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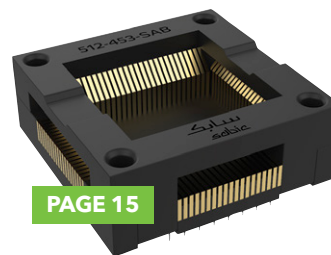
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# SKZ extends capabilities with first RingExtruder

German plastics technical institute SKZ has extended its extrusion technology portfolio with the installation of its first RingExtruder from CPM Group's Extricom Extrusion.

RingExtruders are said to

provide good dispersion due to high extensional flow while the multiple small screws can reduce shear and pressure peaks to allow efficient and gentle compounding. They also

provide a large surface area

for heat exchange and degassing.

"The advantages of the RingExtruder hold great potential, especially in the recycling and processing of biopolymers. We are therefore very excited about initial inquiries from the industry, as we naturally prefer to research practical applications," said Hatice Malatyali, Group Manager Extrusion and Compounding at SKZ.

The new 12-screw extruder joins a variety of single and twin screw extrusion lines installed at the SKZ Plastics Centre at Würzburg in Germany.

> [www.skz.de](http://www.skz.de)



The new CPM RingExtruder being handed over to the SKZ team

## Kuraray to expand EVOH capacity

Kuraray is to increase capacity at its US and European production sites for ethylene vinyl alcohol (EVOH) copolymer resin, which it markets under the Eval name and is used in food packaging as a gas barrier.

The company said 5,000 tonnes/yr of new capacity

will be added across its production sites at Houston in the US and Antwerp in Belgium in 2024, with a further 5,000 tonnes/yr planned for 2026. The investments will take its global production capacity from the present level of 103,000 tonnes/year to 113,000 tonnes/year.

In addition to the developments at its existing production locations, the company said a project team is currently examining creation of a new base of operations in Asia. It currently has a capacity of 10,000 tonnes at its site at Okayama in Japan.

> [www.kuraray.com](http://www.kuraray.com)

## Ravago invests in M Holland

Polymer distribution and recycling group Ravago is to acquire a majority interest in M Holland, a US-headquartered distributor of thermoplastic resins and associated materials.

According to M Holland, the deal will enable it to accelerate its growth strategy by providing greater scale and resources. "This transaction is an important inflection point for M Holland as it places the company on a clear path to continued and long-term success," the company said.

"This is a rare opportunity for two strong, family-owned organisations to come together in a way that will ensure our customers get what they need, when they need it for years to come."

The Holland family will retain a significant stake in the company, which will continue to operate independently as a subsidiary of the Ravago Group under its existing management team.

> [www.mholland.com](http://www.mholland.com)  
> [www.ravago.com](http://www.ravago.com)

## Renewable TPV options from Teknor Apex

Teknor Apex has introduced a new range of Sarlink thermoplastic vulcanisates (TPVs) containing high-quality post-industrial recycled (PIR) content.

The company said the Sarlink RX 3100B series are based on its existing Sarlink 3100 series technology and has been developed to help brands

achieve sustainability targets. The series includes two grades: an 84 Shore A hardness version contains 25% recycled content and a 94 Shore A grade contains 40%.

The new grades are pre-coloured black and are suitable for injection moulding, extrusion, overmoulding

and co-extrusion with PP or other TPEs. Typical applications for the high-durometer grades, which are also recyclable, include backbone carriers for extruded seals in glass run channels, as well as under hood components.

> [www.teknorapex.com](http://www.teknorapex.com)

## Meraxis takes on RC Plast

Swiss distributor Meraxis will begin distributing selected recycled products in Europe produced by Danish company RC Plast. The portfolio will include high-quality unfilled PP grades made from recycled fibre waste.

"Our collaboration with Meraxis will not only allow us to exploit new international markets, but also address additional industry sectors and applications," said Allan Poulsen, CSO of RC Plast.

"Our recycled materials meet all quality standards for use in technical applications," he said. "We're confident that our partnership can help companies in the automotive, furniture, and construction industries to reduce their consumption of new materials and promote the circular economy."

➤ [www.meraxis-group.com](http://www.meraxis-group.com)  
➤ [www.rcplast.dk](http://www.rcplast.dk)

# Arper's green seating line uses Sirmax PCR material

Italian compounder Sirmax has worked with furniture manufacturer Arper to create a sustainable collection of chairs produced using PP blends containing post-consumer recycled (PCR) material.

Conceived by Finnish designer Antti Kotilainen, the Aava 02 seating line is injection moulded in a custom glass reinforced PP compound incorporating PCR material primarily from flexible and rigid food packaging. The compound meets Arper's demands for strength and durability without compromising on the surface finish or colour.

The recycled content varies according to the colour. Darker coloured versions contain up to 40% PCR with, on average, more than 500g of waste plastic used in each chair.

"While our core business focuses on the home appliances and automotive sectors, we have always kept

**Arper's Aava seating uses a PP compound from Sirmax with PCR content**



IMAGE: ARPER/SIRMAX

an eye on the Made in Italy furniture industry," said Sirmax Group President and CEO Massimo Pavin. "Thanks to Arper, we are able to solidify our commitment to high-end design."

The new chairs were shown on the Sirmax stand at the Italian Plast show, where Pavin also announced the renaming of some of its business units. The SER business unit, responsible for post-consumer recycled

plastic products, is now called Sirmax New Life while Microtec, which makes compostable bio-based compounds, becomes Sirmax Biocomp.

Pavin said the new names are intended to enhance the transparency of the company's business units to the market and amplify its efforts in the recycled and bio product segments.

➤ [www.sirmax.com](http://www.sirmax.com)  
➤ [www.arper.com](http://www.arper.com)

## Management changes at Maag Group



Paul Merich



Aaron Kong

Pelletising and filtration equipment specialist Maag Group has appointed Paul Merich as its new VP and General Manager for the Americas. He moves from his role as VP of the company's APAC (Asia Pacific and China) business, a post he had held since 2019.

Aaron Kong, who joined the Maag business in 2021 and was previously General Manager of its China operation, takes on Merich's former post.

Maag has been expanding its presence in China, establishing a local operation that build localised equipment and now employs more than 100 people. It recently announced plans to double the size of this local assembly operation.

➤ [www.maag.com](http://www.maag.com)

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# DuPont agrees sale of Delrin

DuPont has agreed to sell an 80% stake in its Delrin POM (acetal) business to private equity group TJC (formerly known as The Jordan Company). It said it aims to complete the sale by the end of the year.

The deal completes DuPont's exit from the engineering plastics sector following last year's divestiture of most of its former Mobility & Materials segment to Celanese. The business is valued at around \$1.8bn.

The Delrin business unit produces and markets acetal homopolymers, which are typically used in high-load mechanical applications such as conveyer belts, safety restraints, gears and medical devices.

DuPont Executive Chairman and CEO Ed Breen said the move will advance the company's position as a premier multi-industrial company. "We are excited to partner with TJC given their successful track record of creating

value through an operations-focused approach and are confident in their ability to drive growth and opportunity for employees and customers of the Delrin business," he said.

"Delrin is widely recognised as the material of choice for safety critical and high cost-of-failure applications," said TJC Partner Ian Arons. "We look forward to working closely with the entire Delrin team to drive future growth."

> [www.dupont.com](http://www.dupont.com)

## Covestro to pilot PC recycling

Covestro says it is to step up its chemical recycling process for converting PC resin to monomers suitable for reintroduction to the production process from laboratory to pilot scale.

The company said it is planning a multi-million euro pilot facility to be set up at its Technical Centre at Leverkusen in Germany to further develop the chemolysis technology.

"Pre-sorted waste streams containing a product content of more than 50% polycarbonate can be recycled this way. This has been successfully demonstrated with various polycarbonate-containing plastic waste streams," said Markus Dugal, Head of Process Technology at Covestro.

"With the help of this chemolysis, the cycle can be closed to a direct precursor of polycarbonate. This makes the recycling process very sustainable," he said.

> [www.covestro.com](http://www.covestro.com)



Covestro is to move ahead with a pilot chemolysis plant for recycling PC

IMAGE: COVESTRO

## Ampacet launches pharma antistat

Ampacet has introduced ProVital+Permstat, a non-migratory antistatic masterbatch specifically developed for use with polyolefin films for pharmaceutical applications.

Used in the external layers of packaging films, ProVital+Permstat is said to create a dissipative polymeric network that allows

electrostatic charges on the film surface to dissipate. The antistatic effect lasts as long as the film is in use, preventing particles from sticking to the inside of the packaging when it is emptied.

According to Ampacet, the masterbatch can also be incorporated into PE-based cleanroom films used to store and transfer pharma-

ceutical raw materials or active ingredients used in drug production.

ProVita+Permstat is offered with full consistency of formulation and a no-change policy for raw materials at the CAS and commercial level. It is manufactured under controlled-room conditions.

> [www.ampacet.com](http://www.ampacet.com)

### IN BRIEF...

**MBA Polymers UK** is expanding its recycling activities with a new plant – its fourth – at Wimblington in Cambridgeshire. The facility will begin operation later this month and is part of the company's plan to lift its capacity to 100,000 tonnes of recycled PE, PP, PS and ABS by 2030.

[www.mbapolymers.co.uk](http://www.mbapolymers.co.uk)

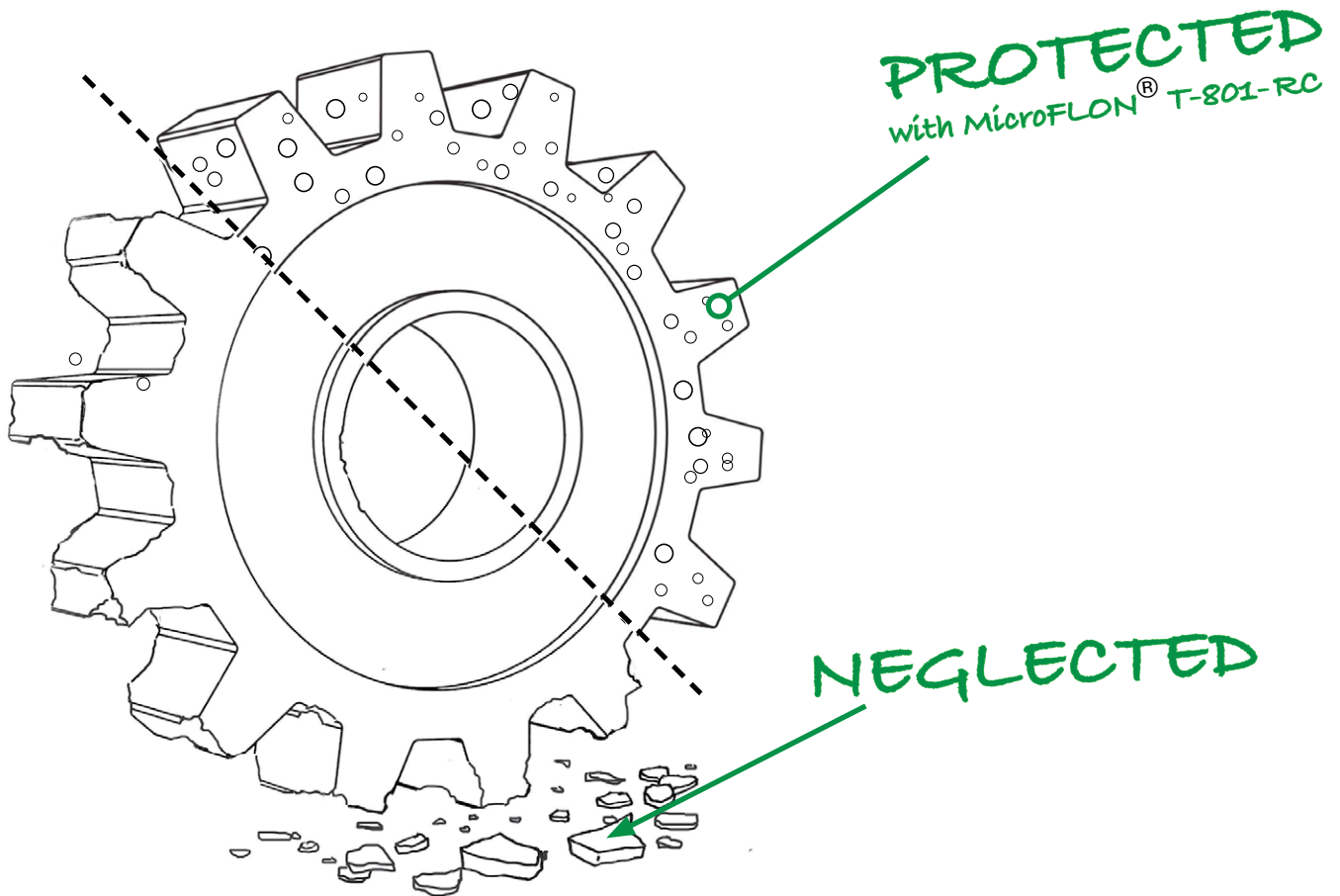
**BASF** has broken ground on a new polyethylene (PE) plant at its Verbund site in Zhanjiang, China. Scheduled to start up in 2025, the 500,000 tpa plant will be backward integrated and will serve fast-growing demand in the region for products such as pipes and specialty films.

[www.basf.com](http://www.basf.com)

Private equity group INVIL Baltic Sea has acquired a 70% stake Polish PVC window recycler, **Metal-Plast**. The Świebodzice-based company has an annual capacity of around 29,000 tonnes.

[www.metal-plast.pl](http://www.metal-plast.pl)





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Shamrock Recycles



# Mocom develops recycled PC grades for light guides

German compounder Mocom is now offering light diffusing compounds based on recycled polycarbonate. The compounds contain both post-consumer recyclates (PCR) and post-industrial recyclates (PIR) and form part of the new Alcom LD Eco (Light Diffusion) and Alcom LG Eco (Light Guiding) portfolios.

"New regulations in the automotive sector will increasingly demand recycle-based solutions in the future, even in applications where it would not be expected," said Kurt Maschke,

Senior Director Global Marketing Automotive at Mocom.

The company says the production process for the new Eco grades involves careful screening of the materials. Photometric properties are individually adjusted and specified for each grade, which can contain up to 100% polymer recycle.

■ In a separate move, Mocom is moving towards implementation of a 'uniform brand presence globally' by renaming its Albis Plastics Corporation



**A transparent light diffusing element moulded in Mocom's new recycled PC**

in Monterrey, Mexico, to Mocom Compounds Mexico with immediate effect. It said the renaming will not affect customers, contractual partners, or existing business relationships.

> [www.mocom.eu](http://www.mocom.eu)

## Nexam gains new reactive patent

Swedish additive maker Nexam Chemical has announced that the European Patent Office has informed it that it will approve a second patent covering the company's Reactive Recycling technology.

