pinfa
Phosphorus, Inorganic & Nitrogen Flame Retardants Association

Your newsletter for non-halogen fire safety solutions
No. 84 October 2017

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Technical Workshop
A unique opportunity to meet the Spanish polymer industry and European experts in plastics fire safety.
Speakers from Budenheim, Tolsa, Clariant, A Schulman, Dupont, Catalonia Fire Brigade, CREPIM (smoke toxicity research France), standards experts (AFITI, CTA), AIMPLAS, Materia Nova France, Avanzare, OELs …

PLASTICS AND FIRE
Flame retardants for thermoplastics and thermosets
Valencia Spain, 14-15 November
Organised by pinfa and AIMPLAS

AIMPLAS INSTITUTO TECNOLÓGICO DEL PLÁSTICO

The enquiry into the tragic fire in Grenfell Tower, London, which killed at least 80 people is still ongoing (see pinfa Newsletter n°81). pinfa shares the grief of all those impacted by this tragedy and their families. Regulators are already reacting to reconsider fire safety in buildings, both at the national and EU levels (see below). More buildings are being examined to identify others which may be at risk because of use of inappropriately flammable materials in façade claddings and insulation. Calls are made to update fire safety regulations, especially for tall buildings, to better account for modern materials and insulation requirements (energy efficiency), as well as for enforcement of regulations and education of all concerned parties: architects, housing managers, contractors. Calls are also made for improved fire testing of cladding materials, including smoke emissions and smoke toxicity. The EU Construction Products Regulation, currently subject to consultation regarding its revision, extension or abandon, should provide a basis for this and pinfa supports its reinforcement. The European Commission has announced the launch of a "Fire Information Exchange Platform" to improve information exchange between Member States and stakeholders. pinfa will provide input on how to reduce the fire risks of foams and polymers used in construction and in consumer products in our homes, and how to reduce the danger of smoke to occupants and to fire fighters. We underline that this is only part of the action necessary, alongside maintained smoke alarms and sprinkles, fire safety engineering of buildings, use of fire barriers and importantly regulatory reinforcement, maintenance and education.

pinfa, Avenue E. Van Nieuwenhuyse 4, 1160 Brussels, Belgium
pinfa@cefic.be Phone +32 2 676 74 36 www.pinfa.org
@pinfa_eu

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EU Commission statement on fire safety

The European Commissioner for Industry, Elżbieta Bieńkowska, made a statement on fire safety in buildings to the European Parliament on 13th September, following the Grenfell Tower fire London. She underlined the importance of enforcement of fire safety regulations at the national, regional and local levels and that subsidiarity allows each Member State to decide to what extent flammable materials are authorised in different applications in construction, with common testing methods for products being fixed by the Construction Products Regulation. She underlined the emerging issues of smoke toxicity from construction products and fire performance of facades. Political Groups and members of the European Parliament responded in a 25 minute debate online. Many speakers underlined fire smoke toxicity, including suggesting product labelling with information about smoke emissions, and mentioning firefighter cancer risks. Many also spoke of the need for tighter regulation and better fire testing of façade materials. Speakers noted that there are 5 000 fire incidents per day in Europe, suggesting that most fire deaths are caused by smoke, that risks are accentuated by increasing use of flammable insulation materials, that fire statistics are inadequate, and that new materials which can slow fire spread and reduce smoke emissions should be investigated. The European Commission announced the launch of a "Fire Information Exchange Platform", on 16th October in Brussels, bringing together national authorities and stakeholders to discuss fire safety practices, new products and technologies and fire engineering principles.

European Commission statement on "Fire safety in buildings"
https://ec.europa.eu/commission/commissioners/2014-2019/bienkowska/announcements/fire-safety-buildings_en and European Parliament debate 13th September 2017 (25 mins.)
http://www.europarl.europa.eu/plenary/EN/vod.html?mode=unit&vodLanguage=EN&vodId=1505313499921#

French Government announces tighter fire safety

Following the London Grenfell tower fire, the French Government ordered an initial report into fire safety in housing buildings. Based on this report's initial conclusions, the Government has recognised the need to reinforce fire safety regulations in French buildings, in particular those undergoing renovations, and has announced that regulatory changes will be engaged rapidly. Also, a further report has been mandated to identify buildings with thermal insulation materials similar to those on Grenfell tower. The 40-page initial report for the French Government, by the national construction technical body (CSTB), underlined the need to reinforce the fire safety requirements for buildings. The report summarises the current organisation of construction fire safety requirements in France, covering both tall (>50m) and other buildings, new and existing buildings, fire prevention, detection and evacuation, renovation, policing of implementation, legal responsibilities of owners and occupants. The report conclusions note: an absence of fire safety regulations concerning renovation of non-tall buildings; the need to review fire safety requirements for buildings of families 3 and 4 (collective housing of >4 stories, <50m height); issues with complexity and overlapping of regulatory and voluntary requirements. The regulatory review should in particular address smouldering fires, smoke emissions, durability of fire performance over time.

