from these countries showed time to peak heat release two to four times higher than those from other countries, meaning significantly longer times for occupants to escape a fire. One of two sofas purchased in Ireland was not conform to regulations, showing the importance of market surveillance. In the room tests, the time before the temperature at the room open doorway reached 200°C was over 20 minutes for the UK sofa, compared to 4 - 8 minutes for sofas from Greece, Ireland, Lithuania, Portugal and Sweden. Similarly, time before significant smoke production in the room with the UK sofa was over 20 minutes compared to 3 – 8 minutes for the other sofas.

*"An overview and experimental analysis of furniture fire safety regulations in Europe", E. Guillaume et al., Fire and Materials, 2020, 1-16 https://doi.org/10.1002/fam.2826 Work funded by BSEF and ACFSE*

## Fire testing solar PV panels

**Efectis has developed a new fire test for photovoltaic panels to take into account mounting and other construction materials**. Solar panels pose fire risks, in particular because of risk of arcing, sparking or overheating of the DC-AC converter, cables or connectors. The Efectis test is an adaptation of the SBI test, and enables testing of the panel as installed, either free standing (air access can accelerate fire) or built into roofing (risk of fire in construction materials).

*"How fire-safe are solar panels? And how can we determine this?", European Fire Safety Community, 12 March 2020 https://eufiresafety.community/news/263096 and "PV panels: are they sufficiently fireproof?", Efectis 3 July 2019, https://www.efectis.com/en/pv-panels-sufficiently-fireproof/*

## "consequence of extreme combustibility"

**The US National Fire Protection Association says one in eleven upholstered furniture fires leads to a death**, and that the death rates per furniture fire has nearly doubled since the 1980's. Death rates for fires starting in mattresses or bedding show a similar increase. The number of home fires has been halved since the 1980's but the probability of dying if a home fire does start has not been reduced. In the NFPA's March-April 2020 Journal, Vice-President Lorraine Carli calls for action towards the furniture fire problem, targeting materials used in furniture, sources of ignition and sprinklers.

*"High Consequence. The extreme combustibility of modern furniture is one more reason to embrace home fire sprinklers", Lorraine Carli, NFPA Vice-President, NFPA Journal March/April 2020 https://www.nfpa.org/News-and-Research/Publications-and-media/NFPA-Journal/2020/March-April-2020/Columns/Outreach*

## European Fire Safety Action Plan

**European Fire Safety Alliance (EurFSA) has published a ten-point "action plan" for fire safety, based on outcomes of the 2019 European Fire Safety Week.** EurFSA state that over 5 000 people per year are killed by fire in Europe. Escape times are reduced because smoke has increased "up to 10 times" since the 1980's, particularly from furnishings, and this is accentuated by low-ventilation energy-efficient buildings. The Action Plan based on outputs of the first European Fire Safety Week, November 2019, and questionnaire responses of 336 fire safety experts. It responds to the challenges of an ageing population (and the objective of living safely at home), the energy transition and the Green Deal. The ten actions proposed are:

- Establish a European approach to improve the fire safety of the most vulnerable
- Introduce an EU fire safety standard for upholstered furniture and mattresses
- Increase application of smoke detectors
- Improve the functioning of LIP (lower ignition propensity) cigarettes
- Address fire risks of new energy systems
- Raise fire safety awareness through community fire safety projects
- Research into fire safe behaviour
- Put in place coherent EU fire data collection
- Widen the EU FIEP (Fire Information Exchange Platform)
- Improve Member States and industry cooperation on market surveillance

*European Fire Safety Action Plan, March 2020 https://www.european-firesafetyalliance.org/publications/10-actions-that-will-improve-fire-safety-in-europe/*

*50 minute video showing the development of smoke from burning furniture, presentation of 19 controlled fire tests, 2019 "Practical research on smoke propagation (Oudewater experiments)" https://www.youtube.com/watch?v=0MTOcGTOryU*

# PIN FR INNOVATION AND APPLICATIONS


## PIN FR 3D-printing for racing e-motorcyle

**CRP Technology's Windform FR2, a PIN FR glass fibre reinforced polyamide for SDS 3D-printing, helps make the Ego Corsa's new battery for Energia**. This is the machine used for the official FIM (International Motorcycling Federation) Enel MotoE World Cup. Windform FR2 is 3D-printed by SDS produce specific design parts for the e-race-bike battery cell pouch frames, requiring flame retardancy, mechanical strength, electrical insulation and heat resistance.

