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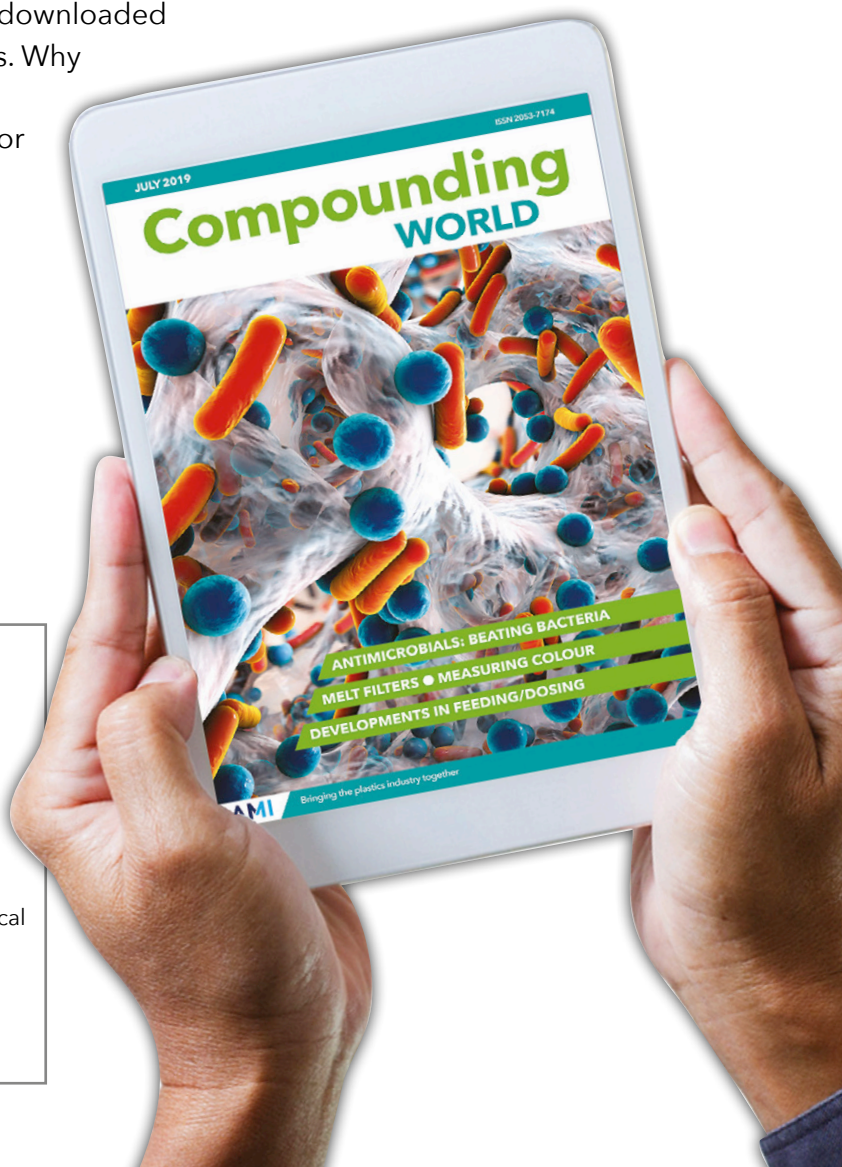
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# Polyplastics to double COC resin capacity

Japan's Polyplastics has announced plans to build a new production plant for its Topas brand of cyclic olefin copolymer (COC) at Leuna, Germany, in response to growing market demand.

This new plant will be operated by the company's Topas Advanced Polymers subsidiary and will have a capacity of 20,000 tonnes/yr when fully operational in the middle of 2023. Capacity will be similar to that from the current Oberhausen facility, which opened in 2000.

Topas COC is used mainly in medical devices for its high purity and glass-like properties. It is also used in some packaging applications; the company claims mono-material structures based on PE enhanced with Topas COC are more easily recyclable than multi-material structures using layers of PET or other PE-incompatible polymers.

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

IMAGE: POLYPLASTICS/TOPAS ADVANCED POLYMERS



**Above: The existing Topas COC plant at Oberhausen in Germany**

## Huber plans co-generation

Huber Engineered Materials' Fire Retardant Additives division is preparing to replace the lignite-fuelled steam and electricity generation plant at its Martinswerk facility at Bergheim in Germany, which makes halogen-free fire retardants and speciality

alumina, with a natural gas-fired co-generation installation.

The investment, which should begin operation in 2023, will see a 40% reduction in CO<sub>2</sub> emissions, eliminate ash by-products, and reduce truck traffic to the site.

The lignite plant was built in the 1950s. While the company said it is still operating reliably, the German government's plans to phase out coal-fired power plants by 2038 mean it will not be economically viable in the long-term.

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

## Lifocolor smooths scratches

Lifoslip D 20/112 PP is a new anti-scratch additive from Lichtenfels, Germany-based Lifocolor claimed to offer long-lasting aesthetics, functional effectiveness and feel, improved thermal stability, and good organoleptic qualities.

Suitable for use with random and copolymer PP, the new masterbatch is available as a standard additive product or a combo-batch, combining colour and additive in one product. The company says typical dosage is 2-3% and applications are envisaged in cosmetics, packaging, and PP housings and linings.

According to Lifocolor, Lifoslip D 20/112 PP "not only strengthens the scratch resistance of the polymer, but additionally prevents the build-up of a white film that can form after using standard anti-scratch additives, and which is especially noticeable on dark surfaces".

➤ [www.lifoslip.de](http://www.lifoslip.de)

➤ [www.lifocolor.de](http://www.lifocolor.de)



## Casco selects StyLight

German safety helmet manufacturer Casco International has chosen Ineos Styrolution's StyLight Hybrid S carbon composite sheet for production of its latest range for bicyclists and skiers.

The styrenic thermoplastic composite sheet material was chosen, according to Ineos Styrolution, for its combination of good surface finish with high stiffness and rigidity.

Casco International CEO Manfred Krauter said: "Our company tries to stay at the forefront of innovation. The performance of this new material fits exactly our needs."

➤ [www.ineos-styrolution.com](http://www.ineos-styrolution.com)



## LB starts MoReTec pilot unit

LyondellBasell has started up a chemical recycling pilot facility at its site at Ferrara in Italy using the company's proprietary MoReTec recycling technology, which was developed with Germany's Karlsruhe Institute of Technology.

The facility will process 5-10 kg/hour of household plastic waste "over the next couple of years", Lyondell-Basell said. The pilot will allow the company to study the interaction of various waste types in the recycling process.

The MoReTec technology is designed to convert post-consumer plastic waste to a feedstock for new polymers for use in applications including food packaging and healthcare products.

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

# Borealis secures €250m circular plastics funds

Borealis has closed a financing agreement with the European Investment Bank (EIB) for a multi-year €250m loan to support development of "novel, polyolefins-based circular solutions" at its innovation centres in Austria, Sweden and Finland.

The circular economy is one of three key sectors of development in the company's recently announced Borealis 2035 Group Strategy. To that end, and following on from the development of its Borcycle recycled polymers, the company has now added Borenewables polyolefins to its portfolio.

Borenewables are produced from renewable feedstocks derived from waste and residue streams, including vegetable oil production, waste oil and



IMAGE: BOREALIS

**A worker on a compounding line at the Borealis plant in Austria**

cooking oil, and by-products from timber industry. All have been ISCC Plus certified for traceability.

According to Borealis, the grades will deliver the same performance as the company's current virgin polyolefins with a reduced carbon footprint and are suitable for all the same applications as fossil-derived grades, including

hygiene and food contact applications.

"The promotion of circular solutions in the polyolefins industry is aligned with our goals to accelerate the transition to a circular economy, including for plastics, and to support cutting-edge innovation," said EIB Vice-President Ambroise Fayolle.

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

## NIR-sortable moves at Toyo Inks and BASF

Toyo Ink Europe Speciality Chemicals, the France-based division of the Toyo Ink Group, has become the latest to offer a black pigment option suitable for automated NIR (near-infrared) recycling sorting systems.

The company's Lioplax range of black plastic NIR masterbatches have been formulated for use in PP trays, PET preforms, films, bottles and other packaging applications. Different grades are available in varying black shades, resins and processing compatibilities.

The Lioplax products have been certified according to the French COTREP recyclability test protocol and have received positive results at the



IMAGE: TOYO INK EUROPE

Pellenc and Tomra testing centres, the company said.

■ BASF's Colors & Effects division has announced that its NIR-reflective Sicopal Black K 0098 FK grade has received FDA compliance certification for recycling. It was granted EU food

**Left: Lioplax is Toyo Ink's new masterbatch for NIR sorting compliance**

contact approval in April.

"Either alone or in combination with other pigments, Sicopal Black K 0098 FK can achieve a jet black colour, which is often sought after in packaging applications," said Dr Breeze Briggs, North America Technical Manager at Colors & Effects. "As well, it can be used for shading in many different colour stylings, thus avoiding the use of carbon black."