The patent covers the use of the additive technology to recycle PE polymers; it complements a patent from July this year covering additives to recycle PP.

Christer Svanberg, Chief Technology Officer at Nexam Chemical, said: "The method means that even the largest recycling streams can be used in more products than was previously possible."

> [www.nexamchemical.com](http://www.nexamchemical.com)

## Polyplastics to re-compound

Japanese engineering thermoplastics supplier Polyplastics has launched its Duracycle re-compounding initiative for recycling performance plastics which, according to the company, "applies to a variety of sustainable solutions that contribute toward achieving a 100% recycling rate for engineering plastics."

The move marks the first phase in the company's plan

to achieve carbon neutrality by 2050. It said it expects the Duracycle re-compounding service business to be able to offer high-quality mechanically recycled materials from March 2024 onwards.

According to the company, re-compounding is a clear departure from conventional recycling. It says its aim is to capitalise on "horizontal recycling"

methods, which transform products back into the same products.

For the immediate future, the Duracycle system will focus on pre-consumer waste materials as they have traceable manufacturing histories so pose little risk of contamination. However, it hopes to develop recycling technologies for PCR in the future.

> [www.polyplastics-global.com](http://www.polyplastics-global.com)

## Kureha ups PVDF capacity

Japanese speciality chemical and polymers producer Kureha says it is to increase production capacity for polyvinylidene fluoride (PVDF) at its Iwaki Factory in Fukushima, Japan, more than doubling capacity from its current level of 6,000 to 14,000 tonnes/yr.

The additional production capacity, together with the 5,000 tonne/yr output of

its existing plant in China and some group wide de-bottlenecking programmes, will take the company's total annual capacity for the specialty polymer to around 20,000 tonnes by 2026. The company's plans also include sustainability improvements.

PVDF is used as an engineering polymer in a variety of industrial applica-

tions as well as finding a role as a binder in production of lithium-ion batteries (LiBs). The latter is an application sector where Kureha said it is seeing rapidly growing demand.

The company plans to increase its global production capacity for PVDF polymer to between 30-40,000 tonnes by 2030.

> [www.kureha.co.jp](http://www.kureha.co.jp)

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# SABIC starts PC plant in China

SABIC and Sinopec have commenced commercial operation of a new polycarbonate production plant at their 50/50 joint venture petrochemical complex – Sinopec SABIC Tianjin Petrochemical – located at Tianjin in China.

The new plant, SABIC's first in Asia, has an annual capacity of 260,000 tonnes and is said to be a "vital element" in the company's PC growth strategy for China. Grades produced at the Tianjin complex will be



**SABIC has started production at its first PC production plant in Asia**

Image: SABIC

marketed under the Lexan brand.

Sabic said the plant will supply customers in the

Greater China region, targeting electrical & electronics, consumer goods & appliances,

automotive, healthcare and construction markets.

"Building on our position as one of the world's leading polycarbonate manufacturers, our first-ever PC plant in Asia underlines our commitment to operate and manufacture in markets that are close to our customers to increase service capabilities, agility, and supply reliability," said SABIC CEO Abdulrahman Al-Fageeh.

> [www.sabic.com](http://www.sabic.com)

> [www.sinopecgroup.com](http://www.sinopecgroup.com)

## Braskem bio plans for Thailand

Brazil's Braskem and Thailand's SCG Chemicals have agreed to set up a new JV – Braskem Siam Company – to produce bio-ethylene by bio-ethanol dehydration to commercialise 'I'm Green' bio-based PE.

I'm Green PE is currently produced in Brazil using renewable ethanol sourced from sugar cane. The company says the bio-ethylene plant in Thailand, which will be located in Rayong, will be the first of its kind outside of Brazil and will almost double existing capacity.

Roberto Bischoff, CEO of Braskem said: "We are always looking for opportunities to expand the I'm Green bio-based PE offer."

> [www.braskem.com](http://www.braskem.com)

> [www.scgchemicals.com](http://www.scgchemicals.com)

## Lanxess signs production MoU with FRX Polymers for Nofia FR

Lanxess has signed a memorandum of understanding with FRX Polymers that could lead to the German chemicals giant contract manufacturing and potentially marketing FRX's Nofia branded flame retardants.

Lanxess is a leading player in flame retardant production. FRX Polymers has developed a range of polymeric flame-retardant

additives with claimed sustainability advantages.

"The Nofia range fits perfectly with Lanxess's existing phosphorus flame retardant portfolio and long-term strategy of sustainable flame-retardant solutions," said Karsten Job, Managing Director of the Lanxess Polymer Additives business unit. "We believe that FRX's Nofia technology will capture important

market share in this market."

FRX Innovations CEO Marc Lebel described the agreement as "a definitive step" in the growth of the Nofia business. "The relationship we are discussing fits well with FRX's mission to be a leader in the environmentally sustainable revolution now driving the flame-retardant industry," he said.

> [www.lanxess.com](http://www.lanxess.com)

> [www.frx-innovations.com](http://www.frx-innovations.com)

## Washington Penn to invest \$100m

US-headquartered compounder Washington Penn Plastic is to invest \$100m to build a new manufacturing facility at Winchester in Kentucky.

The new facility will start operation in 2025 and create approximately 90 jobs.

Washington Penn, which

claims to be among the leading suppliers of PE and PP compounds in North America, already operates a compounding plant at Frankfort in Kentucky.

The company also has three plants in Pennsylvania and a production unit in both Georgia and Ohio.

Washington Penn Plastic is part of Audia Group, which also includes custom colour and additive masterbatch maker Uniform Color, elastomeric solutions provider Audia Elastomers, and distribution company Southern Polymer.

> [www.washingtonpenn.com](http://www.washingtonpenn.com)

# Anton Paar to buy Brabender

Austrian analytical equipment maker Anton Paar has acquired Duisburg, Germany-based Brabender, which manufactures measurement and process engineering solutions including rheometers and both single and twin screw extruders for plastics.

The company will be integrated into the Anton Paar Group under the Anton Paar TourqTec name and the acquisition will be retroactive to 1 January, 2023.

"The decisive factor for

Anton Paar's decision to purchase Brabender was the know-how in the development and production of world-leading measuring instruments," said Anton Paar CEO Dr Friedrich Santner.

"In line with its own long-term strategy, Anton Paar will sustainably expand and further strengthen Brabender's sites in Duisburg and Hackensack (US)," he said.

> [www.anton-paar.com](http://www.anton-paar.com)

> [www.brabender.com](http://www.brabender.com)



Anton Paar CEO  
Dr Friedrich Santner  
(left) with Brabender  
owner Peter Eßer

IMAGE: ANTON PAAR

## EU BPA restrictions temporarily on hold

Following the end of a six-month public consultation in June this year, Germany's Federal Office for Chemicals (BfC) has temporarily withdrawn a proposal submitted to the European Chemical Agency (ECHA) for further restrictions on the use of bisphenol A (BPA) and similar bisphenols.

According to the German

authority, substantial new data was submitted as part of the consultation leading it to conclude that significant re-drafting of the underlying logic of the proposed restrictions is necessary.

Following the re-drafting, the new proposals will be resubmitted and go through a new round of scrutiny and consultation.

> [www.echa.europa.eu](http://www.echa.europa.eu)

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IMAGE: THE PROTOOL PLASTICS GROUP

*Electronic miniaturisation and new markets such as e-mobility are driving interest in cost-effective polymer-based thermal management solutions. Mikell Knights learns more*

# Compound opportunities in thermal management

Global demand for thermally conductive polymer materials is set to increase, driven by a rise in demand for device miniaturisation, space constraints and technological product advancement. Heat dissipation remains the primary driver for the increased use of thermally conductive materials in electronic cooling, automotive applications, and LED lighting. While metals such as aluminum and its alloys can deliver thermal conductivity in the range from 80 to 250 W/m·K, the latest conductive polymer material formulations can now offer thermal conductivities as high as 30 W/m·K, together with the familiar polymer benefits of lighter weight, part integration, ease of processing, and electrical insulation.

According to **Envalior** (the recently formed JV that brought together the ETPs businesses of Lanxess and DSM), thermally conductive plastics hold great potential for use in thermal management

of charging systems for electric vehicles. It cites the recent example of a charge controller for a full electric vehicle for a German OEM, which is manufactured by Leopold Kostal. The controller converts the three-phase or alternating current fed in from the charging station to direct current and controls the charging process, limiting the charging voltage and current to prevent overcharging of the battery.

The new controller contains a cooling element that dissipates the heat generated in the plug contacts while charging takes place. The element is made in an Envalior PA6 compound – Durethan BTC965FM30 – which is thermally conductive and electrically insulating.

“Our polyamide is filled with special mineral heat-conducting particles that conduct this heat efficiently away from the source,” says Dr Steffen Cichy, Technical Key Account Manager at Lanxess. The mineral particles in the Durethan formulation

**Main image:** Thermally conductive plastics have made strong headway in heat sink applications, where they offer cost and design benefits

**Right: This EV charger plug cooling element was developed by Envalior for Leopold Kostal using a thermally conductive Durethan PA6 grade**

provide a thermal conductivity of 2.5 W/m·K in the direction of melt flow (in-plane) and 1.3 W/m·K perpendicular to it (through-plane), says Cichy. The company says thermal conductivity values of 1-2 W/m·K are usually sufficient at the typical wall thickness of most electronic parts to dissipate sufficient heat to protect the electronic parts.

Despite the high content of thermally conductive filler (68 wt%) in the compound, Cichy says the Durethan PA6 compound exhibits good flow, with processing characteristics similar to a PA6 with up to 60% glass fibre content. The halogen-free flame-retardant grade also offers as UL 94 flammability rating of V-0 at 0.75 mm and provides a Comparative Tracking Index A value of 600 V (CTI, IEC 60112).

“The tracking resistance gives designers greater freedom in engineering the component, as they can arrange electrical assemblies even more compactly without having to worry about short circuits and device defects caused by creepage currents,” according to Cichy. Envalior says the thermally-conductive grade has potential for use in a range of electric vehicle components, including plugs, heat sinks, heat exchangers and mounting plates for power electronics.

**Functional fibres**

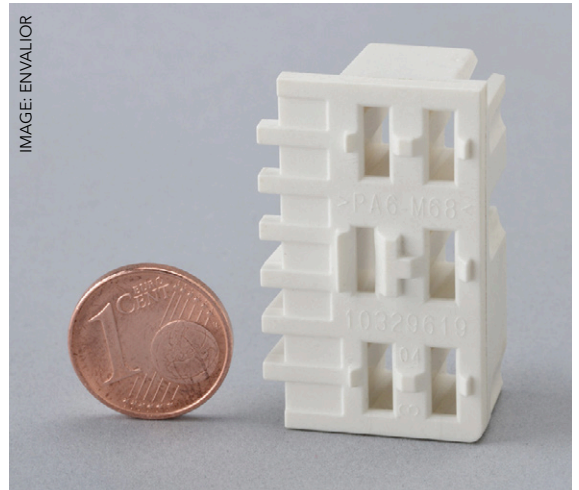
Specially formulated ceramics, metal particles and graphite are the primary materials chosen to provide heat dissipating properties in plastics. One of the latest additions to the compounders’ option list has been developed by **FiberCoat**, a 2019 start-up based at Aachen in Germany. It presented its thermally and electrically conductive AluCoat material additive at the JEC World 2023 exhibition in Paris, France, earlier this year.

Designed as a functional filler for use in technical polymers, AluCoat materials are comprised of short, basalt fibres that are coated in a sheath of aluminum to provide a fibre with both thermal and electrically conductive properties (the electrical conductivity also providing a shielding function against electromagnetic radiation). The basalt

**Below: AluCoat aluminium-coated basalt fibres from FiberCoat provide electrical and thermal conductivity in a range of polymers**



IMAGE: FIBERCOAT



filaments, which are suitable for use in PE, PP or PA, also enhance mechanical properties.

Material properties can be adjusted precisely by varying parameters such as the fibre shape, the sizing, or the density of the additive in the matrix. AluCoat loaded components do not require coating, painting or other additional processing and finishing steps, which can result in a reduction in components costs by up to 50%, according to FiberCoat CEO Robert Brüll.”

The company says that its melting, coating, sizing and winding process is carried out on standard glass and basalt spinning lines with only the addition of a special coating module below the fibre formation area. This is said to help reduce the price of conductive fibre solutions by up to a factor of ten.

The trend in electronics to miniaturisation of components and assemblies means power density continues to increase. This means heat generation in the components can become a limiting factor for service life and makes thermal management an increasingly important issue for designers of assemblies. Current state-of-the-art heat sinks are still largely made of metals, such as aluminum, and rely on costly interface materials for electrical insulation.

**Novel formulations**

Thermally conductive plastic alternatives could significantly reduce system complexity, according to 2018 German-start-up **PlastFormance**. It develops, produces and sells unique polymer compounds developed using a patented technology that can incorporate ceramic, metallic or graphite fillers into a wide variety of polymers at what Chief Operating Officer Maximillian Funck, describes as “unprecedented” levels.

The company offers its Thermally Conductive (TC) series of compounds, which are said to provide thermal conductivity up to 15 W/m·K and are electrically insulating, for thermal management



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IMAGE: PLASTFORMANCE



**Above: PlastFormance has developed a novel 'expansion' compounding process it says allows high filler levels to be combined with good flow**

applications. The compounds, mainly formulated on PA6 and PA12 (and more recently some high-performance polymers), rely on spherical powder fillers with a selected isometric particle morphology, together with certain additives. They are designed for high-flow and injection moulding processability despite having filler loadings typically greater than 50 vol%.

Aside from the use of its patented flow enhancing additive systems, a second key contributor to the novel performance of the TC compounds is the company's use of spherical – rather than flake-form – fillers. "Flaky fillers ultimately lead to a direction dependency of physical properties, for example, the in-plane thermal conductivity can be high whereas the through-plane thermal is low. With spherical particles these properties of thermal conductivity are omni-directional, meaning in all directions of space," says Funck.

PlastFormance does not disclose the exact filler type, source and amounts used but says that the morphology of the filler is optimised for good processability, low abrasion and integral thermal conductivity. Its two patents, authored by the three company founders, involve composition, production methods and use of the final compounds.

The company says its compounding process temporarily expands the melt containing the polymer, filler and additives, which increases the melt volume and the adhesion between polymer and filler. This results in reduced viscosity during injection moulding, it says. The injection moulding process completes with the material cooling and shrinking to the solid phase, resulting in a compound with what PlastFormance describes as the new high loading, high processability attributes.

"Our patents are independent of the types of filler used. We own the technology to increase filler content while keeping up a sufficient level of processability in injection moulding. We can mix

**Right: TC (thermally conductive) grades from PlastFormance are said to be suitable for heat sink applications, as well as sensors and battery cooling**

and match fillers to adjust physical properties," says Funck.

