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pinfa Advisory Board

Fourteenth Meeting

Thursday 22nd June 2023
10:45 – 13:00 CET
HYBRID

pinfa

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Contents of this report

pinfa Advisory Board meeting participants

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Ginevra Sponzilli, *Assistant moderator, Harwood Levitt Consulting*

The pinfa Advisory Board meetings

Purpose of the pinfa Advisory Board meetings

pinfa is the Phosphorus, Inorganic and Nitrogen Flame Retardants Association, a sector Group of Cefic, the European Chemical Industry Council. We represent the manufacturers and downstream users of non-halogenated phosphorus, inorganic and nitrogen flame retardants (PIN FRs).

United by a commitment to improve the environmental, health, and safety profiles of FR products, we constantly seek to foster dialogue between the FR and the fire safety and the environmental fields. Bringing together a diverse group of stakeholders, including FR manufacturers and downstream users, academics, and experts from testing and research institutes, our Advisory Board meetings provide a venue for engaging with world-leading experts in these areas, and share ideas and activities.

The meetings of the Advisory Board take place on a biannual basis. They do not have fixed participation, and attendees are encouraged to extend the invitation to relevant stakeholders. This report captures only the content of the last Advisory Board meeting held on 22 June 2023. Previous meeting reports can be found compiled here, or individually listed in an online library here.

Competition, compliance and confidentiality

The meetings of the Advisory Board are held in strict compliance with EU and international antitrust laws, as well as Cefic dos and don'ts.

The meetings of the Advisory Board follow the Chatham House Rule, whereby attendance and the contents of the discussions are reported, but the affiliation of each individual speaker is not revealed.

The European Chemicals Agency Regulatory Strategy on Flame Retardants

The focus of the first session was to analyse the European Chemicals Agency (ECHA) Regulatory Strategy on Flame Retardants announced in March 2023 as part of the Restrictions Roadmap for harmful substances under the EU's Chemicals Strategy for Sustainability. The presentation was led by Adrian Beard, Chairman of pinfa, and was followed by a discussion.

Background

In October 2020, the European Commission published its Chemicals Strategy for Sustainability (CSS) to bring about a toxic-free environment and to protect people and the environment from hazardous substances. In order to speed up the decision-making process, the CSS moves away from evaluating chemicals on a substance-by-substance basis towards a grouping approach to substances registered under REACH.

The Restrictions Roadmap, published in April 2022 under the CSS, proposed a 'rolling list' of substances that are prioritised for restriction based on a grouping approach. The document references a number of chemicals and substances, including flame retardants such as phosphate esters (i.e., compounds like TCPP or TCPD).

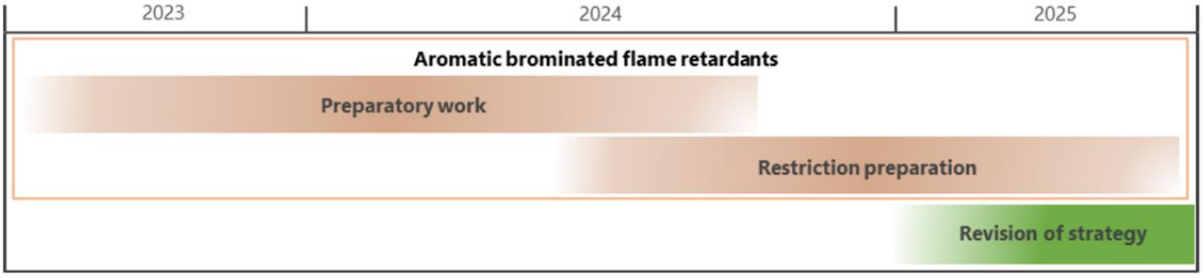
The Restrictions Roadmap prompted ECHA to draft a document known as the Regulatory Strategy on Flame Retardants. The strategy identifies flame retardants, their potential hazards, and information gaps with the aim of avoiding ineffective or regrettable substitution through grouping. The document also covers ECHA's assessment of regulatory needs for halogenated (including brominated) and phosphate esters flame retardants, which make up approximately 70% of the organic flame retardants market.