> [www.toyoink-europe.com/en/](http://www.toyoink-europe.com/en/)

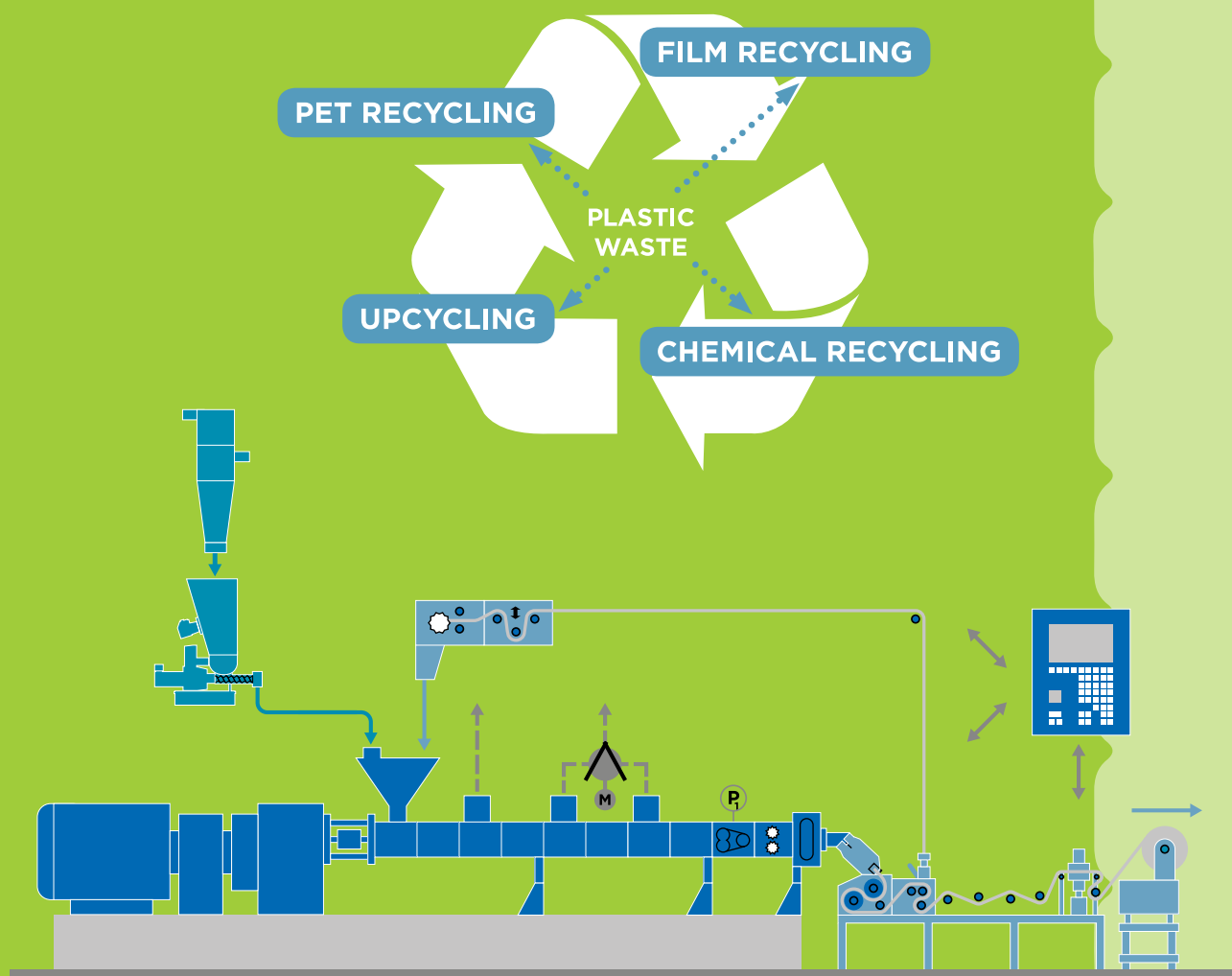
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# Avient extends reSound reach

Avient, which combines the former PolyOne and Clariant Masterbatches businesses, has launched a number of additions to its reSound R line of post-consumer (PCR) and post-industrial recycled (PIR) plastics targeting the North American and Asian markets.

Injection-mouldable reSound R VX TPEs are being offered in 25% PCR and 40% PIR grades in North America, with the former using recycled ocean plastics from Oceanworks. Both can be overmoulded onto PP and are envisaged to find application in personal care



**Avient is extending its reSound recycled compound line**

products, lawn and garden tools, outdoor goods, office supplies, footwear and houseware durables.

ReSound R ND compounds comprise 100% PCR-content PA6 and PA66

grades with varying levels of glass fibre and mineral reinforcements. These are targeted at applications in the consumer, automotive and powersports markets in North America.

For the Asian market, Avient has introduced reSound R PC polycarbonates with 25-75% recycled content and 10-30% glass filler. Several grades are available, which are said to match virgin PC in terms of tensile elongation, tensile strength, notched Izod impact, flexural modulus and flexural strength.

Avient said it is evaluating potential to make the reSound R PC and reSound R ND products globally available, but adds this will depend on regional sourcing capabilities.

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

## Kraton seeks Biaxam approval

Speciality polymers maker Kraton Polymers said it is seeking regulatory approval for its Biaxam sulphonated polymer technology from the US EPA and other regulatory agencies for use as a durable, long-lasting disinfectant.

Studies have shown that Biaxam rapidly inactivates up to 99.99% of SARS-CoV-2

and certain microbes, the company said. Potential applications include coatings on personal protective equipment, such as face shields, and high-contact surfaces including door handles, elevator buttons, public transportation surfaces and mobile phone cases.

The company said the technology is patent-pend-

ing and will be commercially available shortly, depending on EPA approval. Kraton President and CEO Kevin M Fogarty said: "We are currently conducting discussions with a number of possible development partners to explore potential applications in the US and other regions worldwide."

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

## Nabaltec starts up in US

Nabaltec's plant at Chattanooga, Tennessee, US, is now in operation. The Nabaltec facility will produce ground alumina trihydrate (ATH) products, including surface modified ground, fine precipitated, and performance enhanced grades. Capacity is more than 30,000 tonnes/yr.

The facility is the German company's second production site in the US and underlines its intention to expand its position as a leading supplier of eco-friendly flame retardant fillers in the North American region, according to Nabaltec CEO Johannes Heckmann.

➤ [www.nabaltec.de](http://www.nabaltec.de)

## Hexpol launches into cable



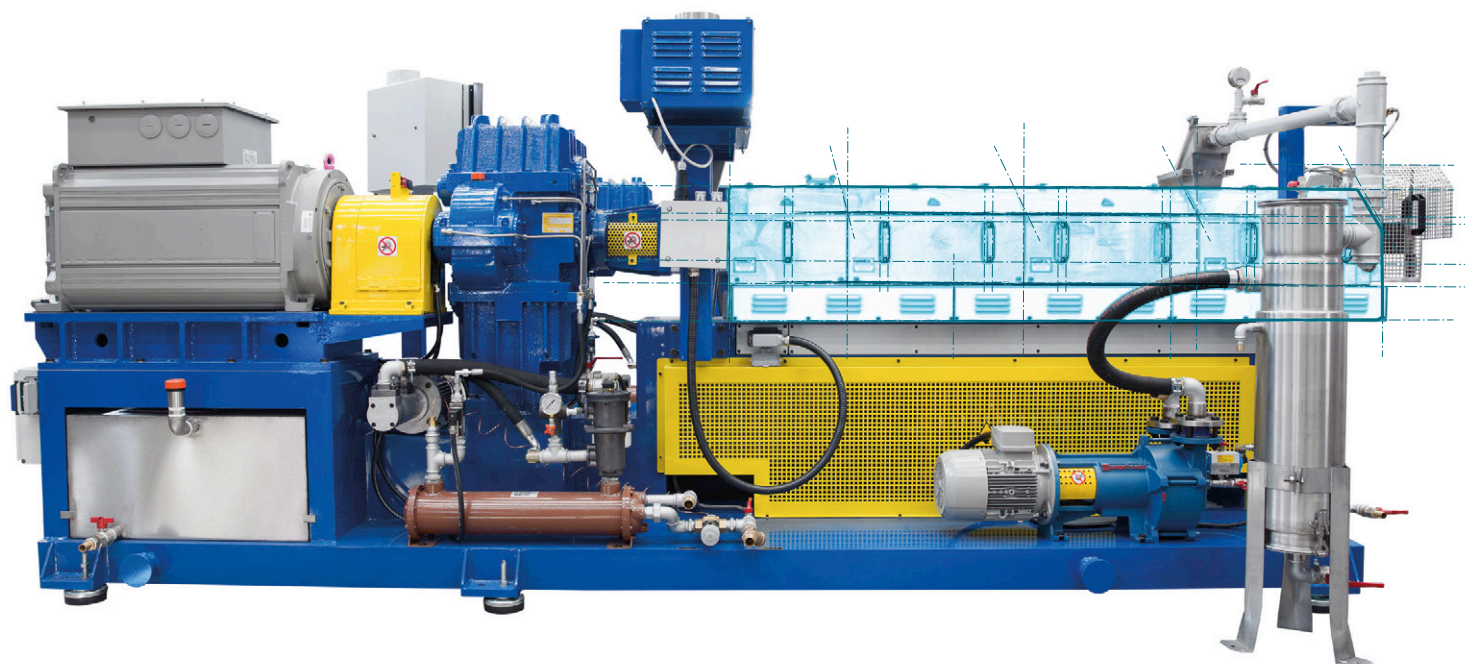
Hexpol has announced the development of a new portfolio of compounds to address the growing wire and cable market.