In a presentation at AMI's Conductive Plastics conference in Germany last year, PlastFormance described a soft magnetic application made with a PA6 material filled 80% by weight with a metal oxide. A 900mm spiral flow part with a 3mm by 5mm cross section was injection moulded using 500 bar pressure at a melt temperature of 265°C and tool temperature of 130°C.

PlastFormance currently provides its TC series in a TC4 grade with thermal conductivity of 4.5 W/m.K and a TC8 grade with 8 W/m.K. Both are based on PA6. The company also offers TC3-FR, a new compound with thermal conductivity of 3 W/m.K and a UL94 flame retardancy rating of V-0 at 3mm. In addition, the company offers TC3 and TC8 grades based on high-performance polymers.

"The TC series is best for heat sinks, sensor housings and battery cooling applications," says Funck. Future markets and applications, achievable through variation of filler particles, are said to include hotspot cooling, bipolar plate production, magnetic property modification, EMI shielding, high-density compounds, and gamma radiation shielding for parts such as syringes.

**Stress testing**

One of the more recent thermally conductive introductions from **SABIC** is LNP Konduit 8TF36E, a new specialty grade that helps address the stringent demands of burn-in test sockets (BiTS) used to stress-test the latest double-data-rate (DDR) memory integrated circuits (ICs). DDR memory test sockets have to accommodate higher voltages, higher-temperature environments and ever smaller form factors as the number of pins for DDR ICs increases while their dimensions shrink.

"Advancements in memory chips are placing new demands on burn-in test sockets. As the

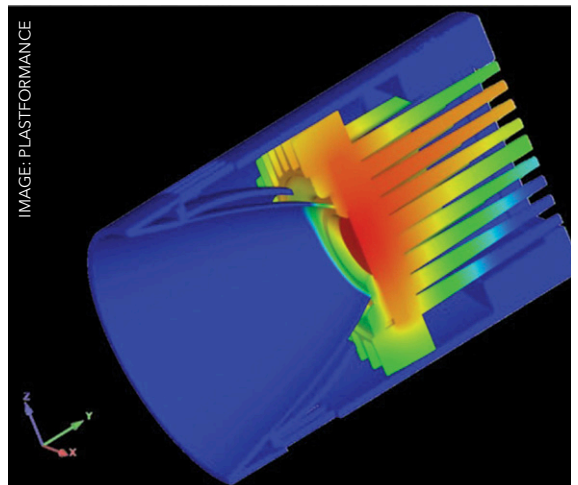


IMAGE: PLASTFORMANCE



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power of DDR ICs increases, temperature control is critical to verify that all devices in a BiTS system are uniformly stressed during reliability testing," according to Jenny Wang, Director, Formulation and Application, APAC at SABIC.

The LNP Konduit 8TF36E compound provides very high flow to help enable the complex, miniaturised designs along with good dimensional stability and high temperature resistance (during the testing process the material has to withstand typical testing temperatures of 150°C). It also offers a thermal conductivity of up to 4.5 W/m.K to quickly dissipate heat after testing, Sabic says.

The Timrex line of thermally conductive additives from **Imerys Graphite & Carbon** are manufactured from natural and synthetic graphite and include its high-aspect ratio Timrex C-Therm product, which can achieve thermal conductivity above 20 W/m.K in-plane and 4 W/m.K through-plane.

The C-Therm product line can be used to boost the thermal conductivity of standard graphites or in combination with other conductive additives. Adding graphite-based products, which can vary in terms of morphology and particle size distribution, enables fine-tuning of the polymer compound's thermal and electrical conductivity and mechanical properties, the company says. It adds that in most resin systems a 20% loading of a C-Therm compound is sufficient to achieve thermal conductivity of 1 W/m.K through-plane conductivity.

**Battery options**

Turkish technical compounder **Eurotec Engineering Plastics** manufactures a range of technical polymers that provide thermal and electrical conductivity, together with high heat resistance, flame retardancy,

and impact resistance. It says, among other applications, the materials can help increase battery performance in electric vehicles (EVs) by providing more effective cooling.

"Thermal management is divided into two main groups: active and passive cooling systems. Active cooling systems require coolant performances of the plastics while passive cooling systems include thermally conductive plastics as metal replacement. Thermally conductive plastics increase the performance of electric vehicles due to their lightness in weight compared to metals," says Buket Turan, Technical Marketing Manager at the company.

Eurotec says that while metals have very high thermal conductivity levels, an actual thermally conductive range of 1-20 W/m.K is enough for the cooling systems of much electronic equipment. The advantages of thermally conductive polymers, it says, are improved operational costs, energy savings, design freedom and lightweighting of parts compared to metals used in critical applications.

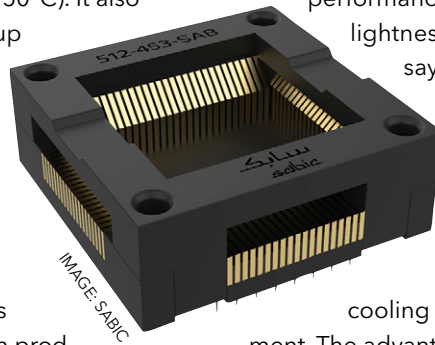
Eurotec materials are both thermally and electrically conductive or thermally conductive and electrically insulating. "In e-mobility applications, components become smaller, require more power and need to have an aesthetic aspect but at the same time with high thermal load. Thus, it is important to dissipate heat to enhance life time and reliable power for the battery," says Turan.

Eurotec says its thermally conductive Tecomid NB30 NL TC 5C PA6, Tecomid NG30 NL TC 5C, and Tecomid NG30 GR10 NL TC 5C 10% glass fibre reinforced grades – all of which are natural in colour – are suitable for use as metal replacement options for housing components of electronic modules, covers of electric motor control housings, or components of EV charging systems.

Two thermally and electrically conductive grades – Tecomid NB30 BK111 TC 1C PA6 (black) and Tecomid NB30 GR15 BK111 1C TC PA6 15% glass-fibre reinforced PA6 grade (black) – offer 5 W/m.K and 8W/m.K in-plane thermal conductivity, respectively. They have been developed for LED heat sinks, miniaturised electronic parts, and housings for automotive headlight sensors.

**Celanese** offers a range of thermally conductive formulations, which it markets under the CoolPoly brand. These grades are based on either polyphosphazene sulphide (PPS), Liquid Crystal Polymers (LCP), a variety of polyamides, or thermoplastic elastomer (TPE) materials. They trace their roots

**Right: SABIC's thermally conductive LNP Konduit 8TF36E grade is suitable for use in DDR memory chip burn-in test sockets**



**Below: Passive EV battery and charging systems are a key potential market for thermally conductive plastics, according to Eurotec**



IMAGE: SHUTTERSTOCK

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IMAGE: SHUTTERSTOCK



**Above: CoolPoly compounds from Celanese have been used in automotive headlamp heat sinks, replacing aluminium**

back to the 2014 purchase by Celanese of substantially all the assets of US-based conductive polymer compounder Cool Polymers. That saw Cool Polymers' formulation, prototyping, moulding and testing capabilities combined with Celanese's polymer chemistry, compounding operations and part design.

Today, Celanese manufactures two classes of thermally conductive plastics. The CoolPoly TCP E series use carbon additives to impart thermal conductivity. ESD and EMI shielding grades are available, with commercial grades offering thermal conductivity as high as 35 W/m·K. These grades are also electrically conductive (when carbon additives are used) and are available based on matrix materials including PA6, LCP or PPS. The Cool Poly TCP D series are electrically insulating, using ceramic additives to provide thermal conductivity. Commercial grades deliver up to 10 W/m·K.

**Sensing success**

The company says it recently helped an automotive parts manufacturer transition from a non-conductive thermoplastic to a thermally conductive material, based on Celanese's Vectra LCP brand, for production of EV battery temperature sensors. The CoolPoly solution delivered improved mould filling, enabling the part size to be reduced. The compound also provided UL94 V-0 flame retardance at 1mm wall thickness.

"Critical to the function of the part, the transition to the thermally conductive material reduced the reaction time of the temperature sensor from 30 seconds to just 14 seconds," says Dr Prabuddha Bansal, Principal Research

Engineer at Celanese.

Another metal transition project for a manufacturer of electronic housing units (ECUs) involved the use of a CoolPoly PA6-based grade of conductive material. The material change resulted in a 45% weight saving (from 185g to 100g) with a comparable reduction in total part costs. According to Celanese, the thermoplastic part met all mechanical and heat dissipation requirements and provided EMI shielding up to 50 dB.

Bansal says that CoolPoly materials have also been used in heat sinks as a replacement for aluminium in automotive headlights. He also says multiple CoolPoly grades are in use along with non-conductive Celanese materials in EV charging stations. However, he emphasises the importance of early and close involvement with the customer. "Materials suppliers always prefer to be involved in a project at an early stage, but with thermally conductive materials, this early-stage collaboration is even more important as these highly filled materials can require a soft touch when processing," he says.

**Expert analysis**

A further example of a collaborative approach to thermally conductive projects can be seen in the partnership between Italian compounder **Lati** and UK-based injection moulder **The Protocol Plastics Group**. The former has combined its expertise in thermally conductive formulations with the latter's knowhow in production and tooling for polymer heat sink products to jointly launch a thermal analysis service for heat sink development.

The two companies offer a complete project development service within the UK market, which includes provision of thermal analysis to optimise heat sink design and ensure effective material selection. Simulation of thermal performance of the plastic heat sink is performed based on the customer's boundary conditions, such as the working temperature of the device and the expected environmental temperature.

The simulation uses CAD files developed for mould tool design and allows for improvements in the design geometry of the part and tool. It includes flow simulation with Autodesk Moldflow and thermal simulation using Ansys, with material characterisation

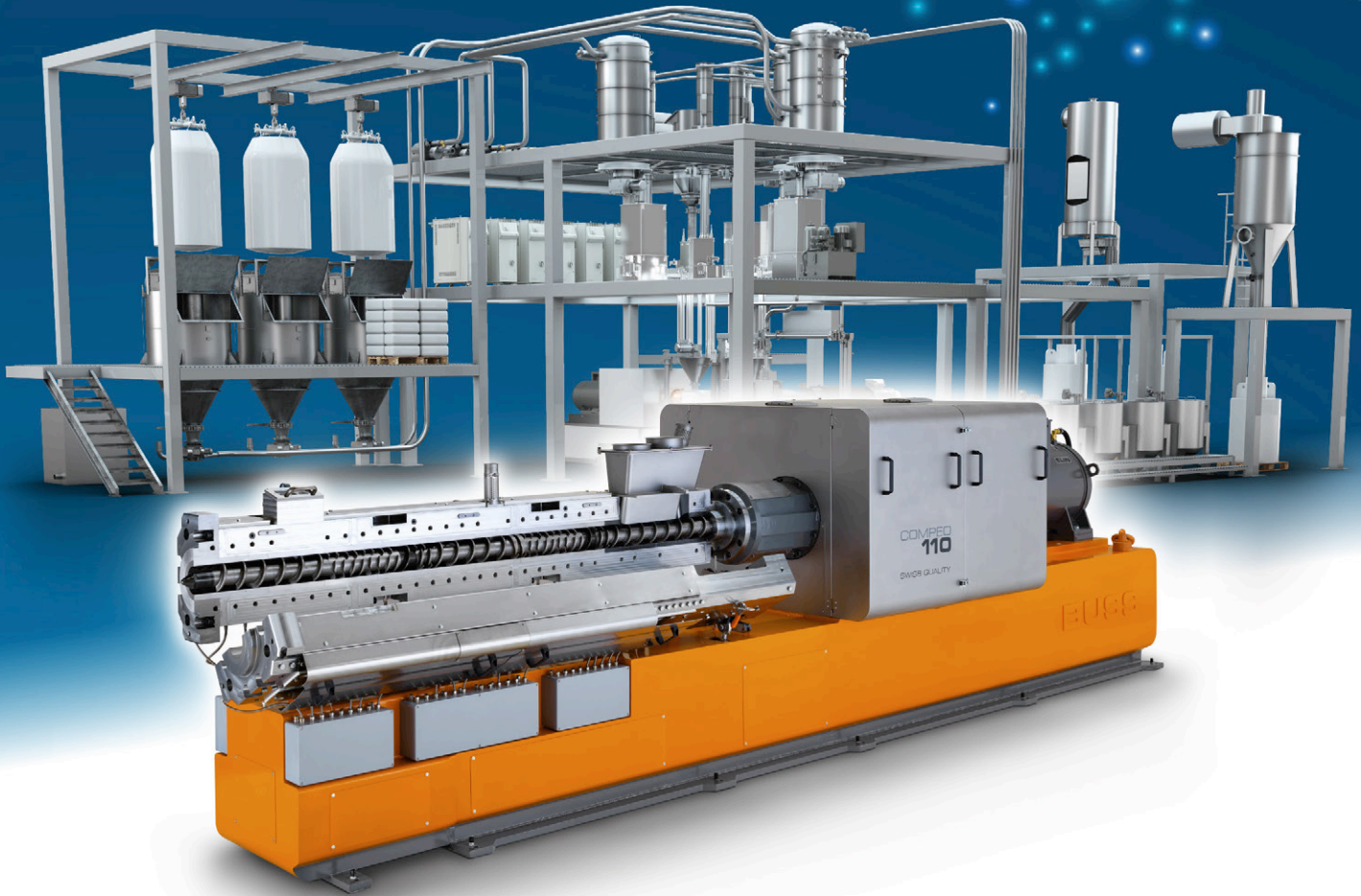
**Right: Lati and Protocol Plastics used their thermal analysis service in development of the PA6 heat sink for Whitcroft Lighting's Mirage 3 LED luminaires**



IMAGE: THE PROTOCOL PLASTICS GROUP

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IMAGE: LATI

**Above:**  
Hexagro's LED heat sinks are moulded in Lati's Laticonther 62 GR/50 graphite-filled PA6 by Protool Plastics

performed using Moldex3D and its software database. Graphite orientation checks and thermal simulations are re-run using Ex-Stream from Digimat, according to Michael Hadfield, Group Managing and Sales Director of The Advanced Plastics Group, which acquired The Protool Plastics Group in 2022.

"All simulation and co-design activities are offered for free to customers in order to reduce time to market, limit failure risks and protect customer's financial investment," says Hadfield.

Lati and The Protool Plastics Group employed the analysis service in an LED lighting project for Whitcroft Lighting, one of the UK's largest manufacturers of lighting for commercial, industrial, healthcare and residential applications. It wanted to improve heat dissipation in the development of the Mirage 3 range of LED luminaires, where light levels of up to 4,000 lumens were to be generated. Replacing aluminum as the heat sink material with

a conductive polymer promised greater design freedom, lighter weight and lower cost.