ECHA's Regulatory Strategy on Flame Retardants: Key findings

In its strategy, ECHA claimed that a wide and generic restriction seems to be the most appropriate regulatory approach for aromatic brominated flame retardants. While this does not mean immediate restrictions or limitations to their use, it prompts the need to prepare an adequate industry response as the legislative future may foresee a ban on these types of substances.

For aliphatic brominated and the organophosphorus flame retardants, ECHA concluded that the scoping of a further restriction should await the ongoing data generation. This information is expected to be able from 2024 onwards and thus, any potential process for restriction is not expected to be initiated before 2025. This would provide the opportunity to reassess the situation for these groups of flame retardants in 2025 and revise the strategy accordingly. Nevertheless, for two reactive aromatic brominated flame retardants (BMP and TBNPA), a restriction targeting professional uses could already be considered.

Preparatory timeline for aromatic brominated flame retardants (source: ECHA FR Strategy)



For the substance groups to prioritise from 2025, there is a need to focus on the ones with a 'worst hazard' property (i.e., cumulative, toxic properties or carcinogenic, mutagenic and reprotoxic properties).

In this context, the strategy also explores the possibility of waste and recycling management of these substances. In particular, the concern raised is what happens at the wastage level with certain flame retardants – are they released in the environment? Do they form degradation products that can be harmful? Do the polymers survive as such, and are also able to be recycled in recycling operations? In these lifecycle stages, brominated polymers may break down.

Lastly, ECHA concluded there is currently no need for regulatory action for several subgroups of the organophosphorus flame retardants due to no or likely low hazard properties. For chlorinated flame retardants, in particular, no additional action is required because regulatory measures are either already in place or being initiated.

Phosphorus in organic and nitrogen flame retardants

Summary of the assessments of regulatory needs for organophosphorus flame retardants

Group/sub-group	No. FR	Immediate next action and hazard endpoints
Triphenylphosphate derivatives	18	CCH and SEV Repro. and ED
Trialkyl phosphates	10	CCH and potentially SEV for ED
Chlorinated trialkyl phosphates	11	Pending data for Carc.
Non-cyclic alkyl aryl esters of phosphoric acid	8	No action, Carc. 2 and unlikely hazard for mutagenicity and skin sensitisation
Alkyl (<C8) diesters of hydrogenphosphonates and alkyl(<C8)phosphonates	13	CLH proposal (IE) for CCH Repro., Muta. And neurotox
Alkyl esters of alkyl(C≥C8)phosphonates	5	CCH for PBT/vPvB
Other hydrogenphosphonates and alkyl phosphonates, their salts and esters	29	CCH unlikely hazard
Dibenzo oxaphosphorine oxide derivatives	11	Skin sensitisers No further action
Tetrakishydroxymethyl phosphonium salts and their condensation products with amines	7	Skin sensitisers CCH Carc. Repro. STOT RE (liver) (1) Then CLH, Restriction entry 72 (REACH Annex XVII) and restriction proposal on skin sensitisers in textiles, leather, and fur and hide articles
Ethoxylated alcohol phosphates	1	CCH and potentially SEV for ED
Hydrocarbyl phosphinates	8	Generally of low hazard potential. CCH for Diethylphophinates to clarify potential vPvM properties

Based on the above table, groups of low or unlikely hazards can be identified as:

- Other hydrogenphosphonates and alkyl phosphonates, their salts and esters Dibenzo oxaphosphorine oxide derivatives (DOPO derivatives)
- Hydrocarbyl phosphinates

For phosphourus, it is a varied situation. Inorganic phosphates, polyphosphates, phosphinates, phosphonates, and phosphorous and its inorganic salts have been assessed with low hazard thus requiring no further EU regulatory risk management.

However, there are a number of queries that producers must help resolve by providing the correct data. While producers have a considerable amount of informational studies on their products, they do not have all-encompassing data because it is not mandatory to test for each and every endpoint.

