LANXESS flame retardants

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Flame retardants play an important role in fire containment: they comply with strict fire safety standards that reduce the impact of fires on people, property and the environment. Flame retardants not only prevent fires from starting, but if a fire does occur, they slow down the spread of the fire and enhance the opportunity time for safe escape. They can mean the difference between life and death. LANXESS offers one of the world's most comprehensive flame retardant portfolios, supported by a global network of sales and technical experience and expertise.

Technical competence centers

LANXESS possesses and operates its own well-equipped technical competence centers and analytical laboratories in Europe, Asia, and North America which are geared to invent, develop, test, and improve both, highly effective phosphorus- and bromine-based flame retardants for various applications.

LANXESS's comprehensive technical capabilities in flame retardants comprise the whole spectrum from the development of high-performance products and formulations, compounding, processing, material and flammability testing to technical recommendations for the customers. The company performs small scale burn testing in its own facilities. Furthermore, LANXESS has established a strong network with reliable and efficient partners for large scale fire testing.

Leverkusen, Germany
In the Leverkusen research area new phosphorus-based flame retardants are synthesized and developed. Additionally, formulation and application proposals for the use of new and proven flame retardants are at the center of our efforts. The application technical competence center in Leverkusen focuses in particular on PUR and PVC processing and physical properties and fire testing of formulations.

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Naugatuck, CT, USA
At the R&D center in Naugatuck, new flame retardants, both brominated and non-halogen are discovered, invented, developed, and formulated in synthesis and testing laboratories together with the early stage process development. For applications development, technical service, and customer problem solving, the company utilizes state-of-the-art compounding equipment, analytical instrumentation, and mechanical property testing equipment.

El Dorado, AR, USA
The chemical process technology laboratory in El Dorado specializes in the process development for both new flame retardants and existing flame retardants. The newly built, modern pilot plant allows scale-up capabilities not only for understanding new and existing processes, but also to provide potential customers with the required new product quantities for their applications.

Nanjing, China
The technical center in Nanjing allows LANXESS to most efficiently serve the needs of the Asia-Pacific customers in terms of applications development and technical service leveraging flame retardant and physical testing equipment and instrumentation. Additionally, the center serves as a training location for customers and suppliers.

Phosphorus derivatives facilities

Based on elemental phosphorus, LANXESS produces a variety of derivatives being used in many industries including flame retardants, lubricant additives, pharmaceutical intermediates, water treatment chemicals, fine chemicals, and agrochemicals.

The company runs a network of phosphorus chemicals production sites in Europe and North America including one of the largest integrated production facilities for organic phosphorus downstream chemistry.

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With its fully integrated phosphorus derivatives facilities LANXESS is strongly focused to further develop its leading position in the phosphorus-based flame retardants market. The company continues to develop phosphorus-based flame retardant solutions helping customers to address increasing regulatory challenges, particularly for the PU industry. Phosphorus based flame retardants are found worldwide in many plastic products.

The brands Disflamoll®, Levagard®, Reofos® and Uniplex serve to flameproof polymers such as polyurethane, PVC, polycarbonate and polymer blends, e.g. for cable sheathing or housings for electrical devices.

Bromine and bromine derivatives facilities

LANXESS is one of the world's leading manufacturers of bromine, bromine intermediates, and brominated flame retardants.

The bromine manufacturing sites at LANXESS Solutions U.S. are located in rural south Arkansas, USA, and sit atop of a bromine-rich brine reserve, the second largest known brine reserve in the world. With access to large concentrated bromine reserves and ongoing investment in the bromine production facilities and ISO tank fleet, LANXESS is one of the leading global suppliers of bromine derivatives. Bromine and bromine based intermediates serve as building blocks for producing highly complex molecules that meet specific performance, environmental, and quality requirements.

Bromine and its intermediates are utilized in many applications including foam insulation for building and construction, fine chemical/pharmaceuticals, agriculture, power generation, transportation, water treatment, oil field services, and more.

LANXESS is amongst the global leaders in flame retardant products and solutions for use in applications such as furniture foam, electronic components, electrical enclosures, building products and

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more. Brominated flame retardants provide optimal processing while maintaining outstanding physical properties in a cost effective manner.