"Despite the fact that aluminum has a thermal conductivity some twenty times greater, if the lighting assembly is to be used in ambient conditions where there is no significant airflow, then a heat sink [made from thermally conductive material] can be effective in ensuring the interface temperature remains below the desired limit," says Hadfield.

Lati's thermally conductive compound Laticonther 62 GR/50, which is based on a PA6 polymer compounded with graphite flakes and provides a thermal conductivity of over 10 W/m·K, was selected for the project.

Lati and The Protool Plastics Group also collaborated on a project with Hexagro, an Italy-based urban product-service platform that designs aeroponic gardens for interior commercial spaces, that wanted to redevelop a critical part for its Living Farming Tree product. It required a heat sink for an LED light source that would be housed in a 3D printed node containing the LED PCB, lens support and electronics housing. The source has to provide the right lighting and heating conditions to maintain the plant products.

Lati and Protool Plastics Group entered the boundary conditions for the 3D node joint + lamp, which is connected to the 'plug & play' design of the farming trays, into software employed in its analysis service. The companies' analysis found that Lati's Laticonther 62 GR/50 material (a PA6-based 50% graphite compound providing thermal conductivity of 12 W/m·K in-plane and 2 W/m·K through-plane and with an emissivity of 0.87 and a

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density of 1.5 g/cm<sup>3</sup>) compared very favorably with aluminum (thermal conductivity of 120 W/m·K, emissivity of 0.22 and density of 2.7 g/cm<sup>2</sup>) in the application.

The software analysis showed that Lati's graphite-based compound outperformed aluminum even at 35°C room temperature using the existing aluminum part design. Lati and Protool then improved the design through filling simulations. Fins were added, which improved thermal performance and dropped residual temperature by 10°C. The part geometry, cooling system and feeding system design were then further optimised to achieve high dimensional stability and ease of assembly.

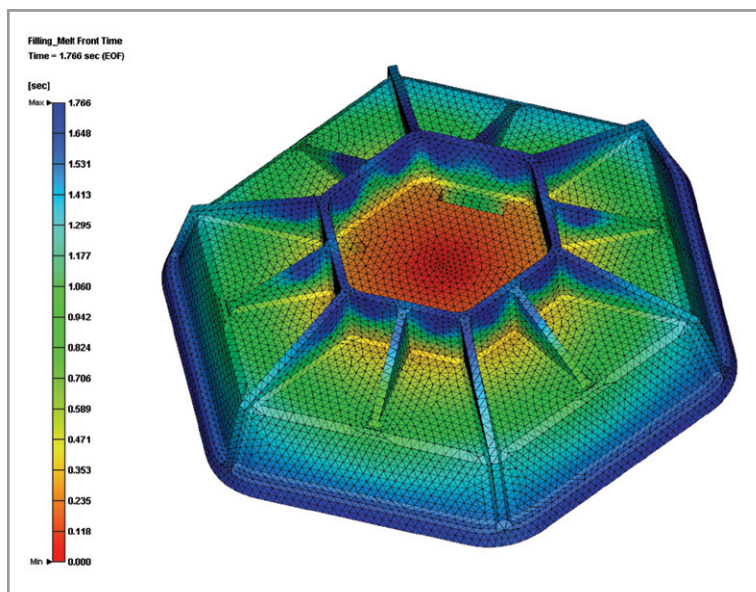
### Cooperation matters

The need for a high level of cooperation between all participants in a thermally conductive project is also highlighted by Christine Van Bellinghen, Business Development Manager, Conductive Compounds at Netherlands-based Wittenburg Group's compounding subsidiary **Witcom Engineering Plastics**.

"There are market expectations for thermally conductive plastics but still barriers and questioning before quick development," she says. "The major questions we encounter are which thermal conductivity shall I target when replacing metal? Are standard plastics not enough? Which measurement method shall I use? Can I get enough mechanical properties despite the high filler loading? What is the best mould design to orient the conductivity?"

The sustainability benefits available by replacing metal with lightweight polymer-based alternatives, and the associated reduction in carbon footprint, are certainly enough to drive interest, Van Bellinghen explains. "The minor space available in automotive and the high weight of electric vehicles will push for new plastics developments to replace metallic parts, involving thermally conductive or EMI shielding thermoplastic compounds, for ECU housings, battery cooling or LED lighting."

However, Van Bellinghen adds that realising a successful outcome requires project partners with the right resources and strong collaboration between all players. "From a material perspective, it is role of the specialty plastics compounder to wisely select the plastics and additives that offer the best overall properties, and to resolve the many open questions to reassure our partners on the benefits," she says. "At Witcom, we have developed thermally conductive formulations that are electrically conductive and others that are insulative. In housings for electronics, the material should remain electrically insulative and often be flame retardant on top, as



**Lati and Protool Plastics used detailed fill analysis to ensure the Hexagro LED light source – moulded in a Laticonther PA6 grade with thermal conductivity of 12 W/m·K in-plane – met required dimensional limits for easy assembly**

Image: Lati

well as reinforced, and easily processable."

Examples include Witcom PA6-342, which is a reinforced, thermally conductive (1-2 W/m·K), electrically insulating, halogen free flame retardant (UL 94 V-0 at 1.6 mm) compound that is easily processable and suitable for dissipating heat in parts such as ECU housings and power tool cover. Witcom PA6-334 is a reinforced, thermally conductive (6 W/m·K though-plane, 20 W/m·K in-plane), electrically conductive compound suitable for LED light heat sinks.

Van Bellinghen says Witcom already has a range of products, and can develop new grades, customised to industry and e-mobility needs. However, she also points out that thermally conductive polymer compounds are competing against more than just metal in EV thermal dissipation applications, citing the example of battery cooling where alternatives – including gap fillers or liquid cooling – could be preferred.

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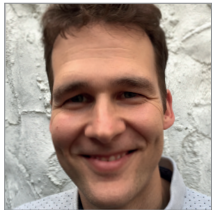
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# Committed to thermally conductive compounds

*Technical compounder Lati has around two decades of experience in thermally conductive compounds. Mikell Knights speaks to Luca Posca to find out more about the company's journey*

With a production capacity of 40,000 tonnes and sales last year of €170m, privately-owned Italian compounder Lati is a significant player in the engineered plastic materials sector, a position earned, at least in part, through its ability to identify new opportunities, to develop new materials that meet the challenging performance requirements they call for, then supporting customers in designing innovative new products to exploit those compound innovations. Thermally conductive compounds are one example: identified as a strategic development area for the business since 2003, it has built a strong position in polymer heat sinks for applications such as lighting.

In this article the company's Group Technical Assistance and Marketing Director Luca Posca talks to Compounding World contributing Editor Mikell Knights and provides some insight into the market for thermally conductive compounds and the company's strategy for future growth in it.

**CW:** Can you provide an update on markets for conductive compounds and the level of interest in markets such as smart technologies (consumer or industrial products), LED lighting, e-mobility and EMI shielding?

**Posca:** We started working on thermally conductive plastics in 2003 following the first signals of the newborn LED lighting technology. For quite a few years LED (PCB, strip LEDs and then high-power COB LEDs) have been leading the way for light and efficient plastic heat sinks.

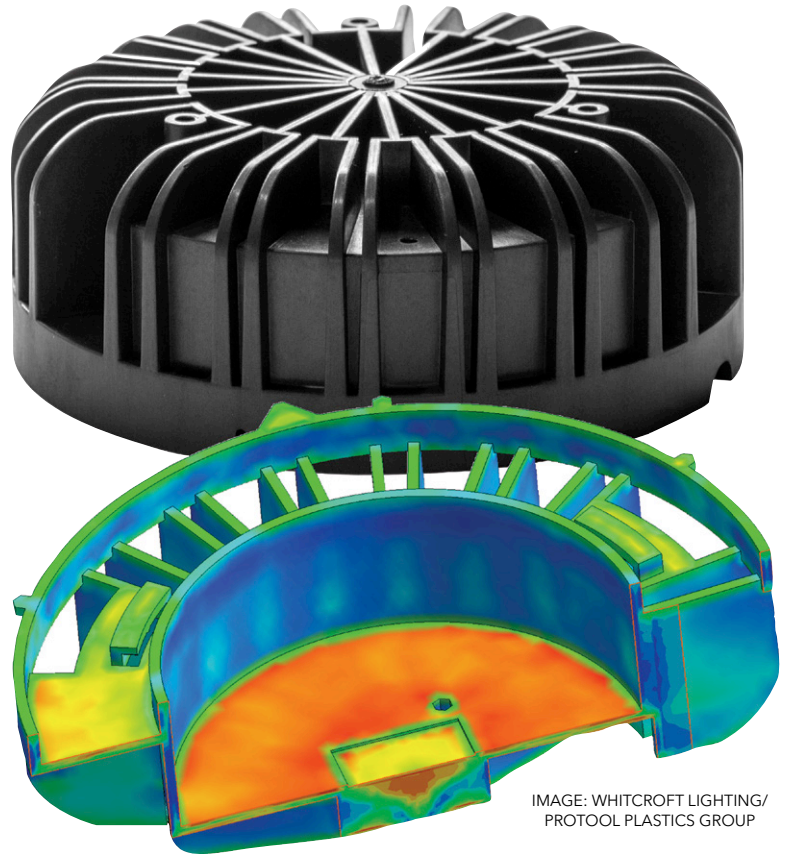


IMAGE: WHITCROFT LIGHTING/  
PROTOOL PLASTICS GROUP

Today we're committed in following a new wave of interest for this solution in e-mobility and other sectors, for example railway and automotive sensors, thanks not only to the performance versus weight versus price ratio, but also because of the intrinsic lower carbon footprint of conductive plastics in comparison to traditional materials and die cast aluminum. Thermally conductive plastics today must meet other requirements to face new challenges: EMI shielding, flame resistance, structural performance. This is the "cutting edge" that Lati is developing to improve its offer in specific industrial sectors.

**CW:** Are trends such as digitalisation or miniaturisation driving interest in these markets? What are the primary market drivers today for your conductive products?

**Posca:** Digitalisation and miniaturisation are major trends in almost any application sector. Miniaturisation means heat buildup and temperature manage-

**Main image:**  
Lati, together with injection moulding partner The Protool Plastics Group, helped UK-based Whitcroft Lighting to switch from aluminium to polymer-based heat sinks in its latest Mirage 3 family of luminaires

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ment and that is also for those devices where such a need was not a priority a few years ago. So, the answer is yes, for sure, although I cannot say that for Lati this is the most important market for conductive plastics. In my opinion, the most important driving forces today are related to power saving and management, energy production and storage, e-mobility and alternative energies.

**CW:** Thermal conductivity of metals is typically 100 W/m·K or higher, far more than can be achieved with thermally conductive plastics. How much thermal conductivity is actually needed to create a functioning thermoplastic system?

**Posca:** Years of Lati experience taught us that conductivity requirements are strictly related to boundary conditions of working devices. To give you an idea, a conductivity of 1-5 W/m·K can be enough for many applications where no huge quantities of heat must be disposed: battery charging in e-mobility, for example. On the contrary, if you must manage temperature in a high-power led lamp, you'll need much higher conductivity, more than 10 W/m·K at least - depending on power density. So I would put the

sentence in this way: a thermal conductivity of 10 W/m·K (isotropic or though plane) may be enough for most applications where natural convection and radiation are the main thermal phenomena. Lower values may work well in many situations, high values may be necessary only in case of forced convection (fan cooled apps). For sure, comparing conductivity values of plastics vs. metals can be very misleading.

**CW:** Have you improved or expanded the Laticonther MI series of PA-based materials that contain conductive fillers?

**Posca:** The MI series was born to provide extra structural performance to average conductive compounds (for example low graphite per cent plus glass fibre) or to add a bit of conductivity to glass reinforced engineering plastics. The main target is automotive applications. For the moment this series of compounds is on hold as we're working on the new CP6 and CP8 grades involving high temperature base resins such as PA9T. Lati developed Laticonther CP6 and CP8 special compounds specifically for E&E automotive applications.



IMAGE: LATI

**Above: Lati's Luca Posca says the company aims to offer 'cutting edge' thermally conductive solutions**

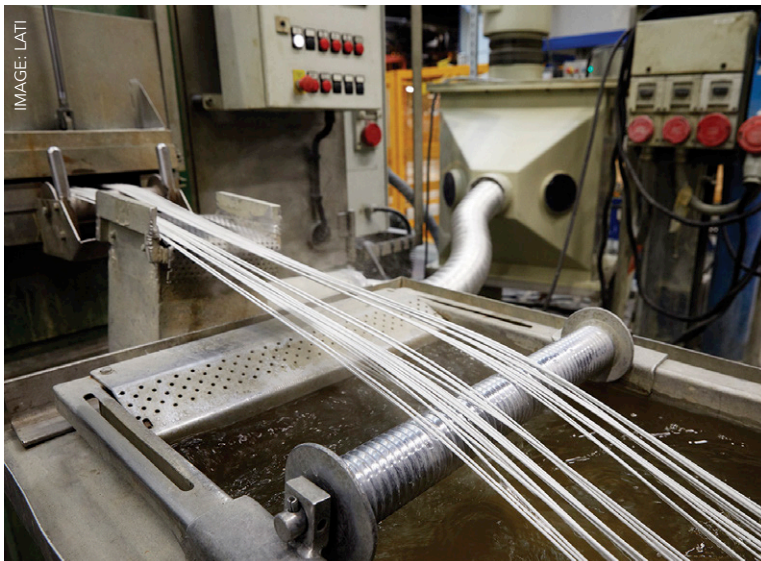


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**Above: Lati has been developing thermally conductive compounds at its plant at Vedano Olona (VA) in Italy since 2003**

**CW:** What other material advances are you working on and for what end markets?

**Posca:** Laticonther CP6 and CP7 were designed to offer electrical insulation, flame retardancy and an interesting price to ceramic-based compounds offering a much higher thermal conductivity than ordinary ceramics (4-6 W/m·K). CP8 is a ceramic based formula developed on PA9T for high temperature and chemical resistance applications, as cooling systems for e-mobility. Laticonther 57T CP8 grades are our newborns and we're promoting them on the market right now.

**CW:** Are you now using a wider range of conductive materials in your products?

**Posca:** For thermal conductivity we use ceramics of different kinds, including boron nitride for electrically insulating. Graphite is used on electrically conductive. Synergistic effects of graphite and other fillers are being tested right now. For electrical conductivity we use carbon black, fibres, nanotubes, steel fibres, conductive polymers. Very interesting developments are coming from these synergistic combinations.

**CW:** What factors need to be considered when selecting a conductive masterbatch?

**Posca:** Of course, the kind of conductivity you want to achieve, dosing and dispersion capabilities of your own equipment, and the base polymers of the masterbatch, which must be compliant to the base resin of the compound.