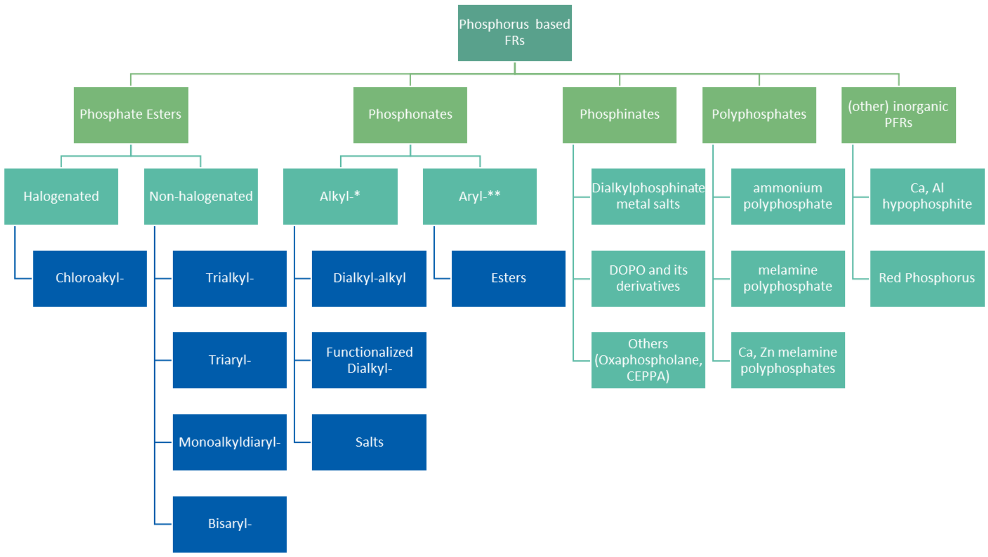
Additionally, there has not yet been any indication or reason for concern thus far. There are now new endpoints being considered, such as specific criteria for endocrine disruption or mobility.

The Grouping Approach

Chemically defined groups are categorised based on the common physical chemical properties that exist. However, when it comes to toxicology, there may be outliers – substances that have fundamental differences even within a single chemical group. This prompts the need for thorough verification of the grouping science based on a case-by-case criteria.

Compared to producers who think of groups of commercially relevant or related products, ECHA defines groups differently because they do not have the overview of applications and markets. Instead, they base the grouping on the database of registered chemicals, processing a single molecule at a time and combining it with other substances that have a common chemical structure or similar chemicals. Flame retardants may also fall in some of these categories because they appear chemically related or similar but in fact, other factors need to be considered when grouping these substances together.

Phosphorus-FRs: a grouping approach example (source: Peter Fisk report for pinfa)



Conclusions

Priority placed on brominated flame retardants: The ECHA Flame Retardants strategy focuses on brominated flame retardants as the top priority. Several groups of phosphorus and inorganic FRs are declared as of little concern and low priority.

Some groups of phosphorus flame retardants up for regulatory scrutiny in the future: There is also a clear indication, as suggested in the table on the *summary of the assessments of regulatory needs for organophosphorus flame retardants,* that some groups of phosphorus flame retardants will be further scrutinized in the future.

Thorough grouping criteria that move beyond chemistry fundamentals: The criterion for grouping needs to be implemented cautiously and with a thorough system in place that considers a number of factors beyond just chemical composition.

Continued commitment on the part of pinfa: Our priority remains to continue supplying helpful findings / studies and foster an open and collaborative dialogue with ECHA, as well as other stakeholders.

Discussion

Do you have more insights into polymeric flame retardants? Are you aware of efforts to bring these substances into grouping strategy based on the monomeric structures?

As of now, there is no requirement to publicly register polymers, but the Commission is assessing the need to change this. Precisely how to register polymers is a meticulous process that is still being defined because of the vast variety that exists among polymers (hundreds of thousands).

When it comes to reactive FRs, a distinction must be made between polymetric flame retardants and polymer bound FRs. Polymetric flame retardants are polymers themselves that one can be blended into another polymer. The other type of FR is referred to as polymer bound or what we know as reactive flame retardants which react with monomers by becoming part of the polymer backbone. The classic example is polyurethane, where reactive flame retardant becomes chemically bound by covalent bonds to the polymer structure.