LANXESS bromine flame retardants products include the brands Firemaster® and Emerald Innovation®. Emerald Innovation® 3000 was introduced as an environmentally friendly alternative to Hexabromocyclododecane (HBCD) flame retardant for polystyrene foams.

Applications

Electrical and Electronic

The application of flame retardants in the Electrical and Electronic (E&E) market can be thought of as four segments: connectors, printed wire boards, enclosures, and cables.

Connectors

Connectors are ubiquitous in today's super-charged growth of electronic devices. They are critical for the proper and reliable functioning of computers, notebooks, televisions, mobile phones, electrical appliances, games, and all devices that enable "smart" technology. They are present in virtually every electronic device we use and encounter every day, and are most recognizable as USB and HDMI ports enabling critical connection to external devices such as printers, monitors, TVs, and docking stations, for example.

Because electronic devices are so pervasive in our lives and because these devices are becoming smaller and more high-powered, it is imperative that flame retardants be used for fire safety if malfunctions were to occur.

LANXESS offers several brominated flame retardants for use in polyamides like PA-66, PA-6, high temperature PA, and use in polyesters such as PBT and PET. Those for polyamides include

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PDBS-80™, Firemaster® PBS-64W, Firemaster® CP-44F and Uniplex FRP 64, while those for polyesters include BC-52™ and BC-58™.

Printed Wire Boards

Printed wire boards (PWBs), like connectors, are in every electronic device imaginable as they serve as the platform for the all the necessary electronical components. Higher electrical and mechanical demands on today's PWBs mandate that fire safety is ensured via the use of flame retardants. LANXESS offers the brominated flame retardant, BA-59-P™ for epoxy-based PWBs.

Enclosures

Polymeric enclosures protect and prevent physical damage to the internal workings of all electrical appliances and electronic devices thereby serving as the necessary "exo-skeleton", and as a result are the largest source of potential fuel if a fire were to occur. It is critical that effective flame retardants are used. LANXESS offers Firemaster 2100® for HIPS and ABS, and for PC/ABS blends, BA-59P™.

Cables

Cables are omnipresent in our daily lives and it is likely that their use will grow in a rapidly developing world with its change towards electrical mobility, smart homes, and linked industries. As common and necessary as electricity is, it also always carries the risk of short circuiting resulting in fires. To prevent such and moreover to ensure many other stringent material requirements, LANXESS flame retardants reduce this risk while also meeting stringent material requirements.

LANXESS offers suitable products for a variety of different polymeric materials: E. g. Disflamoll® DPK for cables based on TPU, PVC and rubber, Reofos® 95 for PVC and rubber cables used at higher temperatures and Uniplex FRP 45 whenever outstanding fire resistance is required.

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Construction

Building and construction products have to fulfill a multitude of performance requirements. One essential criterion for all types of construction material is fire safety. Fire safety is composed of different elements such as building design, type of used materials, use of fire alarms and sprinkler systems. The reaction to fire and the resistance to fire of construction materials can be improved by the addition of flame retardants. The choice of the appropriate flame retardant depends on the type of material and its use within the building.

Insulation foam

Insulation foams help to minimize the energy consumption of buildings and thus contribute to a more sustainable society. Besides excellent insulation properties, other requirements have to be fulfilled, most notably fire safety. In order to meet these requirements, flame retardants are usually added to the insulation foams.

Polyurethane

A major group of insulation foam is based on rigid polyurethane (PU) because of its excellent insulation properties. PU foam can be applied in several ways such as insulation boards with flexible or rigid facing, spray coating or via can foam. In order to meet the required fire standards, flame retardants are usually added to the rigid PU foams.

LANXESS offers a comprehensive range of flame retardants, which are particularly suitable for this type of foam. This includes products based on phosphorus such as Levagard® PP and Levagard® TEP-Z as well as brominated flame retardants such as PHT4-Diol™, a reactive compound.

Polystyrene

The other major group of insulation foam is based on polystyrene (PS). There are two types of polystyrene foam as defined by their

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manufacturing process: Expanded (EPS) and Extruded (XPS). Like polyurethane-based foams, there are strict flame retardancy standards for PS foam. Hexabromocyclododecane (HBCD) had been the standard flame retardant for PS foams.