**CW:** Do you consider thermally conductive or electrically insulating materials to be mainstream and, if not, what are the current barriers to implementation?

**Posca:** Thermally conductive and electrically insulating are, for sure, the new borderline of applications. Low conductivity, brittleness and high viscosity are still issues to be overcome. On the contrary, mature and well performing compounds such as graphite-based electrically conductive are most promising from a market/volume point of view – once designers and decision makers correctly understand their capabilities and how to design with conductive plastics!

**CW:** Any other thermally conductive plastics development going on at Lati you would like to highlight?

**Posca:** One interesting topic – 3D printable thermally conductive compounds. A challenge that deserves better investigation, Lati already has a few grades available for sale but the range needs further development. Another interesting market need is thermally conductive stock shapes for machining and prototyping to verify performance before investing in [injection moulding] tools. There is a massive request but very little – almost no – offer. Another interesting opportunity – accurate prediction using state of the art FEA and computer simulation. Accurate material characterisation is required, as well as experience and competence.

➤ [www.lati.com](http://www.lati.com)

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# Pigment makers tune in to sustainability needs

*Developers of colour pigments are developing products for ever demanding performance needs while also addressing the specific sustainability goals of customers. Jennifer Markarian learns more*

Pigment suppliers are demonstrating they are tuned in to the needs of the plastics colouring market, offering colorants for biodegradable and compostable plastics as well as high-performing options that can enhance the lifetimes of durable plastics and meet requirements in growing markets such as electric vehicles.

Underpinning all these initiatives is recognition that colorants are no less exposed to the increasing scrutiny of the environmental, health and safety performance of all materials used today. With this in mind, **Lanxess** recently started to offer verified Environmental Product Declarations (EPDs) for most of its synthetic iron oxide pigments. This EPD provides information on environmental performance using a cradle-to-gate approach to lifecycle analysis (LCA).

"We expect the demand for detailed LCA data across the supply chain to grow. We know from masterbatch manufacturers that they are already working on concrete strategies to reduce emissions along the entire supply chain," says Stefano Bartolucci, market segment manager for plastics in the company's Inorganic Pigments business unit.

"EPDs provide buyers with a reliable basis for comparing the products of different raw material suppliers," says Bartolucci, who adds that for raw materials, Product Carbon Footprint (PCF) is a key metric. "Bayferrox pigments for which an EPD is available have a PCF of approximately 1.5–2.5 kg CO<sub>2</sub> equivalent/kg product, as confirmed by independent auditors. This value can now be



IMAGE: LANXESS

compared with that of other products."

Another growing focus is on colorants that are suitable for use in biodegradable plastics, which have restrictions on heavy metal content that can limit nickel-, chrome- or copper-based pigments written in to the key regional compostability standards.

"The European standard EN 13432:2000 and the US specification ASTM D 6400 cover plastics and products made from them that are intended for composting in municipal and industrial aerobic composting plants," Bartolucci says.

"Lanxess offers two product lines in this area: Macrolex soluble dyes and Colotherm iron oxide pigments make it easy to comply with both standards. Lanxess thus supports masterbatchers in formulating coloured, biodegradable plastics. In addition, the Inorganic Pigments business unit offers a unique service with pigment analyses: customers receive a recommendation as to how high the maximum pigment concentration of iron oxide pigments may be in low-heavy metal formulations of so-called bioplastics," he adds. ➤

**Main image:**  
Colour pigment producers such as Lanxess are addressing environmental impacts as well as enhancing mechanical, physical and aesthetic performance in their latest developments

IMAGE: LANXESS



**Above: Lanxess now offers verified Environmental Product Declarations (EPDs) for most of its Bayferrox synthetic iron oxide pigments**

**Targeting carbon**

A growing level of enquiries for reliable values for carbon footprint of pigments is also reported by Philippe Lazerme, Head of Marketing Plastics at Heubach Group. He attributes this to the increasing number of masterbatch producers – and masterbatch customers – that have set up targets to reduce greenhouse gas emissions. Certified values from suppliers are important in order to reliably calculate Scope 3 greenhouse gas emissions, explaining why the company is launching a range of pigments supported with certified carbon footprint values.

Pigment users are also concerned about the presence of chemicals such as PFAS or polychlorinated biphenyl (PCB). “In Europe, stricter legislation for specific substances, such as lower limits for PCBs in pigments that are produced or sold in the European market, have triggered requests for purer pigments,” says Lazerme.

This has an impact beyond Europe, Lazerme says, pointing out that customers in other world regions tend to follow often-stricter EU legislation. In addition, some market areas, such as apparel (textiles and shoes for example) have their own lists of restricted substances. Brand owners may also have restricted substance lists that suppliers must follow. An example of a new pigment being developed to meet these multiple market and regional requirements is a greenish yellow pigment with no PCBs that the company plans to launch in the autumn (fall) of 2023.

Biodegradable and compostable plastics place specific requirements on pigments and Heubach has a full range of pigments for such applications that are certified as “OK Compost,” according to Marc Zwart, Technical Manager at the company. Higher colour strength can also improve sustainability by requiring lower levels of pigment usage. He says that Heubach recently increased the colour strength of two of the company’s yellow pigments by up to 20% for this reason.

“The increased usage of post-consumer recycle in new plastic packaging represents a challenge for the masterbatch industry, and pigment experts can help chose the right pigments to get appealing colours,” Zwart says. Colorants with high chroma are helpful in these cases. Recyclability after use should also be considered. “Heubach also has a range of pigments that can withstand several recycling loops (and, consequently, repeated heat cycles) without releasing harmful substances,” he says.

Among Heubach’s new pigment additions is the Ultrazur ultramarine blue, which is said to be

## Forecasting a ‘balanced’ colour future

The ColorForward forecast, developed by **Avient’s** ColorWorks team, looks ahead to the colours and effects likely to be favoured by consumers in 2024. “Purples and greens were the main protagonists of ColorForward 2023 showing an interesting duality between the natural world and the artificial one, but there were also stark contrasting colours underlining a year of ambiguity and contrast,” says Roberto Romanin, Designer at ColorWorks EMEA.

“The 2024 palette is more harmonious and balanced, with colours more evenly distributed across the colour spectrum and only a slight emergence of the yellow and brown families. However, we also see a trend towards bright and saturated colours to represent exuberance and human expressiveness,” he says.

> [www.avient.com](http://www.avient.com)



IMAGE: AVIENT COLORWORKS

**Avient’s latest ColorForward forecast throws light on to the colour trends for 2024**

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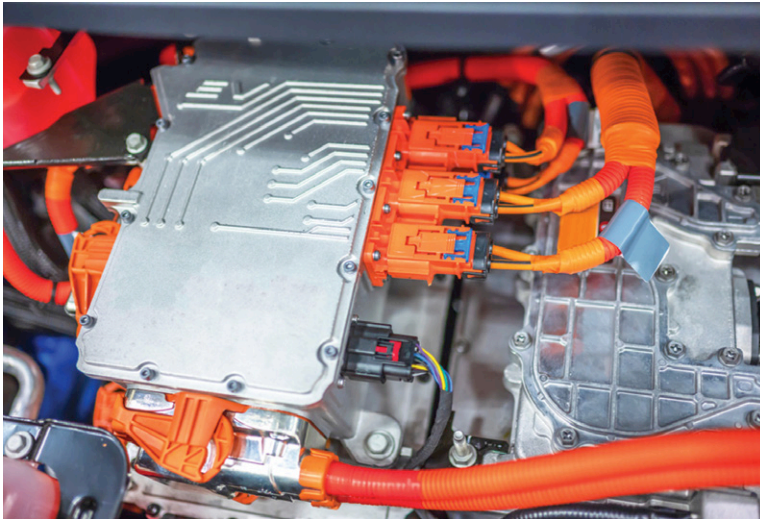
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IMAGE: SHUTTERSTOCK



**Above:** Growing EV demand is presenting challenges and opportunities for pigment producers - especially for orange colours used to indicate high voltage parts

heat resistant up to 350°C, non-warping and non-shrinking, non-migrating, and light and weather-fast, making it suitable for outdoor applications. The company says the technology used in the final pigment production step increases its dispersibility so it is a good fit for fibres and thin film applications.

The pigment is manufactured at Heubach's new facility in Dahej, India. Heubach says this facility has state-of-the-art wastewater and air emissions treatment, and it is investing in solar energy to further reduce carbon dioxide emissions.

**Durable blues**

The latest pigment introduction from **Shepherd Color** is cobalt aluminate Blue 20G599, a super red-shade blue with what the company describes as the highest red (a\*) value and bluest (-b\*) masstone values. According to the company this allows it to provide the maximum chromaticity possible compared to other durable blue pigments when matching colours.

The company says the colour "pushes the edge of the durable colour envelope" due to its high temperature stability and overall inertness. While it is based on its standard cobalt aluminate Pigment Blue 28 chemistry, the new pigment is said to be optimised to attain colour values that this chemistry has not reached before. However, because it is based on the established chemistry of the CI Pigment Blue 28 family, it retains a broad range of regulatory approvals and world-wide registrations including compliance for use in FDA food packaging.

The new blue complements the company's "YInMn" Blue 10G513 pigment, which has lower overall chromaticity than Blue 20G599 but higher opacity and IR reflectance, according to Mark Ryan, Market and Product Manager at Shepherd Color. ➤

Colour choice gets AI touch

Engineering plastics company Envalior, which launched in April this year and combines the former DSM Engineering Materials and Lanxess High Performance Materials businesses, is using its patented, artificial intelligence (AI)-based **Lucidiris** colour formulation technology (originally developed within DSM) to predict colour and mechanical properties of polymer compounds.

Some colourants can have a negative effect on mechanical properties but that depends on the loading, according to the company, so having the ability to quantitatively estimate the effect of colour on mechanical properties can be really helpful in product design.

"Lucidiris changes our design-build-test-learn development cycle for the customer applications of our materials fundamentally," says Erwin Houben, R&T Manager Digitization Envalior.

Several machine learning models were used to build the Lucidiris tool, starting with curated data that included recipes, LAB colour values, and full reflection spectra. A neural network was used to make a first prediction model of colour and mechanical properties, which appeared to be accurate and fast, Houben reports. The model was then improved using an optimised gaussian process model.

"The model is much stronger when used for sequential iterations. The data of every iteration can be added easily and quickly to the model, so it will power up the AI for the next iteration. [The tool] has drastically reduced our lead times to develop coloured compounds with the right mechanical properties," Houben says.

"Characteristics of particle size, hardness, absorption coefficients, and some limited initial experiments will be needed to incorporate [a new or different] pigment in the models. The accuracy of the predictions with new pigments grow with the use in every experiment," Houben explains.

The Lucidiris model could potentially be used to formulate compounds with recycled materials, but the quality of predictions will depend on the quality of input data. If the quality is sufficient, the Lucidiris models could help stepwise to give a prediction of attainable colours or what dilution with virgin material would be needed.

➤ [www.envalior.com](http://www.envalior.com)

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**Above:**  
**Avient's**  
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**Chromatics**  
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**working with**  
**BASF to bring**  
**coloured**  
**Ultrason**  
**high-perfor-**  
**mance**  
**polymers to**  
**the global**  
**market**

### EV opportunities

The growth in electric vehicle demand is driving an increased need for high-voltage electrical parts, such as connectors, that for safety purposes are required to be coloured bright orange (Pantone Orange 1495C or RAL 2003) to warn of the presence of high voltages. These parts often use high heat-resistant formulations in engineering polymers and several suppliers offer pigments to meet this need.

The latest offering in this area from **Milliken** is a high-chromatic orange – Resist XTR 9798 – which offers high thermal stability (up to 300°C) and is compatible with other additives in high-performance polymer formulations, including glass fibres, flame retardants, and heat stabilisers.

Meanwhile, **Sun Chemical's** Sicopal Orange K2430 and Sicopal Red K3050 are both complex inorganic colour pigments (CICPs) designed to enable match of the target standard shade for high-voltage parts in engineering plastics and high heat polymers. "These pigments deliver a strong orange colour after screening by critical requirements of polymer suitability, chroma and shade, as well as UV and light, processing, heat aging, and migration stability," according to the company.

Sun Chemical says that while RAL 2003 is standard for high-voltage applications in Europe even more red shades may be used in Asia. These can be achieved with a combination of Sicopal Orange K2430 in combination with Sicopal Red K3050 FK, which extends the colour space and offers high durability even in shading concentrations. "Both pigments are non-migrating and offer excellent heat aging stability due to their high opacity and inorganic character," it says.

The company says both of the pigments also offer high weather and lightfastness properties,

which is important for applications in building and construction markets.

Not all parts in electric vehicles operate at high voltages. Sun Chemical says its Spectrasense series of functional pigments are finding use in plastic parts for autonomous vehicles that use light detection and ranging (LiDAR) sensors to identify object size and distance by near-infrared radiation (NIR). These pigments can strengthen NIR reflection of plastic parts and enhance the sensitivity and ability of the system to differentiate an object or vehicle from background noise, the company says.

Spectrasense pigments are available as NIR transparent types for heat management and laser welding (top layer) applications or as a colourless absorber for transparent laser welding (bottom layer) or colour filter for sensors.

Other new pigments from the company include Microlen Blue 7460 ECO, which extends the bluish colour space for biocompostable polymer applications, and Paliotol Yellow K 1839 FP. The latter is a new and improved version of Paliotol Yellow K 1841 FP offering higher chroma, colour strength and better dispersibility. The new grade meets the need for dispersibility in finer fibre applications as indicated by better filter pressure values (FPV) with a 14-micron sieve test.

**Avient's** Colorant Chromatics business recently partnered with **BASF** to provide a full-colour portfolio for BASF's Ultrason polyarylethersulphonates (PAES). The companies say this solution will meet demand for various-sized orders with short lead times for multiple areas of application, including reusable household and food industry products, electrical and electronics, and healthcare.

"The market requirements for coloured, high-performance polymers are clear: you have to react quickly and also be able to supply various volumes of coloured material," says Anne Hippert, General Manager, Colorant Chromatics at Avient. "With this collaboration, we can offer the best of both worlds in high-performance polymers. Avient is well-known for its specialised colour solutions, respecting the customers' final application requirements, and BASF is well-known for its excellent Ultrason quality and broad material competency."