In terms of registration from an administrative perspective, every customer would have to notify their product as a new polymer to the authorities. This is because, technically, they would have come up with a new polymer due to a reaction to the flame retardant.

On the scientific side, polymer bound and polymetric flame retardants have inherent advantages. However, the vast majority of flame retardants used today are additive ones, as they are much more flexible to use in a myriad of cases. With reactive flame retardants, you interfere with the production of the polymer. When you look at thermoplastics, such as polypropylene, the producers of these products want to produce in large quantities so their customers can independently add colors, fillers, and flame retardants without needing to do so in the production process. From a practical aspect, and also from a performance point of view, there are many polymers for which there are no good suitable polymer bound flame retardants. A potential concern is the residual monomer content and how a polymer bound, or polymeric flame retardant, breaks down. There is a growing request for more data, but only limited information exists at this time. This is one area where we can improve and attempt to find more data to share with ECHA and other authorities.

Recycling can mean a number of things. Is there room to consider recycling in the form of re-use? Flame retardants are often disregarded for reuse because of their complexity but is this something the European Commission could be interested in?

Although not particularly relevant in the context of ECHA's flame retardants strategy, it is a high priority for the European Commission more broadly.

Unfortunately, additives that you put into a polymer will not improve recycling. Fillers like flame retardants, glass fibres, talcum, etc. will not facilitate recycling but these substances are used for a reason.

We as an industry, together with relevant stakeholders, need to find clever ways of sorting different polymer grades to give life back to materials or products.

As the industry is looking for solutions for the future, do you see advantages in using solid flame retardants in terms of migration, emissions, performance, and recycling?

In general, the flame retardants must be compatible with the processing of the material. However, whether solid or liquid, both kinds are being released so I don't see any particular benefits to using solid flame retardants over liquids.

Are all three organophosphate flame retardants in evaluation? And would these cause issues for recycling?

There is an evaluation process taking place and we should have results for later this year or next.

Bromine can be easily detected so the separation is much easier at this stage than later in the process. Generally, there are many ways to separate the substances. Technology is being developed especially in the chemical recycling area.

Fire Safety will always be catching up with Innovation

The focus of the second session was to address the delays that exist in innovating fire safety to ensure the highest of standards and avoid disasters like the 2017 Grenfell Fire in London.

Guillermo Rein, Professor of Fire Safety in the Department of Mechanical Engineering from Imperial College London, gave a presentation that was followed by a discussion.

Background

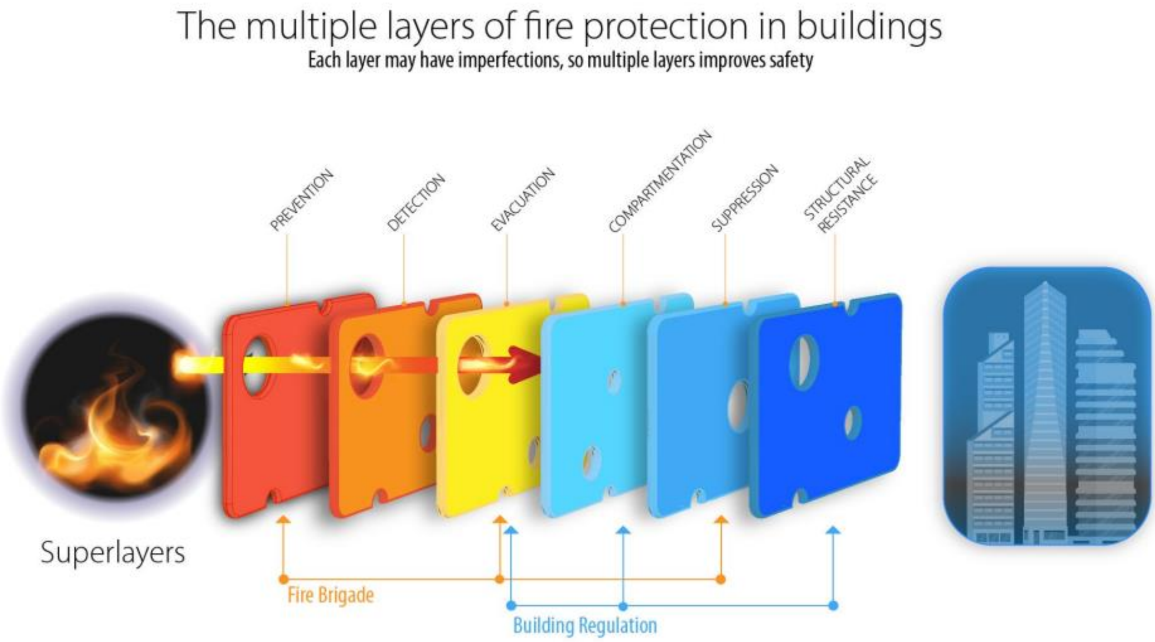
In the last 20 years, fire engineers have stopped communicating effectively on what is being done to ensure fires do not reach populations.

