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Functional additives for polyurethane applications

Additives in polyurethanes are widely implemented as performance aids, to improve heat resistance and prevent from flaming, to reduce emissions of volatile organic compounds, to reduce oxidation and protect from aging, and lastly to improve aesthetics, especially to cover inhomogeneities of products, that may occur.

In a context of increasingly stringent regulations and standards set by industries, additives are under the magnifying lens, required to boost the performance of polyurethane parts and reduce their side-impact on people and environment while complying with more and more strict regulations including product carbon footprint (PCF) data.

Starting from here and trying to get the best, REPI (Lugano, Switzerland) is focusing on innovation and improvement of existing additives.

Everyone in the PU industry knows very well that fire retardants represent – by quite some margin – the largest sector within PU additives. Such additives on the market are required to provide reduced toxicity and improved sustainability, while still fulfilling severe flammability regulations. With the aim of combining requests for fire safety, impact on health, high performance, and easy handling. REPI has in its portfolio, the range of self-extinguishing flame-retardants antiFIAMMA. The range comprises liquid blends of ammonium polyphosphate (APP) and aluminium trihydroxide (ATH) dispersions as well as dispersions of synergistic flame retardants that can be applied to flexible and rigid foams as well as elastomers. These additives represent a new concept of halogen-free flame retardants. While being perfect dispersion into liquid they enhance intrinsic fire resistance in the end-product by increasing the contact surface of the active principles with the foam. All antiFIAMMA additives are classified as non-dangerous products.

The antiFIAMMA ammonium polyphosphate dispersion (-APP) and the antiFIAMMA aluminium trihydroxide dispersions (-ATH) are liquid blends of pure APP and ATH powders dispersed in different kinds of polyols. They show considerable contribution to the formation of a char layer in the intumescent process. The char layer acts as a physical barrier between oxygen and polymer decomposition gases. The APP dispersions decompose to polymeric phosphate acid and ammonia when exposed to fire or heat. The polyphosphoric acid reacts with hydroxyl groups in the formulation to form unstable phosphate ester. The consequent dehydration of the phosphate ester leads to the formation of a carbon foam on the surface, acting as a char insulation layer. ATH decomposes at higher temperatures, absorbing heat while releasing water and suppressing smoke.

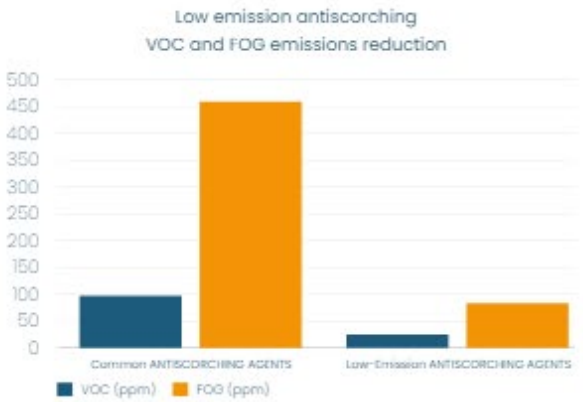
AntiFIAMMA synergistic dispersions (-SYN) are instead combinations of primary solid flame retardants and other synergistic flame retardants blended in liquid polyol. Such a combination leads to increased thermal stability through a barrier effect and, therefore, a delay of thermal degradation. One of the many advantages of this additive is that it reduces the need for conventional flame retardants in the PU formulation by 25 – 30 %.

The strict fire resistance requirements set by flexible and rigid foam and elastomeric applications can be met entirely.

Another strong push coming from the market is the one of human health protection. In the automotive sector, for instance, car manufacturers are setting lower and lower limits related to VOC and FOG levels allowed in the vehicles to minimize the risk of harming consumers. Undesirable carbonyl compounds such as aldehydes can be present and/or formed due to oxidative degradation.