#### CLICK ON THE LINKS FOR MORE INFORMATION:

- > [www.lanxess.com](http://www.lanxess.com)
- > [www.heubach.com](http://www.heubach.com)
- > [www.shepherdcolor.com](http://www.shepherdcolor.com)
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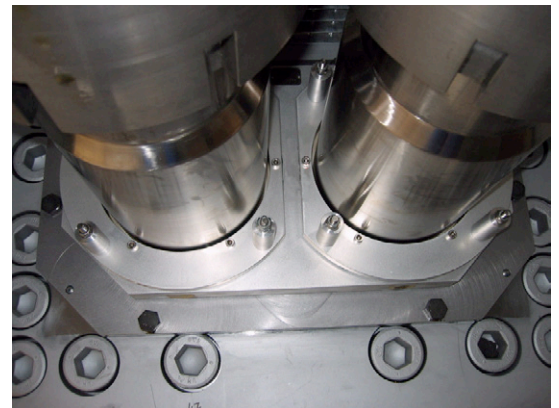
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IMAGE: SHUTTERSTOCK



# Speeding up the path to material insight

*Extending lifetime expectations and shortening product development cycles make accelerated testing an increasingly-needed materials evaluation tool. Chris Saunders learns more*

Accelerated testing plays a pivotal role in assessing the performance, durability, and reliability of engineered plastics and compounds, allowing researchers and engineers to rapidly gather data and to expose potential flaws or weaknesses. As demand for materials with enhanced properties grows, accelerated testing techniques are evolving to provide invaluable insight into the behaviour of plastics under extreme conditions. Furthermore, as sustainability gains prominence, accelerated testing is being used to evaluate the long-term effects of environmental factors, which ultimately helps in designing more sustainable materials that retain their performance for longer.

The lifetimes required of many plastic components significantly exceeds their development times, so their lifetime performance can only be determined via accelerated tests. And the current trend

towards longer part lifetimes and shorter part development times makes test acceleration even more critical. In some cases, such as for plastic pipes or sealing membranes for example, proof of lifetime of up to 100 years is often required. Practical considerations, however, mean that even lifetimes a fraction of that length cannot be verified by conventional means, and simple extrapolation of measured data is only possible over relatively short periods.

The most widely used approach to accelerating testing of plastics involves temperature increases. This shortens the relaxation times of the polymers and speeds up any physical and chemical ageing processes. "As long as the temperature increase does not cause a change in the failure mechanism, the application of the so-called time-temperature superposition principle, at least for engineering purposes, is often possible and has been demon-

**Main image: Accelerating availability of plastics materials test data to quantify expected lifetimes is becoming a priority as development cycles shorten**

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IMAGE: SKZ



strated for a variety of plastics," according to Dr Ruben Schlutter, Group Leader of the Component Properties Research Group at German training and research centre **SKZ**.

"In many cases, the acceleration factors can be described via an Arrhenius relationship or the WLF relationship [an empirical equation associated with time-temperature superposition]. In recent years, many time-lapse or rapid test methods have been (further) developed and evaluated at SKZ to describe the long-term behaviour of plastics. These include the Stepped Isothermal Method (SIM) and the Stepped Stress Method (SSM) for the accelerated determination of long-term creep behaviour," he says.

"In the creep test, the specimens pass through temperature stages (SIM) or stress stages (SSM) and a creep master curve is generated from the resulting strain response. This makes it possible to predict creep behaviour over many years using measurements of one to two days," Schlutter explains.

"To predict the slow crack growth (stress crack failure) of polyolefin materials, two new test methods have been developed, the Cracked Round Bar (CRB) test and the Strain Hardening Test (SHT), which have recently found their way into the ISO standard," he continues.

"The strain hardening modulus determined in the SHT correlates with the failure times determined in media creep tests. Instead of ageing tests in heating ovens, ageing tests in high-pressure autoclaves have been carried out to evaluate the

thermo-oxidative failure of plastics at a highly accelerated rate. There, in addition to (moderately) higher temperatures, increased oxygen partial pressures are used to accelerate ageing. Using an Arrhenius approach modified by the ageing factor oxygen partial pressure, statements can be made about thermo-oxidative failure under service conditions," he says (Figure 1).

### UV weathering

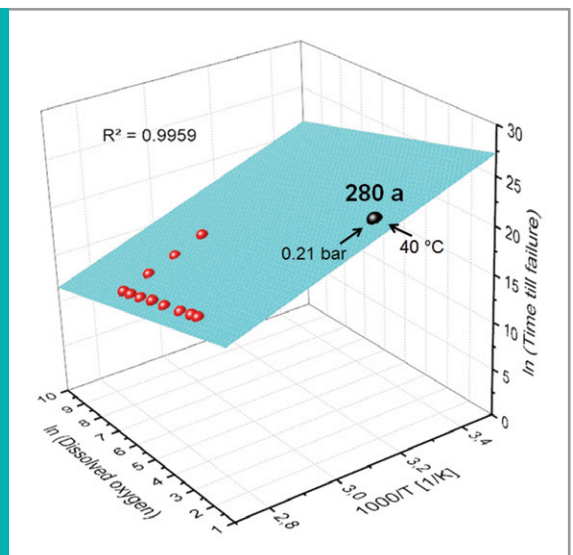
Temperature and humidity cycling is often grouped with the impact of UV exposure under the 'weathering' banner. At last year's K Show in Düsseldorf, **Atlas Material Testing Solutions** – a division of Ametek that has offered weathering testing instrumentation, laboratory, and outdoor testing services for over a century – showed its latest weathering test instruments for plastic materials and products. These included the Xenotest 440, a versatile weathering instrument suitable for use with a variety of materials that features a twin-lamp test chamber using the company's XenoLogic technology to enable faster testing. Powered by two 2,200W xenon lamps, the 440 can reach 2-sun irradiance levels for significantly shorter test times.

Also on display was the high-capacity Suntest XXL+, which meets all common international weathering standards for polymers and coatings, and the Suntest XLS+, a compact bench top instrument for weathering and colour lightfastness testing of plastics boasting a 1,170cm<sup>2</sup> test area. Both instruments have been designed for testing 3D specimens.

The release of a new sealed lamp for the established Atlas Ci4000 and Ci4400 Weather-Ometers was also highlighted. The new design simplifies installation by incorporating all assembly elements - xenon-arc lamp, inner glass filter, outer

**Left: Ageing testing in high pressure autoclaves underway at SKZ**

**Figure 1: Using an Arrhenius approach modified by aging factor oxygen partial pressure, statements can be deduced for thermo-oxidative failure**



Source: SKZ

# Plastics Sustainability Strategies

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glass filter and associated hardware - into a single, factory-sealed unit.

Advanced equipment that enables real-time virtual monitoring of material properties while accelerated field testing is in progress is becoming increasingly popular, according to Atlas, as it provides a viable alternative to on-site visits, so saving time and travel expense. The company's offering in this sector is VIEW (Virtual Inspection and Evaluation of Weathering), a remote service that first went on the market last autumn.

Using VIEW, clients can remotely interact with technicians and experts while observing the effects of weathering on their specimens in real time. The next VIEW generation is WXView II, a web-based application that allows users to securely access their instrument test data from anywhere in the world. This method of data collection allows researchers to identify critical points of degradation at key junctures and to better understand the progression of ageing mechanisms.

The EYE Super UV Tester uses a proprietary high-output UV lamp to generate ultraviolet light and is among the latest introductions from **Applied Optix**. Its UV-irradiation intensity is 30 or more times greater than that of sunlight and conventional weatherometers and, to achieve better solar correlation, the company says UV radiation below 295nm (UVC) is removed from the light source using a custom filter. Removing this radiation, which in natural sunlight does not reach earth, is said to result in an acceleration in deterioration that more closely resembles true outdoor exposure.

The versatile tester can not only be used for plastics and polymers, but also for testing automotive materials, in building and construction, paint and coatings, and composite applications. As a screening tool, it is claimed to be able to generate five years of UV exposure in ten days, offering the opportunity to save money and considerably speed up the time to market for new products.

### UVC exposure

While UVC radiation may not be a component of natural sunlight, there are areas where plastics are exposed and potentially damaged by it. UK-based specialist polymer additives developer **Radical Materials** uses accelerated testing techniques and says UVC radiation testing now plays a key role in its business.

UVC radiation has been used for many years to disinfect water supplies, pharmaceutical products, and general surfaces - the method is called Ultraviolet Germicidal Irradiation (UVGI). In recent times, and especially since COVID, there has been



IMAGE: RADICAL MATERIALS

a dramatic increase in the use of this technology in industries such as transportation, retail, food processing and healthcare, where it is used to kill bacteria and viruses.

"Whilst UVA and UVB radiation will reach the earth's surface as components of sunlight along with infrared and visible light, UVC never does as it is filtered naturally by the ozone layer," says Chris Vince, Technical Director at the company. "Many materials used are therefore not designed to withstand UVC, which is higher in energy than either UVA or UVB and potentially more damaging. UVC exposure can lead to significant degradation if the material is not designed for it, and the speed and extent of this degradation is still largely unexplored. UVGI doses received in-service can be extremely unpredictable and their application and subsequent material testing is currently poorly standardised."

Standard accelerated weathering tests focus on UVA and UVB and tend to filter out the higher energy UVC element. Therefore, a conventional weathering test will tell a manufacturer or user very little about the effect of UVC on a particular material, and it can be a huge challenge to determine whether the material is fit-for-purpose based solely upon its degradation over repeated UVC exposure cycles.

Due to the increasing use of UVGI and its largely undocumented effect on material performance, new dedicated UVC test machines have been developed. Radical says these machines are not designed to administer UVGI, but rather to simulate and accelerate the UVC dosage of repeated UVGI cycles and subsequently test the effects on defined material parameters and properties.

A typical method of utilising such a machine would be to develop a simulation based upon the UVC cycles the material is expected to be exposed to while in service. For example, if it is assumed that

**Above: UVC testing of samples in progress at Radical Materials**

one cycle of UVGI is equivalent to a dose of 1 J/cm<sup>2</sup> then, if performed daily for a year, the UVC machine would be set to an irradiance of 6 mW/cm<sup>2</sup>. It would, therefore, achieve a one-year equivalent UVC radiant dosage over a 17-hour cycle.

“It seems clear that the already rapidly expanding use of UVGI will continue to grow across an ever-widening range of industries and applications. Materials which were never designed for nor expected to be exposed to UVC are increasingly seeing repeated exposures and often without the required testing or even knowledge of manufacturers. Published studies have shown some significant degradation of materials under UVC which would likely reduce performance or, in the worst cases, potentially render the components unfit for service,” Vince says.

“The use of UVC irradiation for UVGI and subsequent testing is not currently well standardised and the utilisation of a dedicated UVC exposure test machine should be considered a powerful tool in assessing whether materials are still fit for purpose based upon new conditions of service or, if not, designing ones which are,” he adds.

**Setting standards**

The need for UVC testing standardisation is recognised by **ASTM International**, which recently announced the publication of ASTM G224, Standard Practice for Operating UVC Lamp Apparatus for Exposure of Materials. It is described as the first international standard to outline the basic principles for operating test instruments to evaluate the durability of materials exposed to UVC light. **Q-Lab Corporation**, a provider of material durability testing products as well as weathering, light stability, and corrosion testers, led the development of the standard, which provides users with a comprehensive reference for conducting UVC exposure laboratory testing.

The team responsible for the standard’s development was led by Sean Fowler, Senior Technical Director at Q-Lab, who said: “One of the big problems the new standard addresses is that exposures using customised, one-off test devices generally lack good UVC measurement and control. Without an international standard, it is difficult for a laboratory quality system to identify the kinds of gross UVC measurement errors that have been observed in some studies. Because G224 includes test cycles with specific irradiance levels, UVC calibration traceability chains and interlaboratory comparisons have a better chance to identify sources of measurement error and correct them.”

Last September, UK-based **Element Materials**

**Technology**, which operates a global network of over 260 laboratories, completed the acquisition of US-based National Technical Systems (NTS). Based in Anaheim, California, NTS provides qualification testing, inspection, and certification services and serves a wide range of end markets including space, defence, aerospace and connected technologies.

The range of testing services NTS offers extends from EMC/EMI and materials to climatic testing. The inspection division is accredited by many international organisations and operates under the Unitek name, while its certification division, NQA, is a global ISO registrar with active certifications in more than 75 countries.

Jo Wetz, Element CEO, said: “NTS is a strategic acquisition for Element, bringing greater scale and complementary sector knowledge in North America and globally. Together, we will be able to further extend our portfolio of services across some of our most important end markets, bringing improved support for our customers all around the world.”

Element has also expanded its presence in Asia with the recent acquisition of CTK, one of the leading connected technologies testing companies in South Korea. CTK’s testing equipment includes three 10m chambers, two 3m chambers, a debug lab, and the largest lab in South Korea for ingress protection (IP) testing. The company recently opened a new 4,400m<sup>2</sup> testing centre, Unhak 2, to meet rising demand for electrical safety, reliability, and wireless testing in targeted end markets.

Earlier this year, another UK company, **Intertek**, announced a significant investment in its production and integrity assurance centre of excellence in Manchester, which specialises in advanced corrosion consultancy and testing. The upgrade includes a suite of Instron Electropuls E10000 electrically actuated load frames, which are versatile machines that increase testing capabilities by introducing torsional force application and enabling uniaxial (tension or compression) or bend testing of lighter weight, lower strength materials. Installed in a dedicated laboratory, the new rigs can accommodate humidity control chambers with temperature ranges of -196°C to 350°C.

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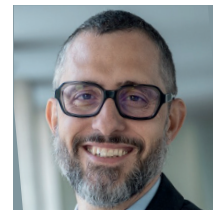
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# New demands call for advanced stabilisers



IMAGE: BASF

**Whether to lift virgin resin performance or to enhance functionality in recycled resin streams, stabiliser manufacturers are working hard to meet new user demands, writes Mark Holmes**

Antioxidants and UV stabilisers for plastic compounds have a simple role – to provide protection during processing and long-term stability in demanding end-use applications. However, demands and expectations of end users change continually so antioxidant and additive manufacturers are required to satisfy ever higher performance criteria, meet tightening regulatory limits, and to develop solutions that will function with new bio-based resins and, increasingly, with recycled plastics.

Antioxidant manufacturer **Dover Chemical Corporation** sees the market evolving and changing in two specific areas, in particular. “Firstly, I think a significant portion of polymer producers will switch from standard, commodity antioxidants to newer ones, largely due to regulatory concerns,” says Shawn Cook, Technical Manager - Plastic

Additives. “Of course, this does not mean all polymers – there will be holdouts – but I think most of the big polymer manufacturers will eventually change over. Secondly, I think that with the development of new polymers and their architectures, antioxidants will have to perform better, which also signifies the evolution. After all, I could not imagine the development of a new, premium polymer without the need to address an additive package designed to meet future demands.”