To ensure high quality fire protection, the current system consists of six layers that help maintain a distance between fires and people (see slide below for visuals). This is referred to as the 'Swiss cheese' approach. There is a myriad of views on this method, but one practical benefit is that there are only six layers which facilitates implementation.

The first layer is the single most important one for protection: prevention, which is to ensure the fire does not occur in the first place. In fire engineering, this is considered the starting point. This is the stage where flame retardants play a crucial role by simply avoiding a fire to begin with.

A growing risk of fire begins if there is an ignition source with some intensity and a flammable material. If the ignition source is strong enough, and the material flammable enough, then a fire starts and we must rely on the remaining 5 layers to distance the fire: detection, evacuation, compartmentation, suppression, and structural resistance.

The six layers of fire protection



In the case of the second layer, detection, it is technology (i.e., smoke detectors) that helps people evacuate. This is followed by compartmentation, which is very important in the UK, although less important in the United States and continental Europe. Suppression comes in the form of sprinklers or handheld devices such as fire extinguishers, possibly through the early arrival of fire brigades. The final layer is structural resistance, or the concept that the building structure is resistant enough not to collapse, helping ensure that people inside, whether victims or fire brigades, are able to escape.

There are also a number of super layers, or agents that act on several layers at the same time. Examples of this include fire brigades, building regulations, industry, and insurance companies. Each of these layers are activated – by wish or by force – to help ensure fire safety.

Regulation

Although often mistaken as such, regulation is not in fact fire engineering. The 'unsinkable' Titanic can help allude to this more clearly. The ship was compliant with all the laws, standards, and regulations of the time. However, it was an unsafe technical device. To quote Professor Brannigan from the University of Maryland, 'the Titanic complied with all codes. Lawyers can make any device legal, only engineers can make them safe.'

By definition, regulation is the minimum level of safety in any given environment. However, the minimum is so low that if one operates just below the standard, it is immediately considered a criminal offence and there are legal consequences to whoever implemented that (low) level of safety. The question to consider is why people do not do more to operate well above the minimum required standard? This is simply because there is no market for it. It is not being informed by anyone, it is not being appreciated by anyone, not even the people who are asked for the building to be built in the first place.