The French report makes nine recommendations:

- Overall revision of French fire safety regulation and standards (Arrêté 31/1/1986) for housing, including tightening control regimes
- Clarify regulations for buildings with mixed uses (housing and other occupations)
- Develop fire safety regulations for building renovation
- Reinforce fire safety requirements for building façades
- Facilitate the authorisation of innovative fire safety solutions not covered by existing regulation
- Abandon the French building material fire classification system and use only the EU system (Construction Products Regulation)
- Oblige fire safety audits of all buildings of family 4 (28-50m high)
- Reinforce education of the public on building fire safety
- Develop technical knowledge necessary to accompany tighter fire safety regulation, including fire modelling, smouldering fires, safety of use of wood in high buildings, durability of fire safety performance, risk of smoke explosion in modern air-sealed buildings, smoke toxicity.

"Le Centre Scientifique et Technique du Bâtiment a remis son rapport au ministre Jacques Mézard", French Government press release 17th July 2017 http://www.cohesion-territoires.gouv.fr/IMG/pdf/17.07.2017_-_cp_suite_incendie_tour_grenfell.pdf and "Evaluation de la réglementation sécurité incendie en habitation", CSTB (French scientific and technical centre for construction) report, 29th June 2017, refs. AI-550-170001, 40 pages http://www.cstb.fr/assets/documents/rapport-mission-securite-incendie-fr-300617.pdf

UK drops plans to relax school fire safety

Following the Grenfell Tower fire, the UK government is said to have abandoned plans to deregulate school fire safety requirements in order to save costs, which had been submitted to consultation last year (Draft Guidance on Fire Safety in Schools). Savings envisaged included not requiring sprinklers in new school buildings, which the government had claimed would add 2 to 6% to building costs. Today only a third of new UK schools are fitted with sprinklers. The government is today quoted as saying "what we do will be a strengthening of fire safety requirements, not weakening any of them"

"Ministers in abrupt U-turn over fire safety in schools", The Guardian, 24 June 2017 https://www.theguardian.com/uk-news/2017/jun/24/government-u-turn-over-fire-safety-controls-for-new-schools

First lessons from Grenfell Tower fire

Following the tragic London Grenfell Tower fire of June 14, in which at least 79 people died, actions are underway to try to prevent such a disaster happening again. In the UK, the government has announced an independent review of "the regulatory system around the design, construction and on-going management of buildings in relation to fire safety; related compliance and enforcement issues; and international regulation and experience in this area". External wall cladding materials for thermal insulation are one aspect which will be addressed alongside issues such as smoke detector and fire alarm installation and maintenance, fire escapes, verifications … Reports suggest that over 600 other buildings in the UK have the same combustible exterior wall cladding as Grenfell Tower. The 2014 FPRF (Fire Protection Research Foundation) has noted combustible cladding fires in Australia, Canada, China, France, Germany, Hungary, Japan, Russia, South Korea, the United Arab Emirates,

the U.K. Tests by BRE Global on panels thought to be the same as those on Grenfell Tower showed that although the polyethylene core was Cat.3 (highest) fire rated, the whole panels failed the assembled wall panel fire test BS 8414. BS 8414 is similar to NFPA 285 which is applicable in the USA since 1998. However the 2012 edition of the IBC (International Building Construction and Safety Code) allows skyscrapers to avoid NFPA 285 testing in some conditions. There is also a lack of standard vocabulary for panel assemblies. To address uncertainties, NFPA and FPRF are developing an online tool for regulation enforcers or building owners. The tool will help to determine the level of risk based on materials, building height and configuration and safety installations such as sprinklers. This aims to be available by end 2017. NFPA's President states that the Grenfell Tower fire, along with a number of other deadly recent fires, shows that the "global fire prevention and protection system is broken", despite the public belief that it still exists. He accuses outdated fire codes and standards, reducing safety standards to save money, inadequate enforcement, inadequate education around codes and standards and lack of public fire awareness. He further calls for a global "recommitment to a full system of fire prevention, protection and education". NFPA also underlines that the cost/benefit of fire regulations should not only consider possible building cost savings but also the "true cost" of deaths, burn injuries and fire fighter casualties.

"London Calling. Experts say the problems that led to the deadly Grenfell Tower fire in Great Britain may exist in thousands of buildings around the world." A. Verzoni, NFPA News (US National Fire Protection Association) Sept-Oct 2017 http://www.nfpa.org/news-and-research/publications/nfpa-journal/2017/september-october-2017/features/nfpa-285

European fire services recommend furniture standards

On request of a major international furniture producer ("first mover"), the Federation of European Union Fire Officer Associations (FEU) has carried out an expert assessment and published an opinion on test methods which the firefighters consider necessary to improve survivability of furniture fires. The report is based on statistics from Italy, Finland, the Netherlands, Romania, Spain, Sweden and the UK, but underlines the difficulties in comparing data. The firefighters underline that some 5 000 people die annually in home fires in the EU and suggests that this could be cut by one quarter by requiring furniture to be fire-safe. The FEU report covers upholstered furniture and mattresses, considers fire development, smoke, fire spread and survivability in practice, and recommends that resistance to ignition by both cigarette and match flame should be implemented rapidly, and resistance to a larger flame (crib 5) within a "realistic time frame". A table of recommended test methods is specified (page 12) for furniture and for mattresses: EN 1021-1, EN 1021-2, EN 5852, EN 571-1, EN 571-2, BS 6807. FEU recommends the use of alternative flame retardants, noting the ENFIRO conclusions (see pinfa Newsletter n° 36) that some PIN FRs offer fire performance with lower risk for health and the environment. FEU "accepts the use of flame retardants to increase the fire safety of upholstered furniture if they meet the requirements of REACH".