*"CRP firms alongside Energica for the new season of MotoE" 20th March 2020 https://www.crp-group.com/crp-firms-alongside-energica-motoe-2020/*

*Photo: Energica official tester Alessandro Brannetti*

## Orange PIN compounds for electric vehicles

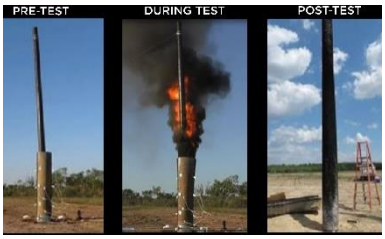
**Lanxess offers a variety of PIN polyamide and PBT compounds with colour stability for high voltage e-mobility components.** Orange colour is prescribed as safety and distinguishing feature for high voltage cables and components in electric vehicles. However, it is a challenge to ensure colour stability over time. Lanxess now offers a variety of unfilled and glass fibre reinforced performance PIN compounds in orange RAL2003 and RAL2010. Colour stability has been demonstrated for 1 000 hours at up to 150 °C. Among others, the product range includes glass fibre reinforced polyamide 6 compounds, offering excellent mechanical properties such as high stiffness and strength, good flowability and processability, as well as outstanding flame protection properties (UL94-V0 @ 0.4 mm). A Yellow Card (Underwriters Laboratory certification) is available for each grade. Target applications for such materials are high voltage connectors and busbars. Specific orange-coloured, glass fibre reinforced PIN PBT compounds also achieve UL94-V0 @ 0.4mm and offer significant advantages with regard to tracking resistance, laser marking and colour stability.

*"Orange-colored compounds for high voltage components in electric vehicles", Lanxess http://bond-laminates.com/en/company/press-releases-media/latest-press-releases/2019-00049e/*

## HP using recycled PIN FR plastics

**Hewlett Packard has objectives to phase out brominated flame retardants and to use 30% recycled plastics. Phosphorus based PIN FRs provide the solution.** Three-quarters of HP's personal IT products (laptops, PCs, displays …) achieved "low halogen" in 2018. Now, HP will use a PIN flame retardant plastic produced from Ocean Bound Plastic waste with non-halogenated phosphinate-based flame PIN retardants from Clariant (see pinfa Newsletter n° 113). Initial challenges in processing were related to the change in base polymer, not to the PIN FRs. HP is reported (Chemical Watch) to be advocating for legislation to restrict brominated FRs, as well as other substances of concern, because although alternatives exist for most applications, widespread adoption needs regulatory restrictions.

*"HP using halogen-free recycled plastics to achieve 2025 goal. Clariant's phosphinate-based compound 'a sustainable replacement', Chemical Watch, 18th March 2020 https://chemicalwatch.com/100573/hp-using-halogen-free-recycled-plastics-to-achieve-2025-goal*




## TFP PIN FR fibres deliver UCC fire performance

**Valmont Utility has chosen TFP's non-halogenated fire protection nonwovens, enabling new composite structure poles to resist 1150°C without structural loss**. Valmont is a global leader in engineered products for infrastructure, communication and energy transmission structures and industrial construction. pinfa-na member TFP (Technical Fibre Products Ltd)'s PIN FR nonwoven mat is integrated into Valmont's new composite poles, by centrifugal casting and filament

winding, and protects the structure from fire by intumescent char. Utility poles must ensure integrity of transmission infrastructure in wildfires. The new composite poles pass the USA Utility Company Consortium Fire Test, UL94-V0, ASTM E84 (Steiner Tunnel, Class 1) and pre- and post-burn ASTM D1036 Pole Bending Test.