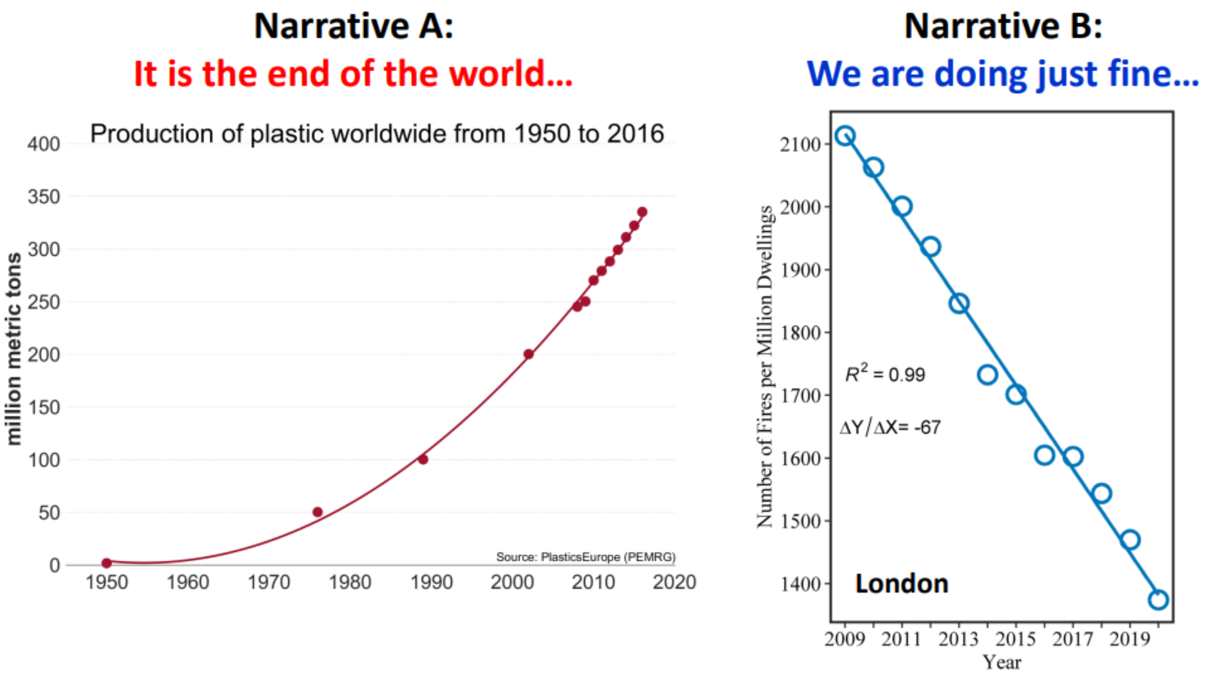
By default, engineers always operate by the regulation (so the minimum level of safety) because there is no incentive to operate above it. The problem with this is that if there is uncertainty in the design, if there is uncertainty in the hazard, and we aim for the minimum then by definition, there are buildings out there which are less safe than what the regulation aims for.

Apparent contradictions in fire safety: two narratives

There are two narratives that exist around fire safety. The first is that society has never before been surrounded by this amount of plastic. People have created an environment that is utterly full of polymers that are highly inflammable and therefore, the world is doomed.

The other narrative, 'we are doing just fine,' is built around the use of statistics e.g. from the UK fire brigade system, which has a long-standing, consistent and very large record of data concerning fires.

Existing narratives on fire safety



Why do these two contrasting narratives exist? The answer has three components:

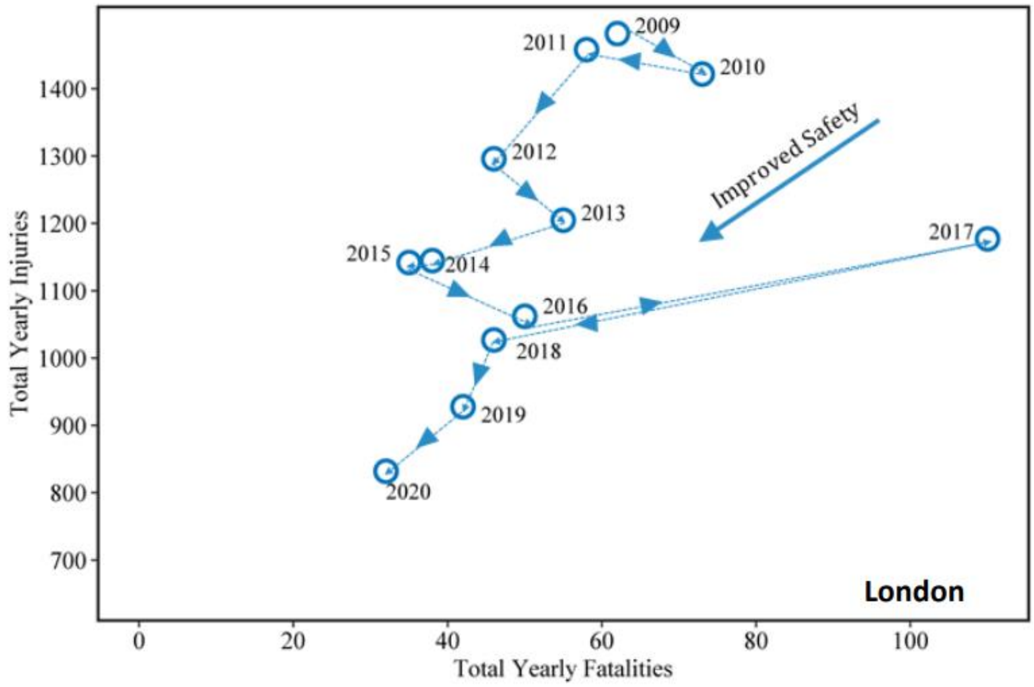
- **Fire inequalities** or the idea that not everyone is suffering the same consequences. There are wildfires that are happening to people who cannot claim the same level of protection for themselves.
  - Fighting fires is costly, amounting to UK £7 billion per year
  - Despite tremendous progress in protecting lives, fire causes 5% of injury-related deaths worldwide. For comparison, war causes 2%.