"Fire safety of upholstered furniture and mattresses in the domestic area, European fire services recommendations on test methods", FEU, May 2017 https://www.ifv.nl/kennisplein/Documents/20170501-FEU-Fire-safety-of-upholstered-furniture-and-mattresses-in-the-domestic-area.pdf

380 000 residential fires per year in the USA

The US Fire Administration has published four reports on residential fires 2013-2015, showing that some 380 000 home fires occurred annually, killing nearly 2700 civilians per year and injuring 12 000. Just over half of the fatalities occurred in bedrooms, with burns and smoke accounting for 90% of fatalities and 78% of injuries. Around 1/3 of fatalities were trying to escape and around 1/3 were asleep. Unintended / careless actions, smoking and electrical faults were the leading causes of fatal fires.

US Fire Administration https://www.usfa.fema.gov/data/statistics/reports.html#new Topical Fire Report Series, July 2017:
"Civilian Fire Fatalities in Residential Buildings (2013-2015)"
"Civilian Fire Injuries in Residential Buildings (2013-2015)"
"One- and Two-Family Residential Building Fires (2013-2015)"
"Multifamily Residential Building Fires (2013-2015)"

pinfa input to Construction Products consultation

pinfa submitted input to the European Commission's public consultation on possible modification or downgrade of the Construction Products Regulation (CPR). pinfa underlined that the CPR harmonisation enables architects, construction firms and regulators to access reliable and comparable information, driving the market towards improved fire safety, and that that the harmonised CPR classifications enable exchange of experience and learning between national and local regulators, supporting improvements in building fire safety regulations and their implementation. pinfa believes "that CPR has brought significant benefits in enabling fire safety and construction quality … any downgrade or repeal would be very negative both for fire safety and for EU industry … supports maintaining CPR and improving aspects of simplification and market surveillance … the EU should also continue to develop harmonised fire safety, smoke and sustainability standards to address the risks of modern constructions and the challenges of the circular economy."

EU consultation on Construction Products Regulation, (closed 18th July 2017) http://ec.europa.eu/info/law/better-regulation/initiatives/ares-2017-3070078_en – feedback is published online including pinfa's contribution at http://ec.europa.eu/info/law/better-regulation/initiatives/ares-2017-3070078/feedback/F2115_en

Fire-safe cigarettes may not be effective

A new study assesses implementation of legislation requiring fire-safe (low ignition propensity - LIP) cigarettes (see also pinfa Newsletter 56), looking at available statistics and studies on effectiveness in preventing fires and testing of such cigarettes as placed on the market. Available studies suggest a reduction in occurrence of fires and mortality ranging from -40% to zero. Tests on LIP cigarettes sold in the USA, in Sweden and elsewhere have all found little difference in actual ignition propensity. This study concludes overall that "claims regarding the effects of fire safe cigarettes may be premature".

"Are fire safe cigarettes actually fire safe? Evidence from changes in US state laws", C. Bonander et al., Injury Prevention 201, 0, 1–6. http://dx.doi.org/10.1136/injuryprev-2017-042322

Clariant PIN FR solution for external applications

Clariant's new nitrogen-based flame retardant for polyolefin offers both fire safety and UV protection for outdoor applications, in particular roofing. The very stable amino-ether based product can achieve DIN 4102-B2, EN 13501-1-E fire performance specifications in polyolefin thin section films and delivers an outstanding light and weather stability performance combined with a high transparency and resistance to chemicals. In addition, compared to traditional halogenated flame retardant systems, the PIN FR is efficient at lower concentrations. It has achieved the Clariant EcoTain® label for products offering outstanding sustainability advantages and have undergone a systematic, in-depth screening process using 36 criteria in all three sustainability dimensions: social, environmental and economic. Clariant provides a broad panel of specialist non-halogenated flame retardant and other performance additive solutions, including light stabilisers, processing additives, antioxidants, antistatic agents, to improve performance and durability of polymers used in sectors such as building and construction, transport, textiles, electrical and electronics.

"AddWorks® LXR 920 Aminoether HALS"
https://www.clariant.com/en/Solutions/Products/2015/04/23/11/40/AddWorks-LXR-920 and EcoTain https://www.clariant.com/ecotain

CEN launches standards work on chemicals in products

The European Standards organisation CEN has launched a project to develop a new CEN Guide to support standards work (CEN Technical Committees) on how to develop requirements in product standards which will contribute to minimise the use of hazardous chemicals, and so reduce health and environmental risks related to exposure to these chemicals. The project was initiated by the European Commission and is led by a team made up of the Austrian, Danish and Spanish national standards organisations and the NGO European Environmental Citizens' Organisation for Standardisation (ECOS). The project will include a multi-stakeholder expert panel and aims to deliver the CEN Guide and an implementation strategy for its uptake before end 2017.