Cook adds that regulatory pressure, fueled at least in part by societal pressure, is causing many companies to re-think how they approach additives. Companies know that they need them and that they need good ones, he says. However, additives will often only be heard of when something goes wrong. Increasingly, companies are now

**Main image: New end user demands and tighter regulation call for more advanced and higher performing polymer stabilisers**

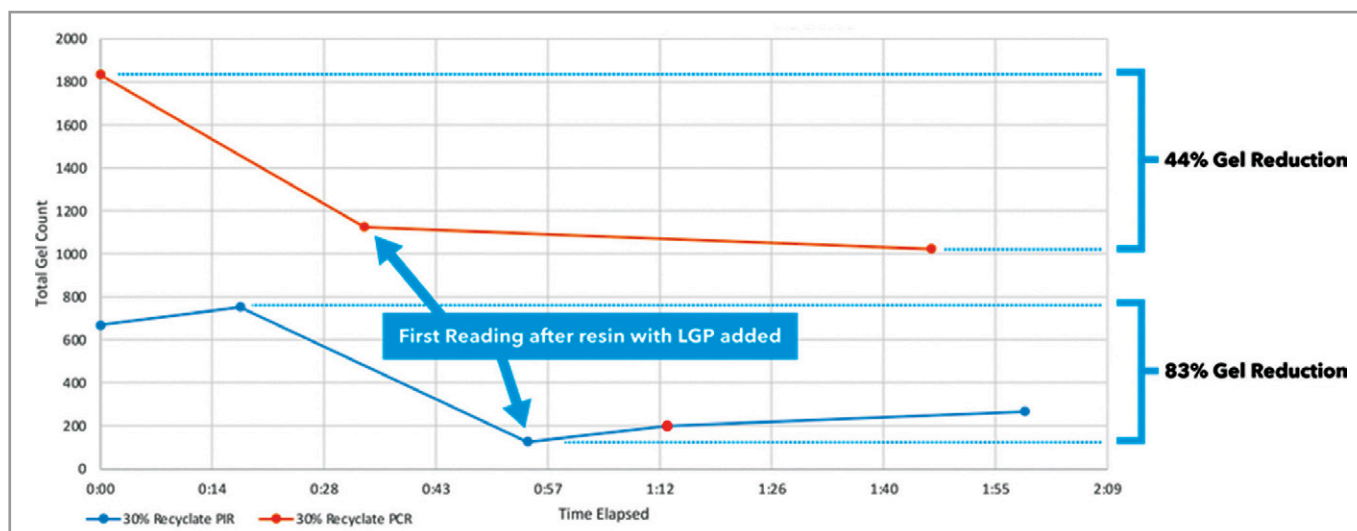


Figure 1: Total gel count in PE film containing 30% PCR and PIR recyclate streams showing the impact of Doverphos LGP-12

Source: Dover Chemical Corporation

thinking about specific additives used further downstream from the resin manufacturers.

Dover highlights two current problems in antioxidant technology (both regulatory driven) that require solutions – the emphasis on increasing recycled content in all polymer streams and finding suitable replacements for fluoropolymers (PFAS). “For recycled streams, the technical challenge is to produce an article that has high recyclate content but with the same performance as when using 100% virgin materials,” says Cook.

### Recycling challenge

“In some cases, the answer is just to use more polymer overall. That is certainly counter to the spirit of using recycled content. No company wants to use more material to make the same articles, but that is the current means to address the issue. I believe the solution lies in engagement throughout the entire system, with collaboration between resin manufacturers, additive suppliers, article producers and recycling companies,” he says.

“For PFAS replacements, it is currently a bit of a ‘Wild West’ situation. There is an industry-wide standard that is soon to be banned with no real viable alternative. Existing solutions are temporary at best, or they would already be used, and new solutions will have to undergo considerable scrutiny. After all, no company wants to commercialise a product and go through lengthy and expensive approvals only to have to repeat the process in a few years. Any solution has to work and be future-proofed,” Cook says.

Dover claims it has solutions for these problems, most based on its Doverphos LGP-12 phosphite antioxidant. The company says LGP-12 was designed to be high-performance while minimising

current and predicted future regulatory concerns. As an antioxidant, it can help to stabilise recycling streams in-situ to make a higher quality recycled resin, it says.

The use of post-consumer resin (PCR) and post-industrial resin (PIR) in film production often means that recycled streams are of a lower quality than virgin resin, it says. Gels – visual or structural defects in the film – can have a detrimental impact on elongation strength, leading to premature tearing. They can arise from contamination caused by water and debris, as well as cross-linked resins, typically arising from inadequate stabilisation and/or excessive heat. During re-granulation, PCR and PIR exhibit insufficient stabilisation, leading to excessive gel formation that reduces tear and elongation strength of the film.

Doverphos LGP-12, which has an alkylphenol-free composition and is produced from bio-sourced raw materials, can ease gel problems (Figure 1). It is compatible with thermoplastic resins, reduces additive migration and eliminates plate-out and blooming of the phosphite. Introduced during PCR re-granulation, the company says LGP-12 scavenges free radicals generated during the thermal degradation of polymers, preventing gel formation and other degradation byproducts. It can also help preserve the melt flow index of the resin, leading to comprehensive stabilisation and smoother processing.

A secondary property of LGP-12 is its metal affinity and fast film formation as a polymeric liquid. Dover says it has been able to enhance this inherent property into a suitable replacement for fluoropolymers used as processing aids in the polymeric film industry, under the tradename of DoverClear. >

## Overcapacity issues

According to **Clariant Adsorbents & Additives**, the market for antioxidants and UV stabilisers is facing a long-lasting and deep crisis of overcapacity, with low demand and prices. "During the Covid period, new capacity in China has been built for antioxidants, HALS and some intermediates," says Dr Mohamed Sidqi, Global Manager for Plastics Upstream. "Meanwhile, a decrease in polymer production rates and related market prices has put the whole industry in a difficult situation."

Sidqi adds that drivers for new developments in antioxidants and UV stabilisers are based on natural and sustainable stabilisers, focusing mainly on antioxidants. For UV absorbers, drivers are mainly replacement of benzotriazoles, which are on the EU SVHC (substance of very high concern) list.

In performance terms, one of the major obstacles to overcome, when it comes to plastics circularity, is the need to maintain high polymer quality over multiple recycling cycles. "New concepts for polymer stabilisation and new additive solutions are required to improve original plastic quality. This is crucial for recycling, for recyclate quality and for achieving plastics circularity," says Sidqi.

"Recycling is one of the interesting technical areas where a lot of development is being undertaken in both mechanical and chemical recycling. Most polymer producers are acquiring recycling companies or building their own recycling lines. The high cost of recycled materials, availability and quality of waste remain a real challenge. Some additive solutions largely based on traditional antioxidants are available, mainly for mono-material polymers. However, those solutions are not sufficiently efficient to ensure circularity," Sidqi adds.

The latest development from Clariant is Ad-dWorks PKG 158, which was launched at the ChinaPlas trade show earlier this year. The additive is designed to improve ESCR (environmental stress-cracking resistance) and OIT (oxidative induction time) in HDPE blow moulding and related recyclate quality. The performance benefits include improved melt flow (MFR) and colour after multiple extrusions, as well as boosting mechanical performances at a lower dosing levels.

As part of its Ecocircle circular plastics programme, in which Clariant works in joint projects with a number of different partners and expert teams in the packaging sector, the company has developed a performance additive system that is claimed to maintain the properties of high-value PCR material. It is said to confirm the viability of 100% PCR content in skin and body care packaging applications.

Meanwhile, the *Design4Circularity* project – a

collaboration between Clariant, Siegwark, Borealis and Beiersdorf – was launched to produce recyclable consumer packaging based on 100% retrieved plastic packaging waste for cosmetics applications. It aimed to develop truly circular packaging by incorporating full life cycle thinking at each development step so that a cleaner input waste stream can loop back into high-value applications.

The project centred on a colourless polyolefin bottle with 100% PCR content, which was full body sleeved in a printed deinkable shrink sleeve. Critical design parameters included polymer and additive composition, material selection of sleeve and bottle, sortability and deinking of sleeve material, recyclability and PCR quality. First sorting trials in existing recycling infrastructure proved the sortability of the full body sleeved HDPE bottle and are said to have achieved a high recovery of bottle material. Trials conducted with full body sleeved, transparent PET bottles achieved similar results.

## Sustainable investment

Softening demand has been evident through 2023, according to specialty additives maker **SI Group**, which says that restocking, initially anticipated for the middle of the year, is now shifting towards the fourth quarter. "Although demand for certain legacy products is weak, companies like SI Group are using the time to invest in their sustainability developments and innovation pipeline, while expanding product offerings such as Evercycle," says Jeroen Frederix, Market Development Manager – Circular Economy.

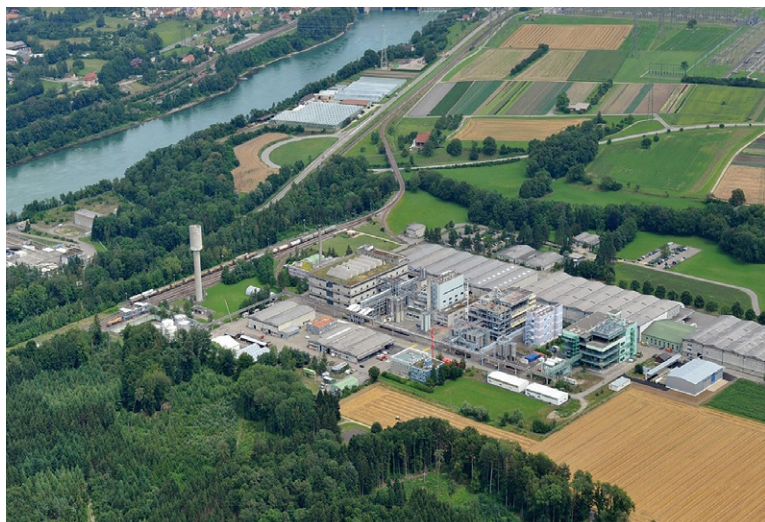
"Without question, the challenge of ramping up



The Design4Circularity project saw Clariant, Siegwark, Borealis and Beiersdorf take on the challenge of creating recyclable cosmetics packaging based on 100% plastic packaging waste

Image: Clariant

IMAGE: BASF



**Above: BASF's additives plant at Kaisten in Switzerland is one of two sites piloting its ISCC Plus Biomass Balanced (BMBcert) product introductions**

the levels of recycled content and the desire to increase recycled content in plastics is driving new developments in sustainability. SI Group has already seen this for a long time in non-food packaging and consumer goods, but we see these impacting other markets such as the automotive, industrial and building segments," he says. "SI Group is leading the way in providing customers with innovative bio-sourced products, such as Naugard Bio-XL and broadly applicable products for plastics recycling, such as those in the Evercycle portfolio."

According to SI Group, increasing demand for recycled feedstock content that makes products more sustainable (circular) means challenges arise in maintaining product performance. The company says this means antioxidants and UV stabilisers that protect plastics need to be upgraded across the value chain to work not only with the extended lifetime challenges of the polymers but also the recycled-stream challenges to which they will be applied. It says it has invested significant capital over the past three years – including commissioning of a new R&D facility at Houston in the US – to make improvements to antioxidants and UV stabilisers in these areas.

One of the biggest challenges to fulfilling market demand for recycled resins is availability of good quality feedstock and proper sorting processes at scale. "More flexibility in feedstock sourcing will support the growth of the mechanical recycling industry," says Frederix. "Understanding the relation between feedstock impurities, or cross-contaminants, and the performance of both stabilisation packages and polymer is crucial. In addition, chemical recycling mid-term will play a crucial role in the circularity of plastics, provided key hurdles in the policy domain like acceptance of the mass-balance approach are overcome. With

these virgin-like polymers hitting the market, there is an opportunity to rethink with the polymer producers how to properly stabilise and enable resins for a more circular future."

Last year, SI Group launched the first generation of its Evercycle additive products, designed to support circular economy-based goals such as performance enhancement and recyclability initially in PET and polyolefin applications. It says it is now focusing efforts on improving and expanding the portfolio to additional specific, tailored solutions such as multilayer film and automotive compounding. This will increase coverage across different additional feedstock types and recycling streams.

Slower activity in antioxidant and UV stabiliser demand is also reported by **BASF**, although the company's expectation is that this will recover in the medium term and that sustainability will be a key driver in that. "Sustainability and regulation are clearly driving all new developments in plastics and the additives that protect them. As the plastics industry becomes more circular, renewable, bio-based, and increasingly regulated, antioxidants and UV stabilisers must adapt to these new expectations," says Dr Achim Sties, Senior Vice President, Plastic Additives.

"The public is learning to ask more questions about the safety and content of their consumer goods. This requires a new approach from the industry to demonstrate the safety of their products, beyond what is already required for the legal production and sale of additives to the market. The combination of these two trends is inspiring resin producers to develop new sustainable materials," he says. "While many existing additive solutions can readily be used in these applications, there is also a need for new, more sustainable antioxidants and UV stabilisers to match these polymers."

### Parallel solutions

However, Sties adds that plastics recycling rates have not scaled with the rate of production. He says several parallel solutions are needed to address this larger problem. Most importantly, recycled plastics must be able to perform at, or near, the same level as virgin resins. This is technically possible, particularly with advances in collection and sorting infrastructure, but the inherent damage to plastics from their first life must still be mitigated by an appropriate additive package to prevent further damage during processing.

Sties also notes that research into biodegradable or bio-based plastics has exploded. While these materials are often used in limited applications, the same technical needs for processing



stability and UV protection are expected. Additives need to be tailored accordingly, he says.

According to BASF, there is a great need to find additive solutions to support an accelerating plastics recycling market. "Technically, recycled plastics present more challenges than virgin materials because they have suffered and aged through their first life. Therefore, new antioxidant and stabilisation solutions are needed to address the challenges of each application and material stream," says Sties.

As part of the company's broader Valeras sustainability portfolio, it has introduced a range of additives under the IrgaCycle brand to address the mechanical recycling market. Five core products address some key challenges for recycled polyolefins – gel formation, processing instability, UV sensitivity and other mechanical failures. Knowing that the recycling market and streams are highly variable – regionally, seasonally and by consumer demand – the company expects to develop new solutions to support increasing recycled content concentrations and performance demands.

"Recycled polyethylene designed for film applications can exhibit high levels of gel forma-



IMAGE: BASF

tion and poor processing stability. To resolve these issues, additives must be included in processing as early as possible to prevent thermal degradation during regranulation and to provide appropriate stability for subsequent film extrusion processes. For example, IrgaCycle PS 031 G restabilises rPE films and prevents crosslinking even after multiple heat and extrusion cycles," says Sties.

Further technical challenges foreseen by Sties include contamination of the recycled polymer by residual pigments and waste, as well as other

**Above: This floating photovoltaic prototype at BASF's McIntosh plant in the US uses its new Tinuvin 2730 ED stabiliser**



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mixed plastics. "Additives will play a key role in enabling high quality performance of recycled materials while mitigating any negative interactions associated with contamination in the material stream."