However, due to environmental bioaccumulation concerns, its use has dwindled significantly in favor of the new, safer brominated polymeric flame retardant of LANXESS, Emerald Innovation® 3000. Due to its the large molecular size, Emerald Innovation® 3000 minimizes bioaccumulation concerns.

Its highly designed polymeric backbone of styrene and butadiene coupled with subsequent surgical bromination techniques provide the necessary high temperature stability for processing. Its high bromine content provides all of the required flame retardancy to PS foam without the bioaccumulative concerns of HBCD.

Flooring

Flooring is not just an aesthetic matter. In most countries, rigorous requirements for the fire protection of floorings in public buildings must be met. Furthermore, one feels safe and secure when floors of theaters and hospitals, for example, meet such requirements. Typical requirements for public floorings are low flammability, slow flame propagation and low smoke density in case of fire.

PVC floorings which contain Disflamoll® DPK or Reofos® 50 show excellent fire resistance. Low smoke requirements can be achieved with Disflamoll® DPO. These products are also suitable for rubber- or PUR-based floorings.

Transportation

Transportation plays an important role in our modern society. Different types of transportation involve different risks for fire and different fire scenarios. Thus a variety of different fire standards reflect the different fire scenarios. Various types of flame retardants

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are used in materials for transportation depending on the type of material and its final application.

Automotive
Materials used in automotive applications must meet a variety of requirements including functionality, low emissions, and fire performance.

LANXESS offers a broad range of flame retardants enabling materials to meet these requirements. Levagard® TP LXS 51114 and Levagard® TP LXS 51135 are flame retardants designed for flexible PU foams used in automotive applications addressing the trend towards lower emissions in this industry. Disflamoll® DPK and Disflamoll® 51092 are effective flame retardants for cables (e.g. based on TPU) used in automotive applications.

Railway/Subway
Rail vehicles are heavily regulated in most countries in terms of fire safety. A large number of passengers in a confined space and limited escape possibilities, e.g. in a tunnel, require special material properties.

In addition to the flammability of materials, also fire side effects such as smoke and smoke toxicity must be considered. These strict requirements severely limit the product selection.

Especially the halogen-free phosphorus-based Disflamoll® and Reofos® products help to meet the requirements placed on rubber and plastic articles for rolling stock. Levagard® products can be used for a variety of PUR-based materials such as upholstery and coatings.

Aircraft
In the case fire in an aircraft in flight, immediate stopping and escape is impossible. There is essentially no time for landing and subsequent

evacuation. For this reason, the fire protection requirements in aviation are particularly stringent.

Halogen-free phosphorus-based Disflamoll® and Levagard® products from LANXESS can be part of flame retardant coatings and sealants.

Support

LANXESS has a long history of promoting the safe and effective use of flame retardants. The specialty chemicals company has a strong belief in the value of fire safety in our modern world and supports those organizations that seek to improve fire safety standards that benefit society. LANXESS strives to provide regulators, legislators, the public and other stakeholders with the best science-based facts to address questions that arise around the use of flame retardant products.

LANXESS is a leading specialty chemicals company with sales of EUR 9.7 billion in 2017 and about 19,200 employees in 25 countries. The company is currently represented at 73 production sites worldwide. The core business of LANXESS is the development, manufacturing and marketing of chemical intermediates, additives, specialty chemicals and plastics. LANXESS is listed in the leading sustainability indices Dow Jones Sustainability Index (DJSI World and Europe) and FTSE4Good.

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Forward-Looking Statements
This company release contains certain forward-looking statements, including assumptions, opinions, expectations and views of the company or cited from third party sources. Various known and unknown risks, uncertainties and other factors could cause the actual results, financial position, development or performance of LANXESS AG to differ materially from the estimations expressed or implied herein. LANXESS AG does not guarantee that the assumptions underlying such forward-looking statements are free from errors nor does it accept any responsibility for the future accuracy of the opinions expressed in this presentation or the actual occurrence of the forecast developments. No representation or warranty (expressed or implied) is made as to, and no reliance should be placed on, any information, estimates, targets and opinions, contained herein, and no liability whatsoever is accepted as to any errors, omissions or misstatements contained herein, and accordingly, no representative of LANXESS AG or any of its affiliated companies or any of such person's officers, directors or employees accept any liability whatsoever arising directly or indirectly from the use of this document.

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