"Guide on chemicals in products standards", European Committee for Standardization
http://www.cen.eu/work/areas/env/pages/guidechemicalsproducts.aspx

Legacy chemicals challenge for circular economy

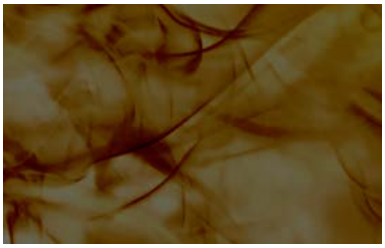
Responses to the European Commission consultation on the chemicals – product – waste interface show the challenges posed by legacy chemicals in plastics and textiles. Whereas the EU waste management industry FEAD argues that recycled products should in some cases be allowed to contain traces of SVHC (Substances of Very High Concern) legacy compounds, environmental NGOs (such as ChemTrust and ECOS) want these chemicals excluded from recycled materials. Both agree that legislation should prevent problematic chemicals being added to virgin materials. There is also disagreement as to whether EU End-of-Waste criteria are an appropriate tool to address this question.

"Stakeholder consultation paper chemical, product, waste interface", European Commission
http://ceoe-tenerife.com/wp-content/uploads/2017/05/2017-04-12-Instructions-stakeholder-consultation-Chemicals-products-wa....pdf

EPEAT mobile phone category targets halogens

The Green Electronics Council / US EPA programme EPEAT (Electronic Product Environmental Assessment Tool) has launched a new product category from mobile phones, which already includes devices from Apple, LG and Samsung. The criteria include points ($9.2.3) for low halogen content of the telephone device itself and also for its wires, cables and external power supply, defined as <900 ppm for both bromine and chlorine and <1500 for the total of both.

"Green Electronics Council Launches EPEAT Registry Mobile Phone Category", 31 July 2017 http://greenelectronicscouncil.org/green-electronics-council-launches-epeat-registry-mobile-phone-category/ EPEAT criteria for mobile phones http://www.epeat.net/resources/criteria-2/



Symposium on Advanced Fire Science and Technology

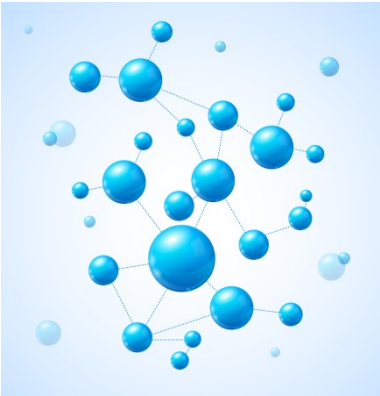
On July 19-20th, Case Western University (Cleveland, Ohio) hosted a symposium and workshop on "Advanced Fire Science and Technology", with twenty-five speakers representing academia, government and industry. Participants heard information concerning the latest fire science developments from organizations including North Carolina State University, University of Dayton Research Institute, Case Western Reserve University, Polyone, ICL-IP, W.L. Gore, Underwriter Laboratories, FM Global, U.S. Air Force, U.S. FAA, NIST and NASA. The second day was a workshop. This identified the need for the education of more MS and PhD students in fire safety engineering and material science and for a centre for continuing education for fire safety professionals including on-line education. Further discussion topics included modelling and simulation, new material process chemistry and fire test development.

For further information: Professor Hatsuo Ishida, Case Western Reserve University (Cleveland, Ohio, USA), hxi3@cwru.edu Article provided by Timothy Reilly, Clariant.

Low emission PIN FR for foams and biopolymers

pinfa member Lanxess has developed an innovative PIN flame retardant, based on phosphorus chemistry, with low emissions (losses of the flame retardant from the finished product, or fogging) and low contribution to foam discoloration (scorch). This new PIN FR can be used in flexible polyurethane foams (PUR, both polyether and polyester based), achieving VDA 278 (volatile organic carbons) and FOG (condensables) emissions standards. It contains no raw materials on the GADS (Global Automotive Declarable Substances List). The PIN FR can also be used in technical biopolymers, such as cellulose derivatives (e.g. CTA cellulose triacetate) in applications including LCD screens and electronics housings where UL94-V0 is required.

"LANXESS Launches Two Flame retardants for Biopolymers and more. Levagard TP LXS 51114 – low-emission flame retardant for flexible PU foams and biopolymers" https://lanxess.com/en/corporate/media/press-releases/2016-00050e/



PIN FRs for thermoplastic elastomers

Styrene – ethylene – butylene – styrene elastomers (TPE-S) are a challenge for flame retardancy because they burn without residue and with a very high heat release (PHR > 2000 kW/m^2). Aluminium diethylphosphinate (AlPi) alone is effective in flame inhibition but does not achieve UL94-HB (3mm). However, when combined with other PIN FR compounds, a total 30% PIN FR loading enable to achieve this standard, that is almost immediate self-extinguishing in a horizontal set-up. Using AlPi as the principal component with melamine polyphosphate and either titanium dioxide or boehmite synergist, LOI of up to 27%, UL94-HB and a reduction in peak heat release of 85% to below 300 kW/m^2 were achieved.

"Halogen-free fire retardant styrene–ethylene–butylene–styrene-based thermoplastic elastomers using synergistic aluminum diethylphosphinate–based combinations", K. Langfeld A. Sut, et al., J Fire Sciences 2015, 33(2) 157-177
http://dx.doi.org/10.1177/0734904114565581

Plant-based PIN FR for cotton

The natural compound phytic acid is widely present in plant materials, especially in seeds and grains, but is not digestible by non-ruminant animals such as pigs, poultry and humans. Phytic acid was reacted with urea to generate ammonium phytate. This was applied as a PIN flame retardant for woven cotton fabric (115 g/m^2) by two cycles of immersion for ten minutes in a water solution with dicyandiamide catalyst then pressing (padding), curing at 170°C, rinsing and drying. The catalyst enables grafting of the ammonium phytate into the cotton fibres through covalent bonding ("reactive"). This application increased the Limiting Oxygen Index (LOI) of the cotton fabric from 18% to 43% (30% after 30 laundry cycles, 25% after 50) and reduced vertical char length from 300 mm by 90%.