Products include silicone rubbers, CPE, EPDM, NBR+PVC, CR rubber compounds, pigment and additive masterbatch; thermoplastic, EVA, TPE and TPV technologies. Grades are available for bedding, insulation and sheathing applications.

Typical properties include halogen-free flame retardancy, low smoke and low toxicity. The materials are also RoHS, SVHC and REACH-compliant.

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





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# Pandemic hits German plastics recycling hard

A survey by German waste trade body BDE found the country's plastic recyclate market "collapsed" during the Covid-19 crisis, with overall use of recycled materials falling by 41% due to the combination of low virgin resin prices and declining demand from users.

The impact varied according to polymer type and market sector. PVC was the most severely affected polymer type (down 53%), followed by PET (-45%). The biggest market slumps were felt in the automotive and electronics segments, where demand fell by an average of 60% and by up to 80% in isolated cases. Smaller falls

IMAGE: SHUTTERSTOCK



**Use of recycled plastics fell by 41% in Germany during the pandemic, says BDE**

in demand were seen in the horticultural and agricultural (-35%), construction (33%) and packaging (-30%) sectors.

"The BDE views the development with great concern because the current crisis poses the risk

that not only the planned expansion of the recyclate markets will be slowed down, but that what has been achieved so far will be called into question," said BDE Managing Director Dr Andreas Bruckschen.

➤ [www.bde.de](http://www.bde.de)

## LehVoss pitches into additives

Hamburg, Germany-based Lehmann&Voss has launched a new Plastic Additives business unit, which will focus on supplying additives and fillers for

the compounding and masterbatch industry.

The company said the new division's portfolio will include in-house manufactured products as well as

product from the firm's distribution partners.

Nadia Kursawe recently joined the company to head the Plastics Additives team.

➤ [www.lehvoss.de](http://www.lehvoss.de)

## IN BRIEF...

All 16 **Birla Carbon** manufacturing facilities across the globe have now gained International Automotive Task Force (IATF) certification. The company claims to be the first carbon black manufacturer to achieve this certification.

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

BASF 3D Printing Solutions is to buy the XStrand business line from Owens Corning and add it to its **Forward AM** 3D printing materials portfolio. The XStrand portfolio comprises three 30% glass fibre-reinforced filaments based on PA6, PP and PC.

[www.forward-am.com](http://www.forward-am.com)

**KraussMaffei** said it delivered the first of its large ZE BluePower twin screw compounding machines to customers at the end of the summer. Launched at the K2019 show, the machines cover 98, 122, 142, and 166mm screw diameters and offer throughputs up to 2.5 tonnes/h.

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

## Suez and Loop invest in rPET for Europe

Suez and Loop Industries announced plans to build a PET recycling facility in Europe based on Loop's depolymerisation technology that they say will be the largest PET recycling plant in the world.

The partners said the planned recycling facility will have a production capacity of 84,000 tonnes of rPET pellets per year, requiring approximately 96,000 tonnes of PET and polyester fibre waste feedstock.

Final site selection and engineering are targeted to be completed by mid-2021 and commissioning of the facility is currently projected for 2023.

➤ [www.suez.com](http://www.suez.com) ➤ [www.loopindustries.com](http://www.loopindustries.com)



IMAGE: SUEZ

**The planned Suez/Loop rPET facility will be built at a yet-to-be-decided European location**



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## Vinnolit to close PVC unit

Vinnolit is to close its paste PVC plant at Schkopau, Germany. The company said the decision "was driven by the plant's lack of economic viability and long-term competitive sustainability".

Customers will in future be supplied from the company's three larger, backward-integrated sites at Burghausen, Gendorf and Cologne.

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

## Sukano masterbatches show antiviral effect

Sukano of Switzerland has developed new masterbatches for PET and PA that are said to have "a strong antiviral effect on the plastic parts, while also potentially helping to reduce waste and improve the sustainability credentials of the final articles produced".

In Sukano's technology, an antiviral additive is integrated directly into the polymer so it is consistently present on the surface and

not released into the environment. The antiviral effect remains stable during product usage. In fibre applications, it is maintained after multiple washing cycles at 40°C without any impact on the fibres' physical properties or yellowing, according to the company.

The effect has been demonstrated against Influenza H1N1 and feline coronavirus in external tests

on both PET and PA in fabrics, injection moulded parts and film extrusion. More than 98% of the latter was eliminated within the first two hours and, because feline coronavirus has structures and mechanisms similar to SARS-Cov-2, applications are envisaged in personal protective equipment (PPE) and face masks for protection against COVID-19.

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

## Domo targets pump bearings

Domo Chemicals has introduced Thermec S, a glass and mineral-filled, lubricated PPS-based material aimed at replacing sintered carbon in applications such as submersible pump thrust bearings.

The new material is said to combine very good abrasion and wear resistance properties with easing processing, making it suitable for both injection moulding and extrusion applications.

Submersible pumps are mainly used to extract water from below the soil for agricultural irrigation purposes. The thrust bearings are critical to performance but subject to application

temperatures of up to 200°C, high pressures, and abrasion by sand, mud and the metal housing surfaces.

While sintered carbon offers outstanding wear performance at elevated temperatures and cost performance ratio, Domo said it is also brittle and hard to process. Thermec S is said to "deliver a final product with higher mechanical properties than sintered carbon samples".

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

**Right: Domo's Thermec S PPS targets submersible pump bearings**

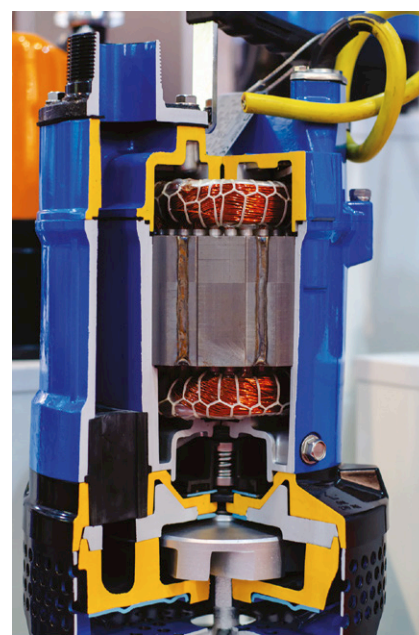


IMAGE: DOMO CHEMICALS

## Polyplastic claims a first for ESD compound

Russian compounder R&P Polyplastic has introduced Armlen PP-10AS-9010, an antistatic non-migrating PP compound suitable for electrostatic discharge (ESD) applications. The company claims to be the first local manufacturer to offer a product of this type, which it says will benefit Russian processors facing exchange rate volatility.

The new grade uses conductive

carbon black to provide the required electrical conductivity with a good balance of mechanical properties. It is said to be suitable for production of plastic packaging and trays for components and microchips, transportation and storage systems, as well as pallets.

The new compound joins a number of conductive compound developments at Polyplastic. Its Armamid