BASF Plastic Additives will soon launch two specific antioxidants as Biomass Balanced (BMB-cert) grades. The additives will enable customers to produce polymer grades that have a significantly lower product carbon footprint than conventional offerings. As the substitution is based on the International Sustainability and Carbon Certification (ISCC) Plus mass balance attributed content concept, customers can expect identical product performance with no change to specification or regulatory status (so no requalification required).

The company has received (ISCC) PLUS certification for certain grades of plastics additives produced at manufacturing sites in Kaisten in Switzerland and McIntosh in Alabama in the US. It says the two sites are acting as pilots prior to global implementation.

**Floating ideas**

BASF has also developed a new UV stabiliser system, Tinuvin 2730 ED, which is formulated to extend the lifetime of polyolefin in high exposure conditions to more than 30 years. The company

expects it to play a role in expanding installation of floating plastic photovoltaic (PV) systems, which provide an alternative to land-based installations that do not compete with agriculture or other requirements.

A proof-of-concept floating solar system has already been installed at BASF's McIntosh additives manufacturing site at Alabama in the US as part of its 2050 net zero CO<sub>2</sub> emissions programme. Developed in conjunction with Noria Energy, the floating pontoon solar system features a flat-pack design based around a TPO floating frame. The pilot system powers three aerators that are used to improve water quality in a pond at the facility.

"Now that we have the installation and the proof of concept at McIntosh, they're [Noria Energy] working with our energy management team to look at installations at our Wyandotte site. That's also going to be a large-scale pilot for the Noria-specific design, which will be a hundred times the size of the pilot we have in place. We're also looking into our Geismar Verbund site, which currently can support a 5 MW system," according to Neil DeLoggio, BASF's Business Development Manager for Plastic Additives in the Americas.

The Baeropol T-Blend product line from **Baerlocher**, which includes its Baeropol RST stabiliser, has formed the basis for a set of additive

# Stabilisation key to TPO roofing success

Polyolefin-based roofing membranes have achieved a prominent position in low-slope roofing solutions in North America, according to Andrea Landuzzi, Global Marketing Director Technology Solutions - Polymer Additives at Solvay, and that success is now spurring considerable interest in both Europe and Asia, where TPO products are gaining market share against PVC, bitumen and other materials.

The key attractions of TPO membranes include good physical performance, puncture resistance, flexibility, and ease of fabrication, installation and sealing. A further attraction, Landuzzi says, is that they are design-friendly, supporting easy integration of building integrated and building applied photovoltaic (BIPV and BAPV) systems.

Extending service lifetimes is an



**Solvay says latest TPO roofing membranes require advanced stabilisation chemistry**

important goal for membrane manufacturers, who are looking for advanced stabilisation systems that provide the required durability in the most extreme thermal and UV conditions and that will accommodate forecast climate change impacts.

Solvay's Cyasorb Cynergy Solutions B Series stabilisers are said to provide very good UV resistance (to 60 kJ/m<sup>2</sup>)

and thermal stability (up to 135°C) in TPO membrane formulations, surpassing the current standards for TPO sheet roofing in North America, Europe and China. Membranes produced using the additive are discoloration resistant and protected against microcrack formation, the company says.

> [www.solvay.com](http://www.solvay.com)

IMAGE: BAERLOCHER



blends that it says have been found to be particularly useful in polyolefin recycling applications. The additives are available in a dust-free pastille form, which is good for recyclers that often struggle to handle powders.

Brand owners are increasingly using recycled HDPE for packaging of goods such as detergents and personal care products and that has resulted in competition for material of suitable quality. Converters of such have identified a variety of processing challenges, according to the company, some of which can be overcome using a Baeropol T-Blend. Benefits include the ability to use a lower quality feedstock, which results in material cost savings, as well as allowing faster processing cycles.

Baerlocher says that the Baeropol T-Blends are also playing a role in film reprocessing, where they can be fed directly into the cutter-compactor unit using low-cost volumetric feeders. The company says the improved quality of the recycled material is evident in, for example, blown film production where gelling and bubble breaking is reduced and more homogenous mechanical performance is achieved.

### PA solutions

Brugolen TP-H2062 and TP-H2217 are the latest metal and halogen-free heat stabilisers for reinforced and unreinforced polyamides for electrical and electronic applications from **Brüggemann**. The company says the additives do not corrode metallic components in parts such as overmoulded sensors and have no impact on the polymer's electrical properties.

Available as easy to handle masterbatches, the company says they enable continuous service temperatures of 170°C with peaks of up to 200°C, so meeting stringent automotive industry requirements and exceeding the limits of conventional

systems such as phenol- and copper-based stabilisers. The Brugolen TP-H2217 grade is said to be particularly suitable for heat-stabilising halogen-free flame retardant polyamides.

Another new stabiliser from the company is Brugolen TP-H1804, developed for aliphatic polyamides used at continuous service temperatures of 160-190°C. The company says the additive outperforms copper salt-based stabilisers in terms of mechanical property retention of the materials to which it is added. It complements Brugolen TP-H1805, which was introduced in 2019 and stabilises reinforced aliphatic polyamides for continuous service at 200°C for PA6 and at 230°C for PA66.

Masterbatch manufacturer **Ampacet** has introduced PET UVA, an FDA-approved masterbatch that provides UVA protection for clear PET packaging. The company says the new product is suitable for blow moulding, film and sheet extrusion processes, offering good clarity and UVA protection with transmission of less than 10% at 13 mils up to 390 nm with a 1% LDR. It is claimed to be able to significantly reduce the cost of UVA protection for PET packaging by providing benefits with LDRs of 0.4-0.8%, depending on performance requirements.

### Making predictions

Researchers at **Fraunhofer LBF** (Institute for Structural Durability and System Reliability) say they have developed an online rheological investigation method for accelerating development of antioxidant formulations. Plastics degrade by auto-oxidation when in contact with air, a process initiated by elevated temperature or light that propagates as a radical chain reaction, causing cleavage of the



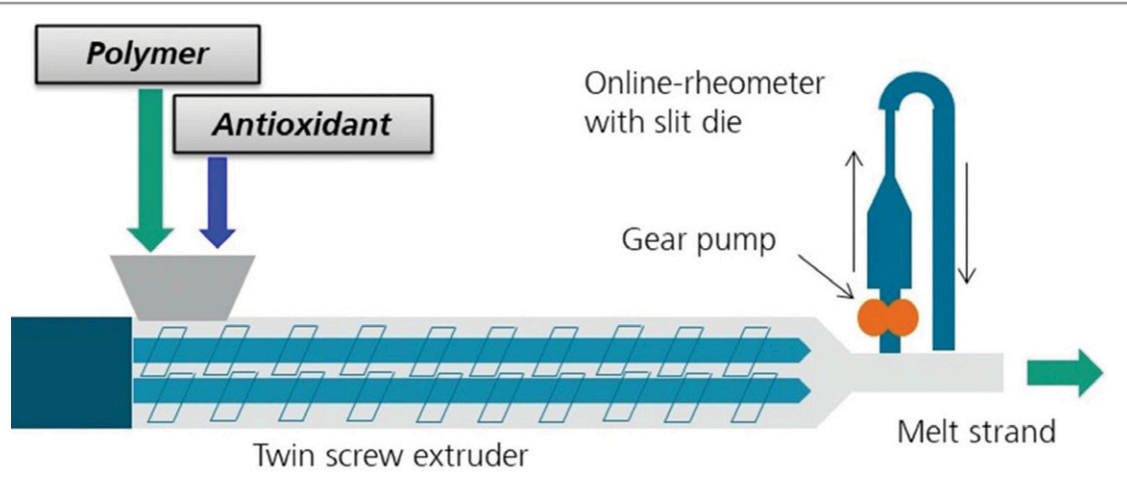
IMAGE: AMPACET

**Left:**  
**Baerlocher's Baeropol T-Blends can improve the quality of PIR and PCR content used in PE film**

**Left:**  
**Ampacet's PET UVA is an FDA-approved masterbatch that provides UVA protection for clear PET packaging**

Researchers at Fraunhofer LBF are using online rheometry to speed up development of optimally stabilised compounds

Image: Fraunhofer LBF



polymer chains. The Fraunhofer researchers say the polymer chains are primarily attacked by the OH-radical resulting in the formation of hydroperoxide moieties, which trigger follow up reactions leading to OH-radical regeneration.

For optimum protection of the polymer, the researchers say two different types of antioxidant must be added. A primary antioxidant, often containing a phenolic structure, quenches the OH-radical. A secondary antioxidant, consisting of sterically hindered alkyl-derivatives of functional groups such as phosphites or thioethers, react with the hydroperoxide without OH formation. Both types of antioxidant act in a synergistic way and a typical commercially available stabiliser package containing both antioxidants in equal amounts was used in the institute's experiments.

Commercially available virgin plastic grades are typically formulated with appropriate stabiliser packages for the expected use for reasons of resource efficiency and economy. As has been mentioned previously, when recycling plastics some of the stabilisers will have been depleted during the previous life cycle. Reprocessing recyclates for use in injection moulding, for example, requires adding stabilisers suitable for the type of plastic and its stage of ageing.

Fraunhofer LBF says the traditional way to optimise stabiliser content is to compound a series containing varying amounts of antioxidants, then characterise them offline using tests such as melt volume rate (MVR, DIN 1133-1) or oxidative induction time (OIT, ASTM D3895-19). As a result, the first reliable results are obtained only after the compounding step has been completed.

The LBF researchers aim to gain an indication of the efficacy of the stabiliser content during the compounding step. To achieve this, the viscosity of the melt is used as a response and recorded while varying the recipe using an online rheometer fitted

behind the screw tips of the twin-screw extruder. It measures the flow curves of the shear as well as the elongational viscosity.

First experiments were carried out on a minimally stabilised virgin polypropylene (PP) with the amount of stabiliser added varied at selected screw speeds. The reduced process-related degradation was immediately reflected in an increase in viscosity in the flow curves. Above a certain additive level there was no further increase in viscosity, meaning that for the actual processing conditions the stabiliser concentration had reached the limit above which no further improvement could be achieved.

The researchers say the experiments show that online rheology provides the formulation developer with high value information regarding the efficacy of a processing stabiliser during compounding. They add that, because the flow curves of different polymers are not identical, their information content is much higher than a single value from an MVR measurement. It is also possible to include the flow curves of the elongational viscosity in the evaluation.

The Fraunhofer team concludes that, when supported by an appropriate AI-based system, online rheology could provide a promising tool to implement stabilisation during the production of recyclates, offering the ability to make real-time adjustment according to the ageing stage of recycled feedstock.

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## Injection World September 2023

The September edition of Injection World magazine takes a look at how plastics suppliers are adapting to OEM demands for materials with recycled content. Plus an update on the latest developments in machine control technology and medical moulding.

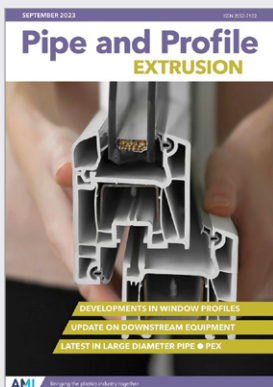
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## Plastics Recycling World July/August 2023

The July/August edition of Plastics Recycling World magazine looks at how car makers are ramping up their plans to use recycled plastics. Plus, the latest developments in chemical recycling, washing technology, and innovation in recovering ABS-base polymers from WEEE material streams.

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## GLOBAL EXHIBITION GUIDE

| Year            | Date                      | Event Name                      | Location   | Website   |
|-----------------|---------------------------|---------------------------------|--|---|
| 2023            | 20-21 September           | Injection Molding & Design Expo | Novi, MI, USA  | <a href="http://www.injectionmoldingexpo.com">www.injectionmoldingexpo.com</a>                      |
|                 | 20-23 September           | T-Plas                          | Bangkok, Thailand  | <a href="https://www.tplas.com/">https://www.tplas.com/</a>   |
|                 | 26-28 September           | Interplas                       | Birmingham, UK   | <a href="http://www.interplasuk.com">www.interplasuk.com</a>  |
|                 | 28-30 September           | Central Asia Plast World        | Almaty, Kazakhstan   | <a href="https://plastworld.kz/?lang=en">https://plastworld.kz/?lang=en</a>                         |
|                 | 5-7 October               | PackPrintPlas Philippines       | Manila, Philippines  | <a href="https://www.globallinkmp.com/packprintplas">https://www.globallinkmp.com/packprintplas</a> |
|                 | 17-21 October             | Fakuma                          | Friedrichshafen, Germany   | <a href="http://www.fakuma-messe.de">www.fakuma-messe.de</a>  |
|                 | 15-16 November            | Compounding World Expo USA      | Cleveland, USA   | <a href="http://www.compoundingworldexpo.com/na/">www.compoundingworldexpo.com/na/</a>              |
|                 | 22-25 November            | PlastEurasia                    | Istanbul, Turkey   | <a href="https://plasteurasia.com/en/">https://plasteurasia.com/en/</a>                             |
| 2024            | 28 Nov-2 Dec              | IPF Japan 2023                  | Chiba, Japan   | <a href="https://www.ipfjapan.jp/english/">https://www.ipfjapan.jp/english/</a>                     |
|                 | 13-15 December            | Arabplast                       | Dubai, UAE   | <a href="https://arabplast.info/">https://arabplast.info/</a>                                       |
|                 | 4-6 March                 | Plast-Alger                     | Algiers, Algeria   | <a href="https://www.plastalger.com/">https://www.plastalger.com/</a>                               |
|                 | 23-26 April               | Chinaplas 2024                  | Shanghai, China  | <a href="http://www.chinaplasonline.com">www.chinaplasonline.com</a>                                |
|                 | 6-10 May                  | NPE 2024                        |  | <a href="http://www.npe.org">www.npe.org</a>  |
| 11-12 September | Compounding World Expo EU | Brussels, Belgium               | <a href="http://www.compoundingworldexpo.com/eu/">www.compoundingworldexpo.com/eu/</a> |   |


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|----------------------|-------------------------------|-----------------------------|
| 26-28 September 2023 | Single-Serve Capsules Europe  | Barcelona, Spain            |
| 3-4 October 2023     | Polyolefin Additives          | Barcelona, Spain            |
| 10-12 October 2023   | Plastics Recycling Technology | Vienna, Austria             |
| 11-13 October 2023   | Executive Summit              | Hilton Head Island, SC, USA |
| 1-2 November 2023    | Medical Tubing and Catheters  | Tampa, FL, USA              |
| 20-22 November 2023  | Fire Resistance in Plastics   | Berlin, Germany             |
| 22-23 November 2023  | Recycling Flexible Packaging  | Barcelona, Spain            |
| 29-30 November 2023  | PVC Formulation Asia          | Bangkok, Thailand           |

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