"A plant-based reactive ammonium phytate for use as a flame-retardant for cotton fabric", Y. Feng et al., Carbohydrate Polymers, 2017 http://dx.doi.org/doi:10.1016/j.carbpol.2017.06.129

Plant-based PIN FR for silk

Phytic acid (see above) was tested as a bio-based PIN flame retardant with titanium oxide nanoparticles as a synergist and BTCA (a polycarboxylic acid) for crosslinking, on silk crepe fabric (52 g/m^2). Application was by 2 x 10 minute immersion / padding, curing at 160°C, rinsing and drying. Peak heat release rate of the silk fabric was reduced by >50% and LOI (see above) increased from 25% to 37%. Issues noted are that the flame retardancy tends to be progressively lost with washing (not durable beyond 25-30 laundry cycles), yellowing of the silk and a small loss of softness.

"Improvement of flame retardancy of silk fabric by bio-based phytic acid, nano-TiO2, and polycarboxylic acid", X-W. Cheng et al., Progress in Organic Coatings 112 (2017) 18–26
http://dx.doi.org/10.1016/j.porgcoat.2017.06.025

Overview & update on bio-based PIN flame retardants

A 25-page review identifies different biomass compounds with potential as PIN flame retardant solutions, with high availability and appropriate properties, and summarises recent progress in developing bio-based PIN fire safety solutions. Compounds discussed are: cellulose (nature's most abundant polymer), hemicellulose (in plant cell walls), chitosan (nature's second most abundant polysaccharide, readily available in seafood wastes such as crustacean shells), other saccharides (starch, cyclodextrin, isosorbide, tea saponin, tartaric acid from wine production …), lignin and other bio-based aromatic compounds (phloroglucinol, levulinic acid, cardanol), DNA, proteins, phytic acid and vegetable oils (which can be reacted to produce polymers with or without flame retardant compounds). Many of these enhance flame retardancy by contributing to char formation; others such as DNA and phytic acid contain phosphorus and/or nitrogen. The authors conclude that the wide range of bio-compounds available offers considerable potential for the development of solutions adapted to different combinations with PIN flame retardant components, polymers and applications.

"Bio-based flame retardants: When nature meets fire protection", L. Costes et al., Materials Science and Engineering R 117 (2017) 1–25 http://dx.doi.org/10.1016/j.mser.2017.04.001

Natural molecules as PIN FRs for PE and PP

A PhD submission tests different bio sourced molecules as FRs or polypropylene (PP) and polyethylene (PE), including tannic acid, ammonium or sodium alginate (derived from seaweed), fish gelatin, carrageenan, in combinations or with PIN flame retardants. Issues noted included water uptake by biomolecules, foaming it in the processing and deterioration of polymer properties. However, fish gelatin, with sorbitol and/or tannic acid enabled UL94-V0 in PP and ignition retarding of LDPE.

"Using nature as a way to flame retard synthetic materials", T. Deans, PhD submission, Case Western Reserve University, May 2017
http://rave.ohiolink.edu/etdc/view?acc_num=case149154227971565

Bio-molecules as PIN FRs for textiles

A PhD thesis, Politecnico di Torino, assesses a number of bio-based molecules as PIN FRs for cotton: whey proteins / caseins, chitosan, DNA / nucleic acids recovered from agri-food wastes. Extraction methods to recover these useful molecules from agri-food by-products were developed. Application to cotton fabrics by both aqueous impregnation and layer-by-layer were tested, as well as UV curing to improve durability in laundering. Synergies were demonstrated between nucleic acids and chitosan and between nucleic acids and caseins. The author notes that layer-by-layer application (resulting in a number of very thin, alternating, layers of different biomolecules) gives better fire performance but is not today developed at an industrial scale. Nucleic acids offer high PIN FR potential and the work carried out shows that industrial extraction from bio-wastes could provide a feasible and economic source.

"Biomacromolecules: A sustainable approach for the design of fire retardants for textiles", A. Casale, PhD thesis, Politecnico di Torino, May 2017
http://dx.doi.org/10.6092/polito/porto/2673802

Nucleic acid PIN FRs from agri-food wastes

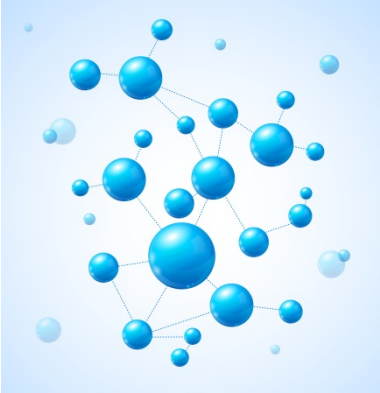
Extraction methods were developed to recover nucleic acids from two different agri-food industry wastes: spent brewers' yeast and vegetable scraps. These nucleic acids were then tested as bio-sourced PIN flame retardants for cotton fabrics (200 g/m^2). A "simple, cheap and green" extraction was achieved using a combination of freezing and milling for lysis of cells to release nucleic acids, with or without detergents, followed by recovery in solvents or in sodium phosphate solution (the latter was not used because it brought an inherent flame retardancy effect due to the phosphorus content, so perturbing this study method), then centrifuging and finally ethanol precipitation. The nucleic acids from brewers' yeast showed better fire performance (probably because the vegetable wastes were less homogeneous) achieving self-extinction of the cotton fabric at 8% weight add-on and with quality comparable to commercial nucleic acids.