- **Layers of protection** or the notion that despite the plastic that surrounds us and our living environments, the layers of protections are effectively preventing or delaying fires from taking place or becoming unmanageable.

- **Innovative blind sports**: the graph below demonstrates that the city of London is gradually reducing the number of injuries and fatalities related to fires. It might take some time, but it is effectively happening year after year. Unfortunately, there is one exception to this: blind spots. A concrete example of this was the Grenfell fire of 2017 that broadly speaking, the international community at large did not see coming.

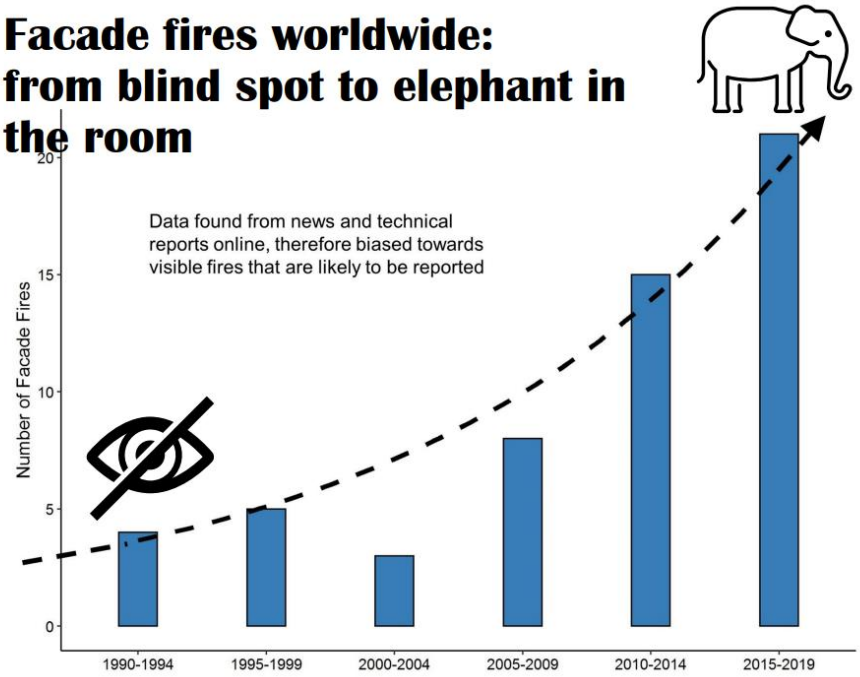
Innovative blind spots

Facade fires happening in London from 1990s to 2019



This is a graph of the number of facade fires that were happening in the world since the 1990s until 2019 when we began responding to blind spots.

The graph demonstrates that the number of facade fires was exponentially increasing. Why is it that we as a fire and human community, as far as safety experts, didn't know these were happening? This is because they were not being discussed. These types of fires were neither being communicated on or being studied. We had a blind spot until Grenfell happened and since then, there has been heightened interest and attention to these kinds of fires.