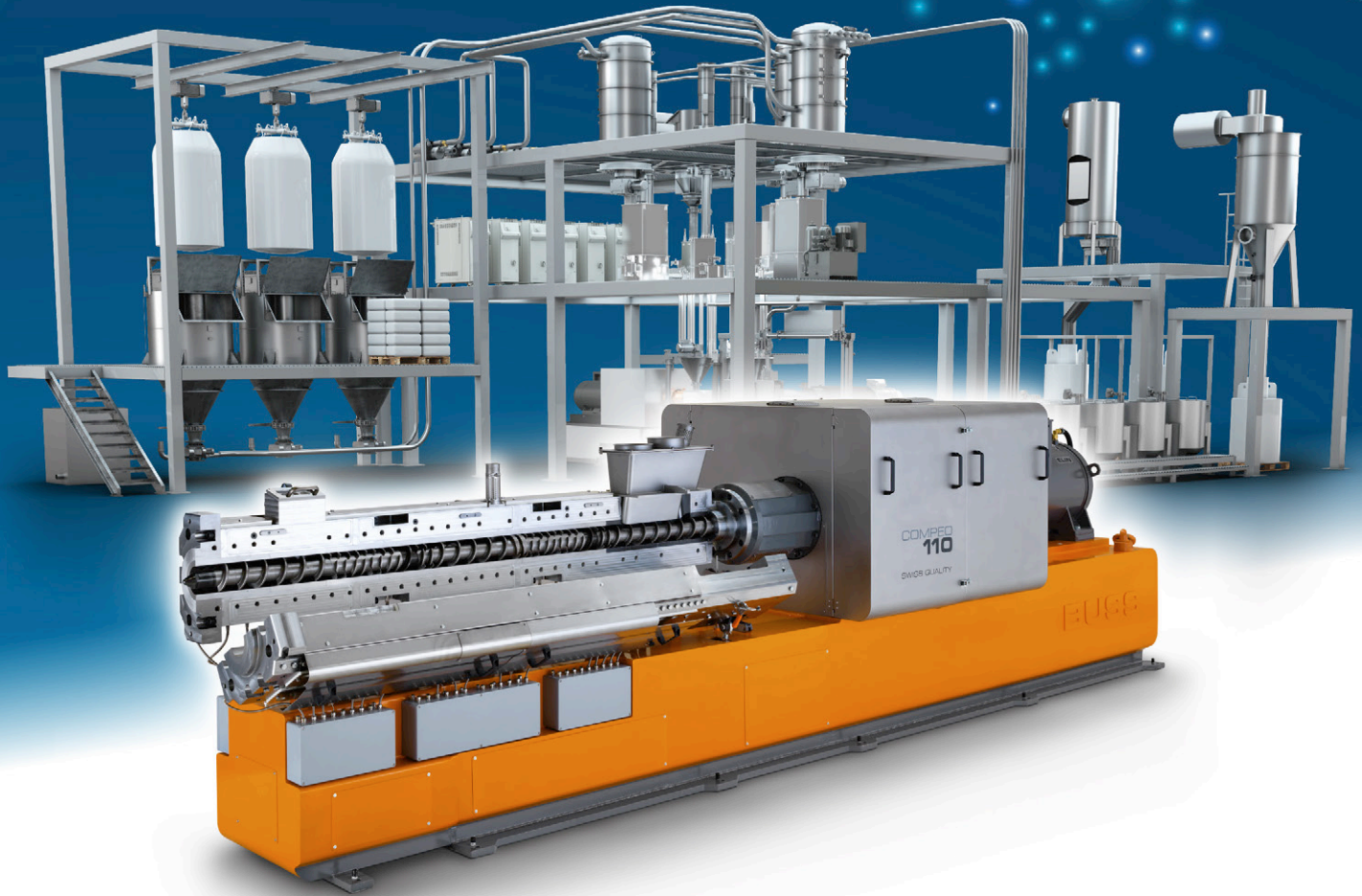
compounds are based on PA with low additions of Tuball Matrix single wall carbon nanotubes from OCSiAl making them suitable for electrostatic painting without the need for conductive primers. The company says it will start preproduction testing of an automotive fender using the material this year.

➤ [www.polyplastic-compounds.ru](http://www.polyplastic-compounds.ru)



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## Songwon adds to FR lines

Songwon has launched Songflame WB 201, a new addition to the portfolio of halogen-free, flame retardant synergists for plastics that the South Korean company introduced last year.

Songflame WB 201 is described as a solvent-free, aqueous, flame retardant dispersion designed primarily for the coatings, adhesives, sealants and elastomers market.

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

# German plastic machine orders nosedived in H1



VDMA Managing Director  
Thorsten Kühmann

The German plastics machinery sector "nosedived" in the first half of this year, with a 20% fall in orders compared to the same period in 2019.

VDMA, the trade organisation that represents German machinery manufacturers, said that this decline in orders continues the poor result of 2019 when exports declined by nearly 7%.

"The pandemic was the stab in the back for customer industries that had already been performing

badly," said Thorsten Kühmann, Managing Director of the VDMA.

"However, we also notice that many machines are being supplied - particularly to the medical engineering and packaging sectors," he added.

The majority of VDMA members expect a turnover decline of up to 30% in 2020, the association said, and do not expect turnover volumes to return to 2019 levels until 2022.

> <http://kug.vdma.org>

## Ampacet set to make a mark

Ampacet has developed LaserMarkFlex, a new portfolio of masterbatches designed for high definition Nd:YAG laser marking on flexible films.

The antimony-free range includes LaserMarkFlex

1081 for black/dark grey marking and LaserMarkFlex 1135 for lighter grey marking with broader food approval status in both EC and FDA regimes.

The company said the masterbatches are suitable

for use in monolayer as well as coextruded film structures and can print logos, barcodes, expiration or best-before dates and serial numbers on labels and packaging.

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



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*Twin screw extruders work very well but compounders have access to alternative technologies that can offer significant benefits in specific applications. Mark Holmes learns more*

# Exploring alternative compounding options

Twin-screw extrusion technology may dominate the plastics compounding industry but it is not the only option available. A number of alternative compounding technologies exist that offer processing features and techniques that can be better suited to handling specialised compounding operations and products. These include, for example, applications where increased residence times and degassing or devolatilisation are required – such as compounding of recycled polymers – or for handling shear sensitive compounds where a high dispersive and distributive mixing intensity is necessary. In addition, some alternative technologies promise more energy-efficient processing.

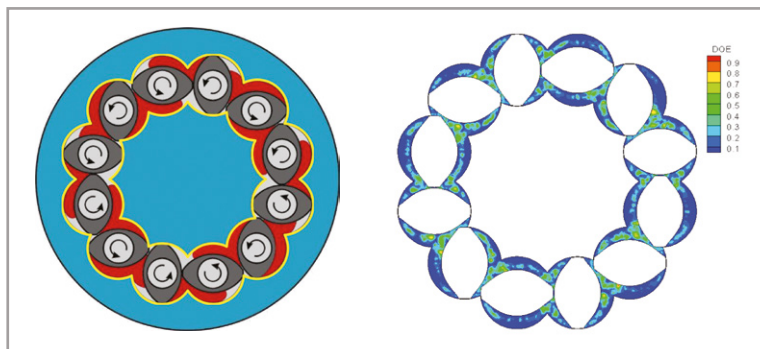
While twin-screw extruders serve the compounding industry very well, there are some specialised products that require processing conditions beyond the capabilities of conventional compounding equipment, according to

**CPM Extrusion Group.** “These materials are pushing the limits of twin-screw machinery in terms of residence time, devolatilisation and temperature control,” says Adam Dreiblatt, Director, Process Technology.

“Materials in these categories are being produced today with traditional twin-screw extruders, however, at increased manufacturing cost,” Dreiblatt says. “For example, two twin-screw extruders can be arranged in series and operated at very low production rate to reach the long residence time requirements for reactive extrusion, as a direct result of the limited free volume in co-rotating twin-screw extruders. The increased free volume of multi-screw extruders offers economical production for such applications, both in terms of capital and operating costs.”

CPM Extrusion Group’s RingExtruder RE, which is equipped with 12 co-rotating and intermeshing

**Main image:** Demand for plastics that can replace an ever-wider range of traditional materials means being able to incorporate a growing range of fillers, according to X-Compound



**Figure 1: Schematic showing the arrangement of 12 intermeshing and co-rotating screws in the CPM RingExtruder RE with a computer simulation (right) confirming it achieves elongational flow**

Source: CPM Extrusion Group

screws (Figure 1), delivers maximum degassing capacity for decontamination of rPET in bottle-to-bottle and bottle-to-melt food-grade applications. "Compared to twin-screw extruders, the RE system has the increased surface/volume relationship necessary for efficient devolatilisation, as well as the lower specific energy needed to preserve the intrinsic viscosity [IV] for the resulting PET melt," says Dreiblatt.

"At high production capacities, large diameter twin-screw extruders become less efficient for degassing and temperature control and reach a limitation above 4 tonnes/h. At these production rates, the degassing efficiency and temperature control of the RingExtruder RE is maintained by virtue of the increased surface area of the twelve screws," he says.

"The twelve intermesh regions existing between the co-rotating screws produce a high degree of elongational flow, a unique feature of the RingEx-

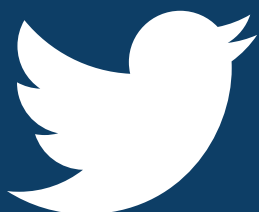
truder RE that cannot be duplicated in twin-screw extruders, which are dominated by shear flow. This translates to significantly lower energy input for melting and dispersive mixing, a major advantage when compounding materials with high viscosity and/or temperature-sensitivity. When processing such materials, twin-screw extruders must operate at low screw speed, and therefore low production rates, to minimise frictional heat and this is a key point of differentiation for the RingExtruder RE," according to Dreiblatt.

### Proven technology

More than 500,000 tonnes/yr of food-grade rPET resin is produced globally using RingExtruder RE technology, according to CPM. The technology is also widely used for continuous mixing of rubbers. However, new applications for the RingExtruder RE are currently under current development that expand on the benefits of elongational mixing in reducing shear-induced degradation. For example, the company says compounding of ABS and PC resin on large-scale twin-screw machines is currently limited by high melt temperature and the accompanying shift in colour/Yellow Index. It says these compounds can be produced with improved properties and lower specific energy using RingExtruder RE technology.