"Nucleic acids from agro-industrial wastes: A green recovery method for fire retardant applications", F. Bosco et al., Industrial Crops & Products 108 (2017) 208–218
http://dx.doi.org/10.1016/j.indcrop.2017.06.035

PIN FR polycarbonate - ABS for rail applications

REHAU, a global polymer engineering company, started in 1951 in Bavaria, Germany, offers a range of PIN flame retardant performance products for railway and metro applications. Products, conform to German "halogen-free" standards VDE 0472 part 815 and VDE 0482 part 267/1 ensure that in the case of fire property is better protected because corrosive gases are not released and acids are not formed with fire-extinguishing water. REHAU's PIN flame retardant range of products for mass transit applications includes cable trunking and live-rail electrical safety protection covers, load bearing live rail supports.

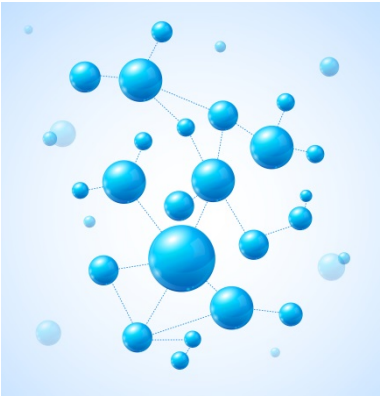
"LEH halogen-free trunking – Prevention is better!" https://www.rehau.com/gb-en/building-technology/cable-trunking-systems/fire-protection-halogen-free/leh-halogen/leh-halogen-free-trunking/790350



Novel PIN FR for flexible polyurethane foam

The authors indicate that flexible polyurethane foam (FPUF) is highly flammable with a LOI (limiting oxygen index) as low as 18%, catching fire easily and spreading fire. They present synthesis and testing of a novel PIN fire safety solution for FPUF, alternative to conventional chlorinated FRs. A melamine phosphorus compound, DPPMA, was synthesised by reacting melamine with diphenyl phosphonic acid (DPPA) in ethanol and water at 90°C for six hours, filtration and drying. This was then added into polyether polyols (GEP-560s), catalysts and surfactant to produce PIN FR-FPUF with 30% DPPMA loading. LOI was increased from 21% to 25% (30% DPPMA) and just 5% DPPMA rendered the FPUF self-extinguishing in CAL TB117-2000 vertical test. The authors conclude that DPPMA provides a potentially high performance fire safety solution for flexible polyurethane foam, acting mainly in the vapour phase.

"Flame retardant flexible polyurethane foams with highly efficient melamine salt", W-H. Rao et al., Ind. Eng. Chem. Res. (I&EC) 2017, 56 (25), pp 7112–7119
http://dx.doi.org/10.1021/acs.iecr.7b01335



PIN FR solution for expanded polystyrene foams

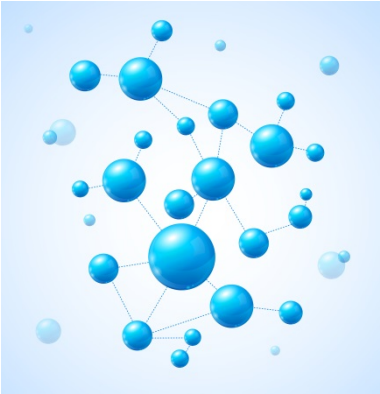
Novel phosphorus nitrogen silicon PIN flame retardants were synthesised by a flexible sol-gel method, then applied by coating to polystyrene beads (0.7-1.1 mm) prior to expansion to form expanded polystyrene foam (EPS) boards. The three FRs were poly-N-β-(aminoethyl)-γ-aminopropyltrimethoxysilanes (P-NMTS) and this polymer reacted with phosphoric or phosphorous acid. P-NTMS does not enable UL94 rating whereas phosphorus P-NMTS achieves UL94-V0 at 40% loading with LOI increased from 17% (neat EPS) to 27%. The authors conclude that phosphorus-P-NTMS, a phosphorus nitrogen silicon PIN FR can considerably improve fire safety of polystyrene foam by increasing char production (up to 49% residue).

"Highly Flame Retardant Expanded Polystyrene Foams from Phosphorus−Nitrogen−Silicon Synergistic Adhesives", Z-M. Zhu et al., Ind. Eng. Chem. Res. (I&EC), 2017, 56 (16), pp 4649–4658 http://dx.doi.org/10.1021/acs.iecr.6b05065

Halco flame retardant fastening tape for Boeing 737 Max

Global hook and loop fastening system supplier will provide recloseable self-fastening tapes for seating in Boeing's new 737 Max aircraft. The polyamide tape uses non-halogenated flame retardants to achieve demanding fire safety, self-extinguishing and low smoke, low smoke corrosivity, low smoke toxicity standards required in aviation interiors, meeting FMVSS 302 and FAR 25.853 (vertical burn), and California TB 117 specifications. The tape is temperature resistant to 356°C and offers hook/loop sheer strength of over 20 lbs.