SenzAA™ scavengers lower the presence of aldehydes, such as formaldehyde and acetaldehyde, resulting in reduced smell and VOC/FOG emissions in PU components for automotive interior trim applications. SenzAA is recommended for PU ether, ester, and integral skin foams. In combination with REPI colors they fulfill very low emission requirements. They can be used as a component in the polyol formulation or can be fed in a separate stream directly into the mixing head.

In the area of environmental protection, the reduction of emissions is demanded. REPI's response lies in the upgrade of its Antiscorching range with the low-emission grade Low-AO Repitan that prevents flexible slabstock foam yellowing without impacting VOC emissions.



Safety also means, to prevent and reduce the risk of accidents. An example is electrostatic charging build-up in the PU productions, especially in areas with risk of explosion or in the electronics industry. In this context, REPI has in its portfolio a solution that acts as a permanent antistatic and anti-dust agent in PU application. REPI High Performance Antistatic Additive (HPAA) is a medium polarity ionic liquid, specifically tailored to improve conductivity properties of microcellular PU and TPU shoe soles and C.A.S.E. and PU composite applications. It also finds applications in flexible slabstock foams.

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Sample – antistatic a.r.	Electrical Resistance
D26 0 %	out of range
D26 0.5 %	1,900 MΩ (megaohm)
D26 2 %	470 MΩ (megaohm)

Electrical resistance analysis results (internal method) of antistatic PU foams (thickness 5 cm – density 26 g/l)

In the field of enhancing performance, two more products are in the spotlight: the bonding enhancer on the one hand and high performance UV stabilizer on the other.

The bonding enhancers are liquid blends of selected reactive additives that provide improved adhesion of PU foams to each other as well as to a fabric after flame lamination with improved hydrolytic stability.

During the flame lamination process, the coupling of polyether PU foams to fabric provides extraordinary adhesion strength to the end-product.

REPI's High Performance UV Stabilizers (HI-UV) combine UV absorbers and antioxidants that improve UV and heat resistance in PU applications like flexible foam, rigid foam and C.A.S.E. for use in automotive and transportation, furniture and bedding, clothing, footwear, building and construction, and marine and offshore industries. They can also find application as stabilizers while thermoforming flexible PU foams.

One of the many advantages of this additive is that it reduces the need for conventional flame retardants in the PU formulation by 25 – 30 %. REPI, as a world leader in color and additive solutions for polyurethanes, works tirelessly to improve its offer of specialty additives that meet the needs of its partners, putting its technical support, know-how, and capabilities at their service.

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PU magazine INFO:
REPI has operated since 1973 as a global supplier of liquid colors and additives for polyurethanes and thermoplastics. With its eight sites in the Americas, Europe, and Asia and a global network of partners, REPI is able to serve more than 80 countries worldwide.

Adhesion and fire behavior (PU ether foam formulations – parts per weight)

Polymeric polyol (OH n° 45 mgKOH/g)	20.0	20.0	20.0
Polyether polyol (OH n° 32 mgKOH/g)	70.0	70.0	70.0
Water	2.0	2.0	2.0
Catalyst	1.0	1.0	1.0
Silicon	1.0	1.0	1.0
Flame retardant	5.0	5.0	---
Repi bonding enhancer	4.0	6.0	8.0
Stannous octoate	0.2	0.2	0.2
TDI	24.0	24.0	24.0
Density (kg/m³)	40.0	40.0	40.0
UL 94 HF-1 fire behaviour	Pass	Pass	Pass
Foam adhesion test (textile)	Very Good	Excellent	Excellent

Polyether polyol (OH n° 56 mgKOH/g)	95.0	95.0	95.0
Water	4.0	4.0	4.0
Catalyst	0.2	0.2	0.2
Silicon	1.0	1.0	1.0
Flame retardant	5.0	5.0	---
Repi bonding enhancer	4.0	6.0	8.0
Stannous octoate	0.15	0.15	0.15
TDI	47.0	47.0	47.0
Density (kg/m³)	20.0	20.0	20.0
UL 94 HF-1 fire behaviour	Pass	Pass	Pass
Foam adhesion test (textile)	Very Good	Excellent	Excellent