"We do not see RingExtruder RE technology competing in today's traditional markets and applications, since existing twin-screw technology is both familiar and widely accepted," says Dreiblatt. "However, increased demand for recycling of mixed plastics and chemical recycling both present significant challenges for twin-screw

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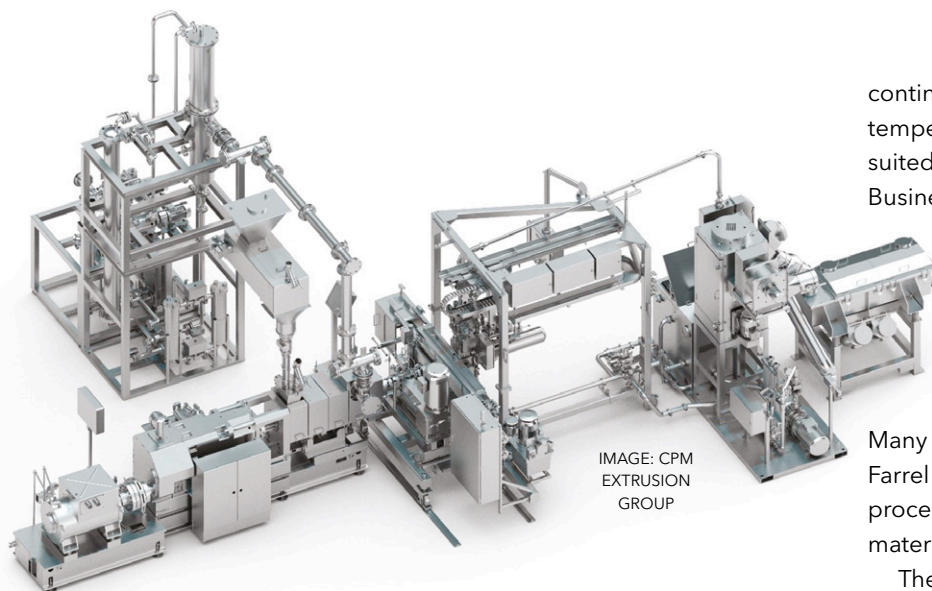


IMAGE: CPM EXTRUSION GROUP

**Above: This rPET production line for food-grade resin uses a CPM RingExtruder RE and has FDA and brand-owner approvals**

extruders, which can be met using RingExtruder RE technology.”

Chemical recycling is likely to require residence times beyond the limits of twin-screw extrusion machinery to become a commercial reality, he says. And scaling-up of reactive extrusion applications such as TPV and TPU polymerisation also becomes a challenge due to the decrease in surface/volume with larger diameter twin-screw extruders and the associated heat-transfer limitations. These applications could be successfully accomplished with the RingExtruder RE but Dreiblatt thinks it will take some time for commercial acceptance of what is, at present, an unfamiliar technology.

Improved energy efficiency may help win that acceptance. “While energy consumption in compounding is not a problem today, the ‘green’ revolution will demand reduced energy in the future. This will particularly impact resin producers with twin-screw production lines and high capacities of more than 5 tonnes/h, more than the small-to-medium sized compounders, Dreiblatt says. “As the cost of electricity will most likely increase in the future, RingExtruder RE technology will become more viable for high capacity compounding simply due to the reduced energy cost.” He adds that CPM is currently increasing the torque density of the RingExtruder RE to allow higher production rates for a given machine size, which will further reduce operating costs.

### Continuous demand

Demand for continuous mixing equipment is increasing due to the ongoing growth in key application market areas as well as the increased pressure on compounders to utilise the most efficient technologies, in particular with regard to energy, according to **Farrel-Pomini**. “In addition, today’s compounding challenges include the

continued growth of recycled materials and other temperature sensitive materials, which are well suited to continuous mixers,” says Paul Lloyd, Business Unit Director.

“Farrel continuous mixers excel at processing highly filled and temperature sensitive materials. Our principle applications include highly-filled compounds, white and black masterbatch, flame retardant compounds, PVC and flooring.

Many of the world’s leading flooring brands utilise Farrel Pomini equipment. Our activity level with processing biodegradable plastics and recycled materials has also increased significantly,” he says.

The company’s continuous mixing technology is based on two counter-rotating, non-intermeshing rotors and a large free volume mixing chamber. The large mixing chamber is said to allow liberal material circulation and good distributive mixing, while the specialised rotor geometry enables efficient levels of shear and very good dispersive mixing. Other features include incorporation of a single large feed port that allows for introduction of high filler loadings and irregularly sized materials.

Farrel Pomini says mixing intensity can be adjusted by making changes to rotor speed, working volume, thermal conditions and orifice position. In addition, the standard 6 L/D mixing unit ensures a short residence time and a low heat history for the polymer while still providing a high-quality homogeneous mixture at the exit of the processor. Modular components allow for easy maintenance and greater production time.

The company says that it sees processing of recycled materials and biodegradable plastics as a significant trend that will dominate the compounding industry as environmental concerns continue. “Continuous mixing technology is adiabatic in nature and does not impart additional heat or energy into the compound,” says Lloyd. “This is

**Right: The good degassing performance of the RingExtruder RE is related to its high surface/volume ratio**

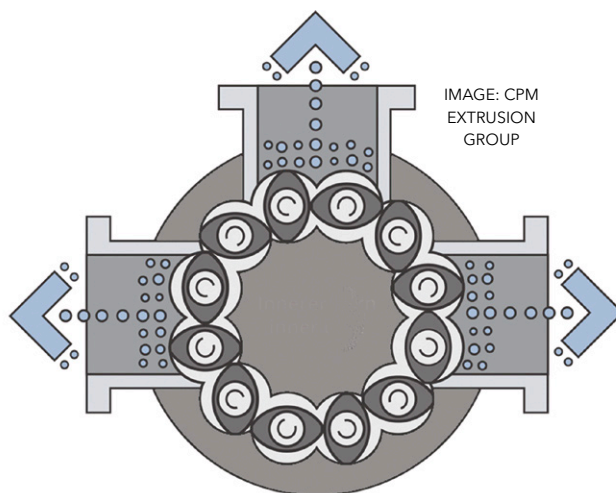


IMAGE: CPM EXTRUSION GROUP



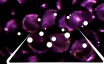
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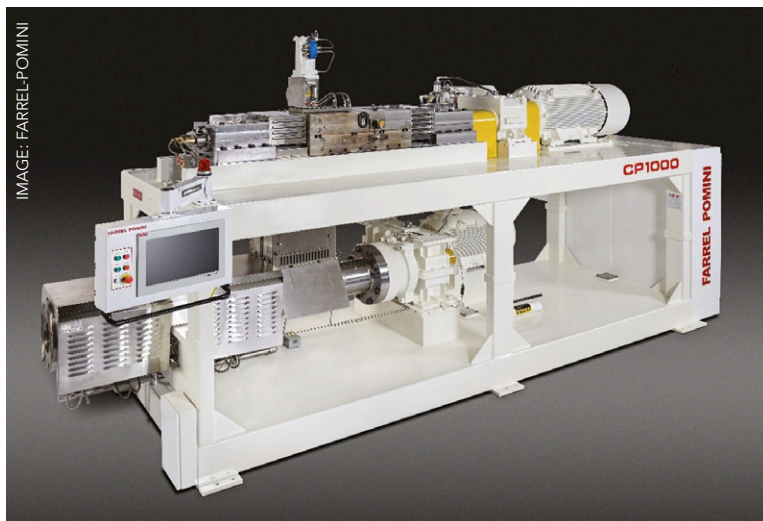
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**Above: The CP1000 compounder from Farrel-Pomini**

important to maintain the integrity of the polymer, including molecular weight, which is extremely important for processing bioplastics. Energy efficiency is also often a primary consideration when selecting compounding equipment and can be a competitive advantage for processors. Our technology is engineered for good energy efficiency and utilises significantly less energy in comparison to competing technologies.”

Compounding recycled plastic materials can be a complex process because recyclates are intrinsically contaminated, often partially degraded, and contain different pigments and granule sizes that make processing challenging. Farrel Pomini says that its continuous mixers offer several advantages for compounders of recycled materials: the large single-entry feed port is capable of ingesting irregularly sized feedstocks as well as large amounts of additives and fillers; the large rotor tip-to-wall clearances and mixing chamber volume allows efficient processing at controlled temperatures, increased material flow, high filler levels and reduced sensitivity to foreign materials in feedstocks; and good temperature control is achieved by the efficient shear levels imparted by the rotor geometry in combination with adjustable dams and orifice position.

**Right: Farrel-Pomini's continuous mixing technology is based on two counter-rotating, non-intermeshing rotors that run in a large free volume mixing chamber**

### Recycling gains

Farrel Pomini says its research and development is consistently working to provide product developments that improve efficiencies and contribute additional value to current customers, as well as for companies for whom the technology is new. “Recycled materials and temperature sensitive materials present challenges that will require innovations in processing technology,” Lloyd adds.

“Recycled materials have become extremely prevalent in compounding and the increasing

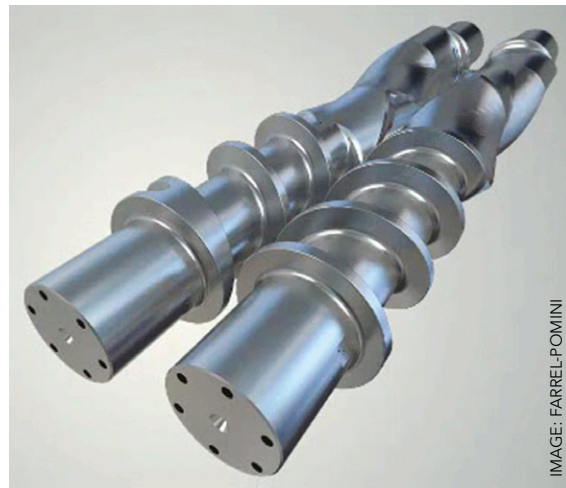
variety of recyclates need to be addressed,” he says. “Continuous mixers offer a number of processing advantages. As well as the large feed port, the non-intermeshing, counter rotating rotors and large free volume mixing chamber can tolerate the often abrasive nature of recycled materials. In addition, the clamshell rotor chamber opening and straightforward drive coupling design make managing any feeding upsets and subsequent return to productivity very efficient.”