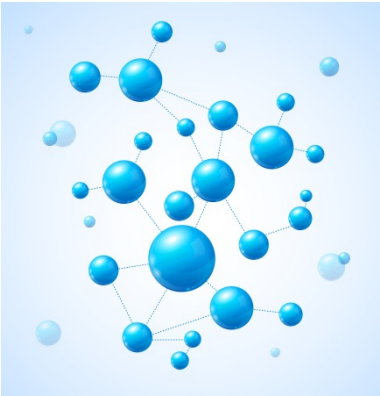
"Halco USA to Supply Hook & Loop for Boeing 737 Seating", 30 Jan. 2017 http://www.prweb.com/releases/2017/01/prweb14014991.htm and http://www.halcousa.com/products/flame-retardant/#



Phosphorus silica PIN flame retardants for PBT

Silica micropearls (several nm diameter) were surface modified with three different phosphorus compounds (phosphoric acid, dihydrogen ammonium phosphate and diammonium phosphate) by reacting in ethanol with treatment agents. 10% of neat modified silica was tested in PBT (polybutylene terephthalate) polymer. The three phosphorus modified silica is showed high effectiveness as flame retardants in PBT, reducing peak heat release by up to 60% and also increasing time to ignition, due to char generation and bubbling of PBT in melting, so limiting heat transfer. The authors conclude that the synergy of phosphorus and silica can be effective in flame retarding the performance engineering plastic PBT, because the silica slows down polymer decomposition as well as favouring char formation.

"Effect of phosphorous-modified silica on the flame retardancy of polybutylene terephthalate based nanocomposites", J. Courtat et al., Polymer Degradation and Stability 143 (2017) 74e84 http://dx.doi.org/10.1016/j.polymdegradstab.2017.06.014



Aluminium hypophosphite PIN FR for LDPE

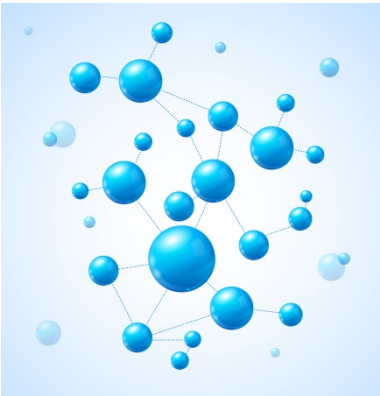
Low density polyethylene (LDPE) is widely used industry, construction, electronics, furniture and elsewhere because of its low weight, low toxicity, electrical insulation and performance, but is highly flammable. Aluminium hypophosphite (AHP) was tested as a flame retardant at 30-60 phr (parts per hundred resin) showing improvement of limiting oxygen index (LOI) from 19% in neat LDPE to 27.5% and achieving UL 94-V0 (4 mm) at 50 phr. FTIR (Fourier transform infrared spectrometry) showed that AHP reduces the content of olefins (and so of combustible gases) in fire gases. The aluminium and > 96% of the phosphorus remain in the char, which is compact and includes P-O-C bonds which improve its thermal stability.

"Study of using aluminum hypophosphite as a flame retardant for -density polyethylene", S. Tian et al., Fire and Materials. 2017;1–10, http://dx.doi.org/10.1002/fam.2443

PIN FR coating for furniture textiles

A blend furniture fibre (polyester-microfilament-fibran-wool) was thin-layer treated by immersion in water disbursed combinations of ammonium polyphosphate (APP), TMSD, graphite powder, titanium dioxide (average 20 nm) and commercial binder. LOI (limiting oxygen index) was increased from 18 to nearly 25, with the highest LOI and lowest Burn rate (zero vs. 118 mm/min for untreated textile) being achieved with the highest APP low (2-5%). TiO_2 deteriorated LOI and increased burning rate. Mechanical and hydrophobic properties of the textile were improved by treatment.

"Synthesis of smart coating for furniture textile and their flammability and hydrophobic properties", N. Attia & N.Mousa, Progress in Organic Coatings 110 (2017) 204–209 Http://dx.doi.org/10.1016/j.porgcoat.2017.04.035



Silicone resin polymer for PIN PUR foam

Several silicone resins were synthesised from silanes, then coated / polymerised onto polyurethane (PUR) foams by immersion in xylene-dispersed silicone resin with polyetheramine cross-linking agent then curing, with c. 5% silicone resin loading on the PUR foam. Peak heat release was reduced from over 190 (neat foam) to just over 60 kW/m^2 and LOI nearly doubled from 15 to 29 %. Analysis shows that the silicone polymer transforms into a self-extinguishing silica char barrier in fire. The authors suggest that this approach could provide new and effective PIN solutions for improving both fire and mechanical performances of foams.