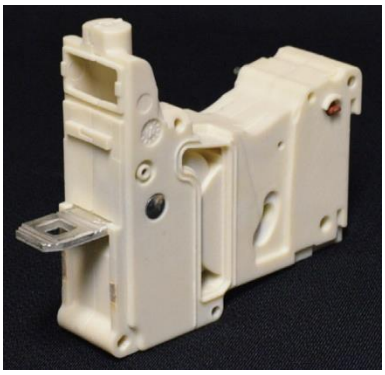
*"A New Composite Application for Tecnofire", TFP press release 9th March 2020 https://www.tfpglobal.com/news-and-media/news/a-new-composite-application-for-tecnofire*

*Photo: testing the pole within a steel culvert to reach up to 1150°C for 3 minutes to simulate extreme wildfire conditions. The pole maintained integrity under load.*

## Special silica FR synergist

**Biesterfeld is now distributing Elkem's low specific surface area silica, as a performance synergist or partial filler replacement, for flame retardant rubbers**. The special amorphous silica's low BET (Brunauer–Emmett–Teller) surface area, 20 - 25 $m^2/g$, means that the material is low reinforcing (does not influence mechanical performance), inert and non-porous, so does not absorb plasticising components. In rubber, its broad particle size distribution enables good dispersion, and it can improve processing and properties such as dynamic fatigue and surface quality. It acts as a synergist with a wide range of flame retardants, in particular reducing dripping and improving char integrity in halogen-free compounds, or as a partial replacement of antimony trioxide. Biesterfeld has been operating international trading for over 110 years, is based in Hamburg, Germany, with 800 staff worldwide, specialised in plastics and additives, rubbers and compounds.

*www.sidistar.com. "Biesterfeld granted distribution rights for Sidistar® from Elkem ASA in German Rubber market", 18th March 2020 https://www.biesterfeld.com/en/es/article/biesterfeld-granted-distribution-rights-for-sidistarr-from-elkem-asa-in-german-rubber-market/*



## Reinforced PA for electrical applications

**EMS-Grivory's PIN FR long glass-fibre polyamide selected for e-vehicle rapid charger and for industrial circuit-breaker**. The long fibre reinforced PAs, with non-halogenated flame retardants offer thermoplastic processability (injection moldable), achieve UL94-V0 (@1.6 mm) and ensure performance at high temperature, low creep, high strength, impact resistance and low warpage. They have been selected by Schneider Electric in replacement of thermoset material for the breaking cell of its range of compact NSXm circuit breakers, where mechanical resistance, heat aging, electrical performance and fire protection are critical because of reduced size. Huber+Suhner have selected the LGF PAs for its new RADOX KPC rapid charger for electric vehicles which operates up to 400A/1000V.

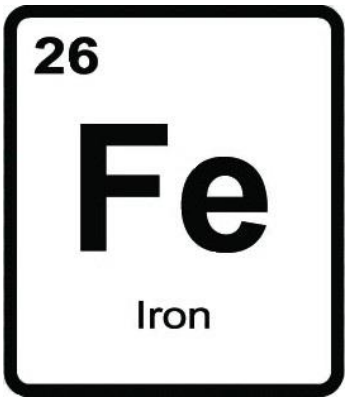
*Compounding World, April 2020 http://www.compoundingworld.com/ and KNews 2019 K-News 2019 https://www.emsgrivory.com/fileadmin/ems-grivory/documents/events/K2019/K-Depesche_2019_EN_web.pdf Photo: Schneider Electric breaking cell.*

## HFFR cable compound for fire performance

Borealis and Borouge new halogen-free flame retardant cable jacketing makes it possible to achieve high CPR fire rating including "d0" – no flaming droplets. The new formulation offers good mechanical properties, enables high speed cable production and can achieve CPR (EU Construction Products Regulation) requirements without adding other flame retardant insulation or bedding materials, so enabling lightweight cables and efficient production. Depending on cable construction, the HFFR compound can achieve CPR Euroclass B2ca-s1,d0 that is the best possible class both for flame spread and resistance to flaming droplets. The material retains its shape in intense heat, so the jacketing remains on the cable in fire.