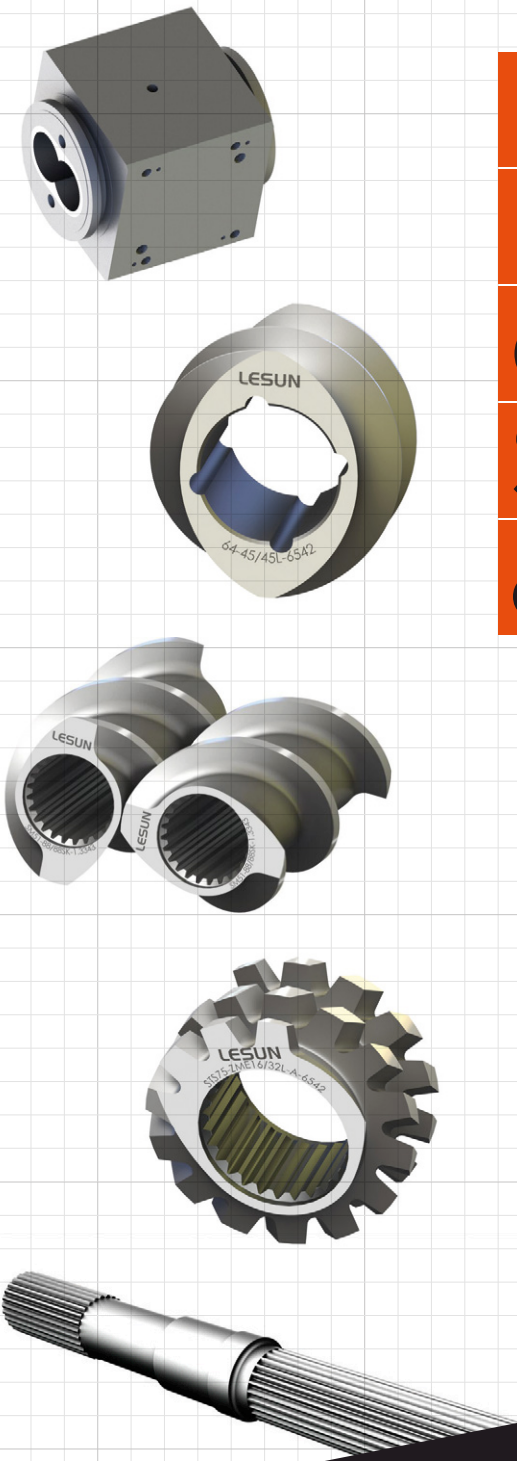
Lloyd says the continuous mixing technology is particularly effective in processing of temperature sensitive materials because of the controlled levels of shear imparted into the polymer blend, the high heat extraction rates from the chamber and rotor, and the minimal residence times.

Farrel Pomini also has a number of hard surfacing options for both rotors and chamber liners that provide an optimised long life surface for abrasive materials. These surfaces also increase drag flow, improving conveying efficiency of the compound that increases production rates. In most cases, the mixing chamber can be supplied with replaceable hard metal liners.

With the single-entry feed port, materials are fed into the mixer either separately or as a pre-blend; liquids can be injected directly into the mixing chamber. This straightforward feeding method eliminates the need for side feeders, which the company says lead to increased energy expense and heat exposure to the polymer. Continuous mixing technology utilises atmospheric venting, eliminating additional vacuum systems that also add to the process energy bill.

The company's most recent equipment addition is the CPeX Laboratory Compact Processor. “As a compact processor, it contains an independently controlled mixer and extruder on a single frame and has a nominal production rate of 10-30 kg/h, which is suitable for testing and development,”



The image displays several 3D CAD models of industrial screw components. At the top left is a square flange with a central bore and four mounting holes. Below it is a circular flange with a central bore and a blue internal component, labeled 'LESUN' and '64-45/45L-6542'. To the left of the center are two helical screw elements, each labeled 'LESUN'. Below these is a circular gear-like component with a central bore, labeled 'LESUN' and '5175 1261/6132L-A-6542'. At the bottom left is a long, threaded screw shaft with a hexagonal base.

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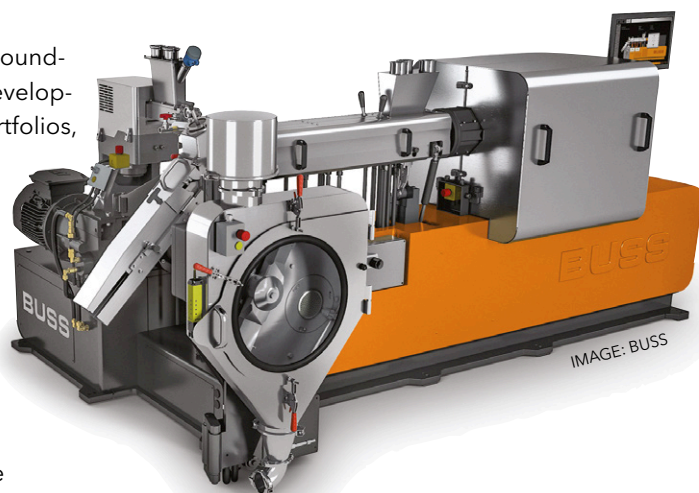
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for PVC  
compounding  
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compounder  
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unit**

says Lloyd. "The CPeX design allows compounders to conduct laboratory-scale product development trials, extend product application portfolios, expedite time to market and reduce development costs. The CPeX is the only compact processor available that supports both standard and CPXL rotor configurations for thorough development trials. It has fully integrated wiring and piping that is 'connect and go' and suitable for any industrial voltage."

One recent application involved joint research with NatureWorks to compare the processing of Ingeo polylactide (PLA) compounds on the Farrel CPeX laboratory continuous mixer versus a twin-screw extruder. The project evaluated the effect of molecular weight loss in PLA while adding a talc mineral filler. It found that processing with the continuous mixer resulted in significantly better molecular weight retention – 95% molecular weight retention when using 50% filler and 88% retention when using 60% filler. Similar results have now been replicated utilising a production scale continuous mixer and these findings will be released in the near future, the company says.



### Kneading technology

The main application area for alternative compounders continues to be shear-sensitive compounds that require a high dispersive and distributive mixing intensity, according to **Buss**. These have traditionally included highly filled polyolefin-based products such as HFFR, Sioplas, semicon and HV-XLPE cable compounds, as well as soft and hard PVC formulations for flooring, cables and medical, elastomers, thermosets such as EMC, and masterbatches and engineering plastics. ➤

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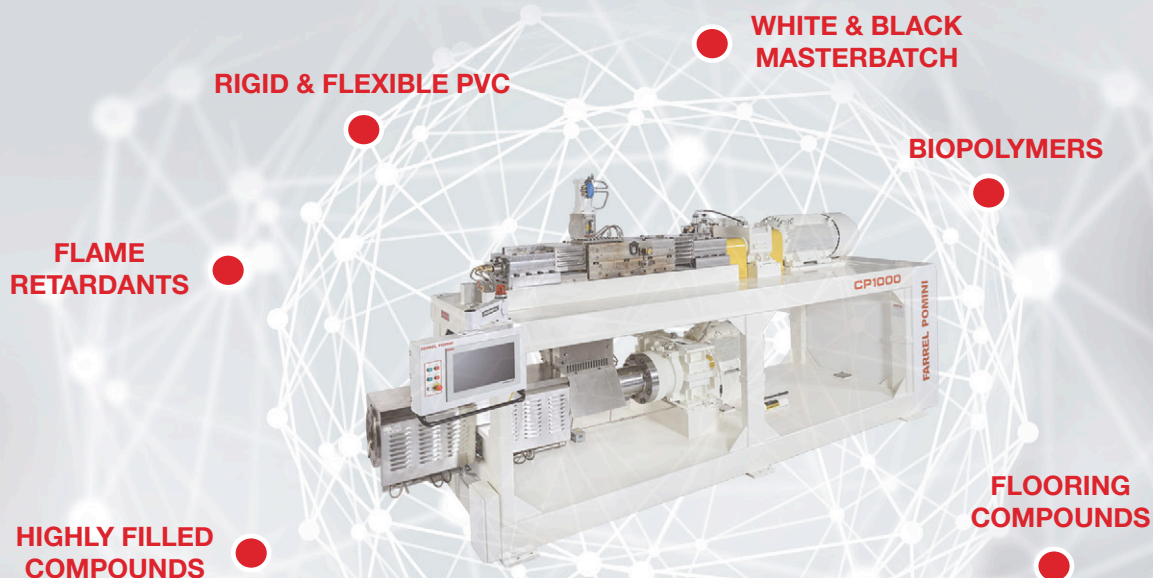
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However, the machinery maker sees considerable scope for development of new applications. "We live in an age with an unprecedented rate of technological advancement," says Dino Kudrass, Head of Design and Engineering at Buss. "Polymers play a vital role in these technological developments as their material properties can be engineered and fine-tuned to specific requirements. This development also raises the bar for the manufacturing and processing demands of these polymers. These demands include the accurate control of critical processing parameters, such as temperature, shear rate, residence time, fill levels and pressure. Furthermore, the demand for reproducibility, data logging and operating safety also provides challenges for machine manufacturers, which is an area that Buss Kneaders are ideally suited for."