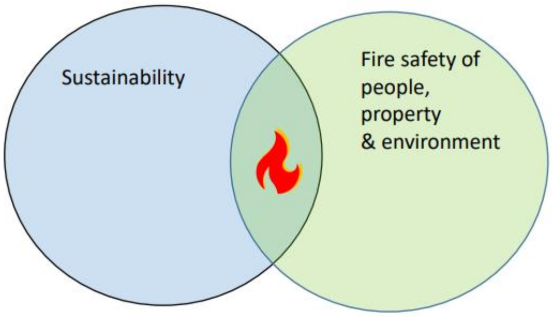


Blind spots exist because innovation is never ending. Innovation, in every realm, brings its own hazards. Identifying and understanding these hazards, or risks, takes time. They exist in the use of new materials, textures, colors, lightness, strength, shape, etc. Architects are asked to be more creative and more innovative, but that kind of innovation needs to be studied and experienced before we understand the full risks.

Fire engineering is always catching up because the hazard comes after the value that the market places on innovation. The question is, how long does it effectively take for the fire community to catch up? What is the danger of discovering these risks late?

Fire science at the Crossroads

The safety of flammable substances is an emerging scientific topic



The intersections between sustainability and fire exist in the following dimensions:

1. Sustainability and Fire: tall timber

Engineered timber is an innovative and sustainable construction material that reduces the carbon emissions of buildings versus materials like steel and concrete.

All wood products are flammable to a certain degree and fire engineering is a prerequisite safe design of tall buildings.

2. Energy & fire: batteries

Lithium-ion batteries are present everywhere: airplanes, cars, children's toys, etc.

As the risk of lithium-ion batteries has not yet been integrated in fire statistics, it is not yet addressed in the regulation, thus the existing solutions do not work. Existing technology, such as smoke detectors, are not efficient enough to prevent or delay a fire started by lithium-ion batteries. By the time the smoke detectors have detected the smoke, the fire is likely to have become unmanageable and it is too late to propagate suppression because the fire is happening too rapidly.

Conclusions

Fire engineering is doing well but it needs to also improve and do better. Specifically, fire engineering is not catching up with innovation as rapidly as it needs to in order to welcome green and 'sustainable' structures made up of tall timber, facades, green walls, photovoltaic panels, batteries, etc.

The role of prevention is where flame retardants belong. Flame retardants have a very important role to play. They are one of the most important tools that we have, albeit not the only solution, but a crucial way to help us prevent and where possible, delay fires.

Discussion

Clients are looking for solutions that will be compliant but when we are looking at innovation and sustainable solutions, a lot of the compliance that people are trying to find are extra-regulatory. Do you have any ideas on how we can find the right intersection or meeting point between extra regulatory and regulatory processes?

Engineering needs to understand what it's doing versus what it is being asked to do, thinking through both regulatory and extra-regulatory. Engineering needs to demonstrate that it is safe, not only assume that it is safe. There is a difference between prescribed fire safety and performance fire engineering.

Performance-based design is the way forward.

Do you think fire engineers are not involved in the early stages of discussion or projection?

The concept of fire engineering and safety is a peculiar one because after we have done our job right, we are forgotten. It is only on the days where we 'fail' that we are remembered or called into question.

The architect will not call the fire engineer if they think the project is safe, just like a high-level political stakeholder (i.e., a Minister) will not want to speak with a fire engineer unless something is burning.

We need to address this issue within society, as it happens in many countries and regions in the world, not just in Europe.

Conclusion and next steps

The participants of the Advisory Board meeting were very positive about the initiative. The fact that there were participants from the scientific community was especially welcome, as the range of backgrounds in the room provided the conditions for sharing expertise and learnings across fire safety and environmental topics.

The multi-stakeholder and multi-sectorial structure adopted for the meetings of the Advisory Board provides a venue for these worlds to come together and ensure a space where knowledge is shared.

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Once agreed by the participants, this document can be used by any member of the group for discussions with others, to show the areas of exchange and to encourage collaboration on the topics involved.