*"Borealis and Borouge raise the bar for fire safety standards with new flame retardant solution", 16th April 2020 https://www.borealis-group.com/news/borealis-and-borouge-raise-the-bar-for-fire-safety-standards-with-new-flame-retardant-solution*

# RESEARCH




## Iron – P - N - silicone PIN FR synergy

A polymeric N-P-siloxane PIN FR with iron oxide achieved UL94-V1 (3 mm) at a combined loading of 2% in PET. Poly(N,N dimethylene phosphate aminopropyl siloxane) (PDPSI) was tested with $F_2O_3$ in PET, with five different combinations of total load 2% (from 0% to 2% PDPSI) and compared to neat PET. Optimal combination was 2/3 iron oxide to 1/3 PDPSI, which increased LOI by over 25% and reduced peak heat release rate by 66% (compared to neat PET), achieved UL94-V1 no dripping and reduced total smoke production by 44%. Continuous and dense char was generated. The strength of the PET was reduced by <2%.

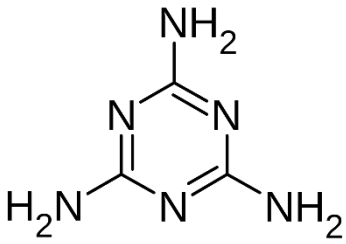
*"Study on flame retardancy and smoke suppression of PET by the synergy between $Fe_2O_3$ and new phosphorus containing silicone flame retardant", Y. Peng et al., High Performance Polymers, April 2020 https://doi.org/10.1177/0954008320914365*

## Tannic acid as reactive intumescent PIN FR

**Tannic acid is found in tree bark and other plant materials and can be recovered from bio-based industry waste streams.** It was tested as a flame retardant additive in DGEBA epoxy at 0.1 – 8% (and neat epoxy), by mixing into the epoxy before hardening and curing. Loads of tannic acid <1% showed to reduce epoxy cross-linking, so reducing mechanical strength, whereas loads >1% increased cross-linking and strength. Mass loss calorimetry showed that the tannic acid did not reduce peak heat release rate, did not modify time to ignition and did not increase the mass of char produced, but did significantly increase char volume. It also reduced the propensity of the resin to crystallise before

hardening, e.g. in storage. The authors conclude that tannic acid can be an effective, reactive intumescent in epoxy and that this depends on the tannic acid molecule's functional external phenol and internal d-glucose and phenol groups.

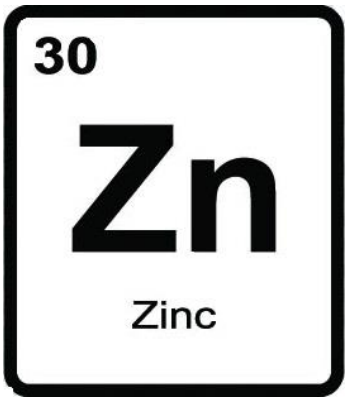
*"Tannic acid-based prepolymer systems for enhanced intumescence in epoxy thermosets", M. Korey et al., Green Materials 2020 https://doi.org/10.1680/jgrma.19.00061*



## New melamine phosphate PIN FR

**A melamine salt of pentaerythritol phosphate showed to be an effective PIN FR in polypropylene, with less toxic fire gases than neat PP**. Phosphoric acid, pentaerythritol and melamine were reacted at 4:1:3 ratio, then extruder mixed into polypropylene at 0 – 25%. With 20% loading UL94-V0 (4 mm) was achieved, LOI was increased by 72%, peak heat release rate was reduced by 82% and toxicity of combustion gases (FED: fractional effective dose) was reduced by 39% (compared to neat PP). The fire performance tests were repeated after one year, with the same results, showing that the PIN FR is stable in the PP compound.

*"Combustion toxicity of polypropylene containing melamine salt of pentaerythritol phosphate with high efficiency and stable flame retardancy performance", G. Makhlouf et al., Process Safety and Environmental Protection (2020), https://doi.org/10.1016/j.psep.2020.04.012*

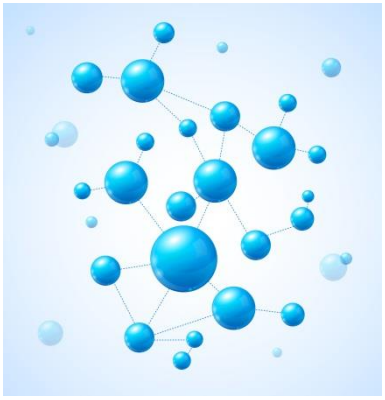



## Zinc – wood nanocrystals

**Zinc oxide coated cellulose nanocrystals, sourced from wood, were tested in 4mm HDPE sheets**. Zinc oxide is widely used in for example sunscreens. The zinc oxide (50%) – cellulose (50%) nanoparticles were ground to a particle size < 44 µm, then screw extruded into HDPE (high density polyethylene). At 0.6% loading, peak heat release rate was reduced by 17%, total smoke release was reduced by 6% and mechanical properties (elasticity, strength) were marginally improved (compared to neat HDPE). However, at 1% loading fire and mechanical performance were not as good as at 0.6%: the authors suggest that this is because of uneven dispersion during processing. The Montana State University has been granted a NIST grant of US$ 220 000 for further work.