"A novel and facile strategy for highly flame retardant polymer foam composite materials: Transforming silicone resin coating into silica self-extinguishing layer", Q. Wu et al., Journal of Hazardous Materials 336 (2017) 222–231 http://dx.doi.org/10.1016/j.jhazmat.2017.04.062

Other News

Replacements for legacy brominated FRs: A literature and data base screening carried out for the Swedish Environmental Protection Agency assesses FRs used as alternatives to the legacy brominated FRs PBDEs, HBCD and TBBPA. 66 studies on alternative FRs in dust, the environment, biota and humans, and data on use and exposure for FR are considered. Ten alternative FRs are identified as priorities for screening: seven halogenated FRs TBBPA-BDBPE, DBDPE, BTBPE, TTBNPP, BEH-TEBP, EBTEBPI, TCIPP, and three phosphorus esters PBDPP = Resorcinol bis(diphenyl phosphate), para-TMPP = tritolyl phosphates, TPHP = triphenyl phosphate.

"Replacement substances for the brominated flame retardants PBDE, HBCDD, and TBBPA", J. Gustavsson et al., report for Naturvårdsverket, n° NV-08295-16, 21st June 2017
http://www.diva-portal.org/smash/get/diva2:1133654/FULLTEXT01.pdf

Endocrine disruptors: a study based on "probabilities of causation" of possible health effects (i.e. probability modelling), based on estimates by expert panels organised by the Endocrine Society, suggest that endocrine disruptor chemicals cause 1.3% of PNB in health damage and costs in Europe and 2.3% in the USA. The studies suggest that the biggest economic loss in the USA is from IQ points loss and intellectual disability estimated to be caused in children by the PBDE brominated FRs. However, a detailed 18-page critical review of suggests that the approach taken had "substantial flaws", including self-selection of the panels of experts whose estimates were used and assumption of causal relationships between exposure and supposed health impacts not established by underlying scientific studies.

"Exposure to endocrine-disrupting chemicals in the USA: a population-based disease burden and cost analysis", T. Attina et al., Lancet Diabetes Endocrinol 2016
http://dx.doi.org/10.1016/S2213-8587(16)30275-3

"Human cost burden of exposure to endocrine disrupting chemicals. A critical review", G. Bond & D. Dietrich, Arch Toxicol 2017 http://dx.doi.org/10.1007/s00204-017-1985-y

Human bio-monitoring network: the 5-year, 74 million €, EU funded project HBM4EU (European human bio-monitoring initiative) aims to bring together scientists, stakeholders and policy makers to define the direction of human bio-monitoring initiatives, to generate data to input to policy making and to better understand exposure – response relationships. The project will collaborate with the newly established Cefic taskforce on human bio-monitoring. A first list of nine priority families of chemicals for bio-monitoring communicated by the project includes "flame retardants", as well as "chemical mixtures and emerging chemicals (to be defined).

European Human Biomonitoring Initiative HBM4EU
https://ec.europa.eu/research/conferences/2016/hbm4eu/index.cfm

Phosphate ester FR metabolites in urine: a study by Carignan et al. (Harvard) has obtained media coverage, with media such as SpecialChem or The Telegraph UK suggesting links between FRs and infertility. The study in fact analysed five phosphate ester metabolites in urine of 211 women undergoing ART (Assisted Reproductive Technology) in Massachusetts. Three of the five metabolites (DPHP, BDCIPP and ip-PPP (metabolites of TPHP, RDCIPP and mono-ITP) were found in 80%+ of urine samples (the others in less than 15%) and only two of the metabolites were correlated to lower IVF (In vitro fertilisation) outcomes (DPHP and ip-PPP).

"Urinary Concentrations of Organophosphate Flame Retardant Metabolites and Pregnancy Outcomes among Women Undergoing in Vitro Fertilization", C. Carignan et al., Environmental Health Perspectives 2017 https://doi.org/10.1289/EHP1021

Organophosphorus FRs in sewage treatment plants: 14 organophosphorus FRs and plasticisers and two diester metabolites were analysed in warm sewage works (New York State). All were detected, at concentrations 0.02-30 µg/litre in influent, 0.008 µg/l in treated effluent and 0.004-7 µg/g dw in sewage sludge. Sorption to sewage particulate matter varied from <2% space to >56% (the latter for TMPP tricresyl phosphate). The three chlorinated organophosphorus FRs showed the lowest (negative) removal efficiency whereas some of the organophosphorus FRs hydrolyse rapidly in wastewater treatment and further research is needed into the fate of their metabolites.

"Occurrence, Removal and Environmental Emission of Organophosphate Flame Retardants/Plasticizers in a Wastewater Treatment Plant in New York State, USA", U-J. Kim et al., Environ. Sci. Technol., 2017, 51 (14), pp 7872–7880
http://dx.doi.org/10.1021/acs.est.7b02035

Maine bans "all FRs" in home furniture: the US state of Maine has passed a bill (LD182) aiming to "protect fire fighters" which bans the sale of domestic furniture containing in its materials >0.1% of any flame retardant chemical, despite the State Governor's attempt to veto the Bill as not supported by science and preventing innovative alternatives. The Bill concerns any chemical for which a "functional use is to resist or inhibit the spread of fire", so potentially banning also inherently fire resistant materials. Industry has underlined that this will ban chemicals which are inert or recognised as safe. A similar bill is also being considered by the city of San Francisco (170867) proposing to ban all "added" flame retardants in furniture and children's products.

"Maine bans all flame retardants in upholstered furniture", Chemical Watch 3/8/2017
https://chemicalwatch.com/58037/maine-bans-all-flame-retardants-in-upholstered-furniture

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For abbreviations see: www.pinfa.org