Kudrass says that emerging technologies – such as electric mobility and renewable energy generation – are driving the development of new polymer compounds. "These polymers demand improved compounding solutions as they place more stringent requirements on their processing machinery. Such requirements include more homogenous material properties for electrical insulators, minimal degradation of semiconductor fillers, and higher processing temperatures for engineering thermoplastics, for example," he says.

### Sensitive solutions

Alternative compounders, such as the kneader extruder designs developed by Buss, are often highly suitable for applications where the compound exhibits high shear sensitivity. "A comparatively homogenous shear rate distribution throughout the mixing zone has always been a strong point of the Buss Kneader," says Kudrass. "In addition to this, shear sensitive polymers are often subject to thermal degradation. Here, the Buss Kneader provides very accurate measurement of the melt temperature through its stationary kneading pins, which protrude deep into the melt flow. For high fill level applications, such as masterbatch or semicon, the excellent distributive mixing characteristics of Buss Kneaders often provide a clear advantage over alternative compounders."

The latest addition to the Buss product line is the Compeo. "Our new Compeo machine series aims to satisfy the compounding industry's current and future high-end needs. The machine's flexibility and configurability allow customers to quickly adapt to the challenges ahead, no matter what these might be. The Compeo has proved to be a capable and yet robust machine, which combines

the best of the Buss Kneaders' technology from the past, while setting new standards for the future," Kudrass says.

The Compeo machine offers processing temperatures of up to 400°C, electric liquid tempering, and a variety of feed systems including side and top-feeders. A range of discharge systems is also available, such as conical twin screw, single screw or gear pump, as well as a large range of processing elements, variable housing configurations and different process lengths. Construction materials with extremely high abrasive resistance can be used. Buss adds that the new machine also provides extensive data acquisition.

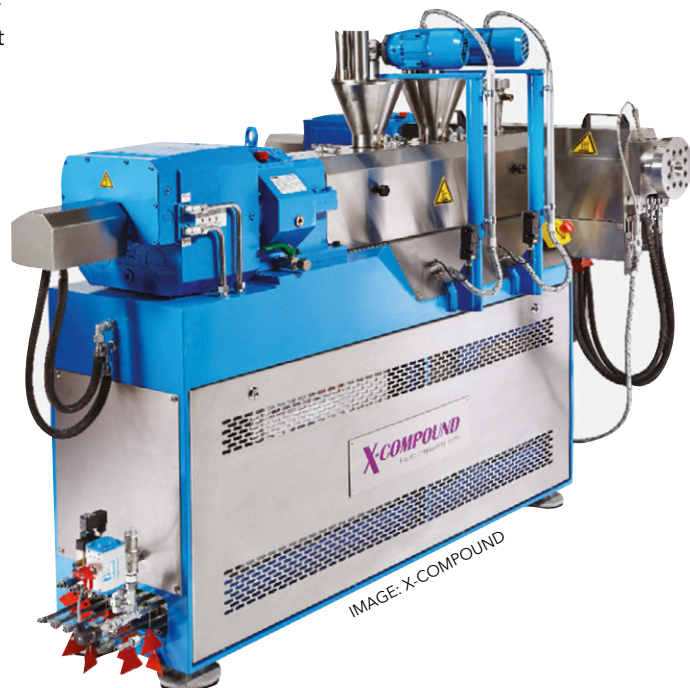
The latest addition to the line is the Compeo 176, which allows for throughput rates of up to 12 tonnes/h. The company says that several of these large, high throughput models have been sold.

### Filler flexibility


According to **X-Compound**, manufacturer of the Continuous Kneader, with polymer compounds finding an increasing number of applications where they are called on to replace traditional materials such as wood, steel or glass, the need to adapt properties to compete successfully has never been greater. "In order to be able to compete with these materials, fillers based on ceramics, metals or glass can be added to achieve these demanding properties," says Dr Karsten Kretschmer, X-Compound Sales Director.

"The performance of polymer compounds is best when the dispersion and distribution of these fillers in the polymer matrix is optimised. From the view of a compounding machine manufacturer, the

**Right: The CK45 Continuous Kneader extruder from X-Compound**







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usual approach is to apply the required shear stresses to achieve good dispersion. When it comes to high-tech fillers, the challenge is that these fillers have very hard surfaces. High shear rates in the presence of hard fillers typically result in significant wear of machine process parts," he explains.

"This is where the Continuous Kneader offers significant benefits. The Kneader technology is based on the special interaction of pins installed inside the barrel and the screw flight, with the screw rotating and oscillating at the same time. As a result of this special movement, the screw flights and pins intermesh and clean each other, which results in a narrow residence time distribution. At the same time, the material is pushed through the gap between the pin and the screw flights," says Kretschmer.

"The compounding process operates at quite low screw speeds. Combined with a large shear gap in comparison with other compounding systems, this results in moderate shear stresses applied to the materials. Excellent dispersion is

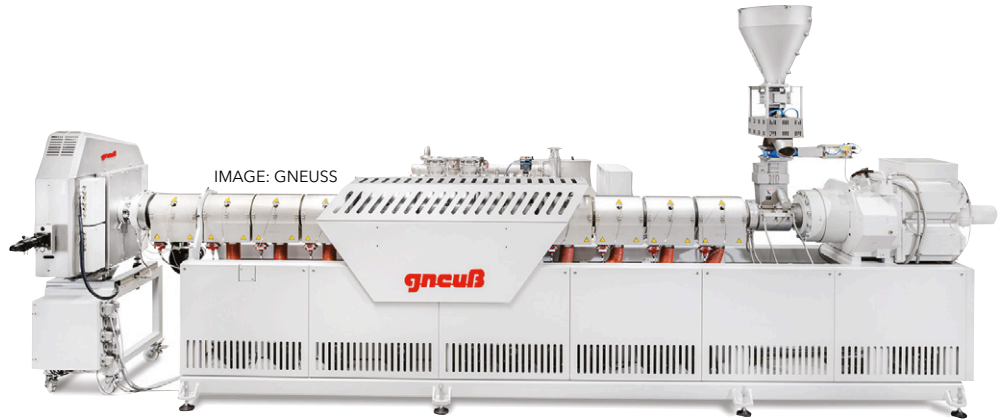


IMAGE: GNEUSS

achieved by the large amount of movement of material through the gaps. These compounding conditions are also ideal for reducing wear in the processing section," he says.

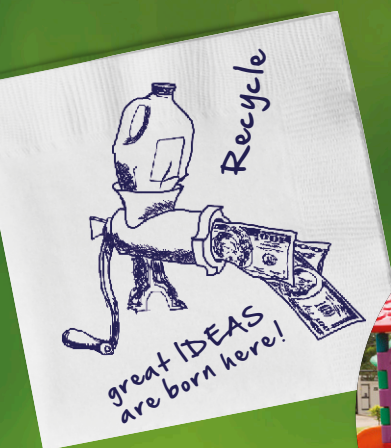
### Gentle processing

Kretschmer says the gentle nature of processing means many applications do not require special steels for the process parts. However, for the most demanding processing it has a number of high durability processing section options, including special alloys and tungsten carbide coatings.

"Continuous Kneaders are highly successful in these applications, as the technology delivers a combination of good compound properties with

**Above: An MRS Extruder from Gneuss with the company's RSFgenius filtration system**

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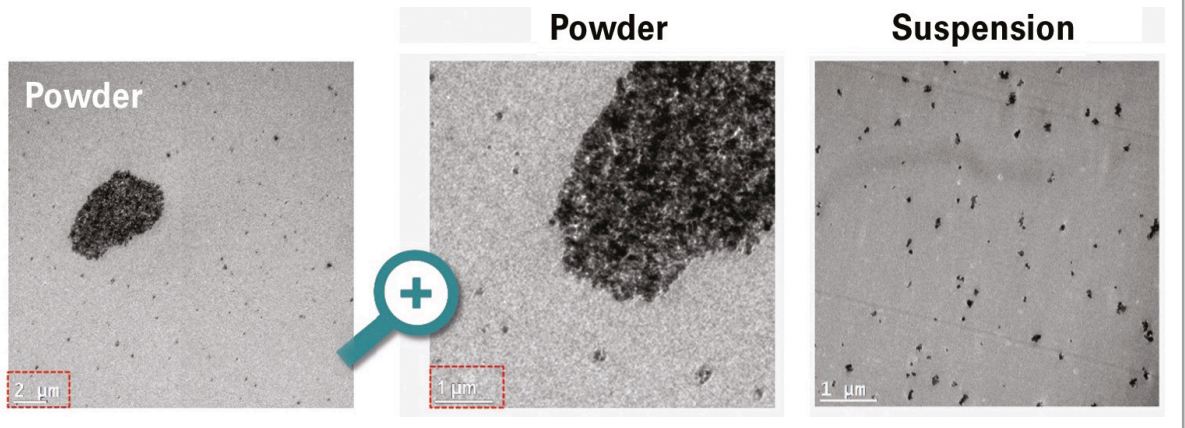
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Images show dispersion quality for 0.5% BaSO<sub>4</sub> nanoparticles added as powder and in liquid suspension using Gneuss Nano Compounding

Source: Gneuss



low wear on the machinery side achieved in the compounding process. This results in the overall cost of production being particularly attractive," he says.