*"MSU researcher advancing ways to make fire-resistant plastics using wood product", 4th March 2020 https://www.montana.edu/news/19676/msu-researcher-advancing-ways-to-make-fire-resistant-plastics-using-wood-product*

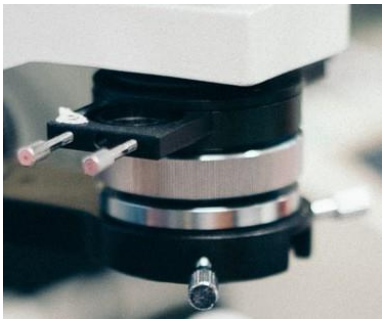
*"Functionalized Cellulose Nanocrystals: A Potential Fire Retardant for Polymer Composites", Polymers 2019, 11, 1361, https://doi.org/10.3390/polym11081361*



## PIN FRs in recycled plant waste insulation

**Mineral PIN FRs prove effective to improve fire safety of insulation boards made from non-reusable plant fibre wastes**. Sodium carbonate decahydroxide [$Na_2CO_3.10H_2O$] and alumina trihydroxide [$Al_2O.3H_2O$] were tested as PIN FRs, at 0 – 30% loading, in thermal insulation boards made from flax+cotton or flax+wood shavings (with 10 – 30 % phenol formaldehyde PF or urea formaldehyde UF binder). The boards where then tested according to Russia 53292-2009 fire standard. These loadings of the PIN FRs reduced mass loss in the fire test by 30 – 65%, depending on the FR loading and the fibre/binder combination. The aluminium PIN FR at 30% loading achieved the "G1" slightly combustible classification (criteria include mass damage <20%, self-burning zero seconds) with UF binder, or G2 (self-burning 30s) with PF binder.

*"Use of Mineral Flame Retardants to Reduce the Combustibility of Thermal Insulating Board Composites from Plant Waste", IOP Conf. Series: Earth and Environmental Science 459 (2020) 062115*
*https://doi.org/10.1088/1755-1315/459/6/062115*



## Mineral and bio-based FRs for PU foam

**Layer-by-layer Laponite, alginate and chitosan achieved self-extinguishing and halved smoke production from flexible polyurethane foam**. Researchers first activated 25mm thick foam samples in polyacrylic acid, then soaked for five minutes consecutively in aqueous solutions of branched polyethyleneimine, chitosan, sodium alginate and laponite (a synthetic magnesium, lithium, sodium silicate clay). Nine four-stage soakings (nine quad-layers) resulted in a 46% weight increase of the foam and (in cone calorimeter) a 74% reduction in peak heat release rate and a > 50% reduction in smoke release rate, and inhibited melt dripping and enabled self-extinguishing in an open flame test. Impacts on the foam mechanical performance and durability of the treatment were not tested.

*"Laponite-based inorganic-organic hybrid coating to reduce fire risk of flexible polyurethane foams", H. Nabipour et al., Applied Clay Science 189 (2020) 105525 https://doi.org/10.1016/j.clay.2020.105525*

# PUBLISHER INFORMATION:

This Newsletter is published for the interest of user industries, stakeholders and the public by pinfa (Phosphorus Inorganic and Nitrogen Flame Retardants Association), a sector group of Cefic (European Chemical Industry federation) www.pinfa.org. The content is accurate to the best of our knowledge, but is provided for information only and constitutes neither a technical recommendation nor an official position of pinfa, Cefic or pinfa member companies.

For abbreviations see: www.pinfa.org

pinfa, rue Belliard 40, B-1040 Brussels, Belgium
pinfa@cefic.be www.pinfa.org
@pinfa_eu