### Dispersion gains

**Gneuss** claims that its MRS Extruder is particularly well suited to specialty compounding tasks. "As a result of the extremely homogeneous distribution of particles in the MRS Extruder, it is possible to introduce the smallest particles in polymers via a suspension," says Andrea Kossmann, Marketing Manager. "Consequently, it is possible to make major reductions in the quantity of additive needed to achieve the required results. This has the additional advantage of making the polymer easier to recycle."

Achieving this high level of distribution requires a different approach. "Currently, many additives are introduced into polymers in powder form. Around 20% of powder (by weight) consists of agglomerates, which reduces the active surface area of the additive. The effectiveness of the additive particles is in relation to their active surface area. Therefore, the proportion of additive needed should not only be determined by weight. If the size of the additive particles can be reduced, then the quantity by weight can also be considerably reduced," he says.

Kossmann says this not only reduces the cost but increases recycling possibilities as, if the additive level used is too high, it is not always possible to reprocess the polymer. Being able to effectively incorporate smaller, nano-scale particles can also result in high value recycled products with an acceptable margin.

"In order to use additives with an extremely small size distribution, it is necessary to include them in a liquid suspension before working them into the polymer. Only in this way can agglomerates be avoided, so that the particles remain as individual particles. As a result, if the combined

surface area of all the individual, separate particles can be increased, then the quantity of particles for the required effect can be reduced significantly," he says.

The MRS Extruder is a key element in the Gneuss Nano Compounding Technology for incorporation of nano-particles into polymer melts. Nano particles in powder form with a high proportion of agglomerates have the disadvantage that the potential total area offered by the nano particles cannot be realised and the potential positive benefits to the polymer are often not obtained. The Nano Compounding Technology is an industrial scale process that permits the introduction of individual nano particles into polymers without agglomerates and with completely safe handling.

### Nano suspension

Kossmann says the introduction of nano particles (less than 100 nm) into polymers takes place by means of a liquid suspension, in which the particles are safely contained so cannot get into the environment. After the polymer is plasticised, it flows through a mixing and hydrolysis chamber where the suspension is injected into the polymer under pressure. The mixture of polymer and suspension flows on into the devolatilising MRS Extruder. This extruder is designed so that, with a mixture of polymer greater than 70% and suspension less than 30%, the suspension is removed in less than five seconds to leave the nano particles completely embedded in the polymer. Because of the extremely fast extraction of the liquid suspension carrier, there is practically no damage to the polymer, Gneuss says.

The company adds that nano-scale additives are characterised by extremely high surface area in relation to their mass. Depending on the additive, this permits a range of significant changes to the properties of the finished compound. These include modification of the crystallisation tempera-



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**Right: The P 2.0 series compounder is the latest development from Collin Lab & Pilot Solutions**

ture for faster cooling, for example. Other benefits include improved heat transfer, electrical properties (conductivity), mechanical properties, surface finish and brilliance, as well as antibacterial properties.

Using Nano Compounding Technology, Gneuss says significantly better dispersion is possible compared with conventional processes so the same material properties can be achieved with a major reduction in the quantity of additive. In many cases, the required results are achievable with such a small quantity of additive that unwanted side effects, such as colouration of the polymer due to the additive, are negligible.

The company says that using the Nano Compounding technology it is possible to disperse carbon nanotubes to achieve conductivity in a polymer without the need for it to be black. It adds that the process is also suitable for reactive extrusion.

### Feeding simplicity

Planetary roller extruder maker **ENTEX** has developed an autonomous-operable side feeder to make operation more flexible and retrofitting to existing extrusion lines easier. Side feeders are installed laterally to the process section of extruders and are used to convey fillers and additives in the form of powders, fibres, granulates or pastes, as well as degassing of the extrudate.

The company says that previously the integration of additional side feeders was complex. While the mechanical connection for material feeding or degassing required only a lateral connection for the roller cylinder, integration into the electrical, control and safety systems of the extrusion line was more extensive. For example, a frequency converter and other electronic components for the side feeder drive was required in the switch cabinet of the extruder, which often led to space problems. For the control of the side feeder it was necessary to customise the programming and visualisation of the extrusion line, as well as safety functions and control of additional auxiliary units on the side feeder. Integration of cooling water monitoring could also prove complex.

With the new, autonomous-operable side feeder, these safety-related and control modifications are no longer necessary. The system requires only an appropriate power and cooling water supply. All other functions, including power supply and control of additional auxiliary units such as metal separator, dosing unit and vacuum unit, are pre-configured in the side feeder's control system and can be controlled via the integrated touch



IMAGE: COLLIN LAB & PILOT SOLUTIONS

screen display. If interfaces are available on the extruder, autonomously-operated side feeders can also be integrated into the control system of an existing extrusion line.

**Collin Lab & Pilot Solutions** recently introduced the P 2.0 series compounder, which is said to offer higher performance and improved processing of materials with poor flow properties. Collin says intelligent, function-related control has been introduced on the new model, which is adjustable for height and space-saving. According to the company, the new compounder offers 25% more performance and capacity (1,200 rpm and torque of 13 Nm/cm<sup>3</sup>). This allows processing of highly viscous or highly filled materials.

The compounder series is available with a processing length of 36D up to 60D. Multiple side feeders with gravimetric or volumetric dosage can be used with the compounder. Another advantage is that the screw can easily be pulled backwards out of the machine for cleaning without having to change the position of the compounder, which is useful where space is restricted.

The new Collin CMI 17 control system offers the option of exchangeable cylinder elements with coded plugs. These are automatically recognised and the system allows elements to be arranged in any order.

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# Additives to enable plastics circularity

*Additives may hold the key to improving recyclability of post-consumer plastics and for improving formulations containing recycled plastics, writes Jennifer Markarian*

Over recent years, the focus of many sustainability initiatives has been on developing plastics parts that perform their design function while using less material. Today, though, the increased focus on plastic waste and the aim to create a more circular economy is placing greater emphasis on end-of-life options for plastic items. A key element in making “circularity” a reality will be ensuring plastics can be effectively recycled into materials that offer good levels of performance. Additive technologies are likely to play a significant role.

A number of non-profit organisations are addressing the problem of plastics waste and the need for better recycling at a political level. The UK Plastics Pact, founded in 2018, is an initiative from the Ellen MacArthur Foundation’s Plastics Pact network that aims to transform “the way the UK makes, uses and disposes of plastic.” In August this year, the US Plastics Pact was launched with 60 members ranging from consumer goods to chemical companies and associations such as the Association of Plastics Recyclers (APR). These non-profit groups have set ambitious goals for the next few years for recycling and the use of recy-

clate. Many consumer goods producers have also set their own individual targets.

Mechanical recycling faces many hurdles, not the least of which is that it is generally more cost-effective to use virgin polymer. While various groups are working on frameworks to address the economic dilemma, industry innovators are pressing forward with solving the technical challenges of recycling through the use of additive technologies.

## Improving rPET

The polyethylene terephthalate (PET) recycle stream is already well established. Meeting brand owner requirements for circularity, however, means the industry is striving to use more recycled PET (rPET) bottle waste back into bottles and other packaging applications rather than use in rPET fibre. To this end, a range of new additives and masterbatches are coming to the market to improve rPET colour, odour, and appearance, as well as to enable better recyclability.

**Avient** (formerly PolyOne) has launched a low-haze, non-polyamide-based oxygen scavenger

**Main image:**  
There are considerable technical challenges involved in effective recycling of post-consumer plastics. Additives are providing the solution to some of them

**Right:**  
**ColorMatrix**  
**Amosorb**  
**4020G oxygen**  
**scavenger**  
**reduces haze**  
**and yellowing**  
**by up to 50% in**  
**PET recycling**

for rigid PET packaging – ColorMatrix Amosorb 4020G. The company says the new grade offers up to 50% lower haze and also reduces yellowing by 50% during the mechanical recycling process compared to earlier grades of Amosorb oxygen scavenger. The company says that, with the increasing use of rPET in rigid containers, brand owners must be sure their oxygen scavenger system is maintaining efficacy. Its tests showed that the 4020G additive had negligible effects on efficacy for the rPET grades tested compared to competitive materials, which it says lost almost all oxygen scavenging ability with rPET content as low as 20%.

Another concern for rPET is the increased levels of acetaldehyde (AA) created during the recycling process, which can lead to off-taste in bottled contents. Avient's ColorMatrix AAzure Acetaldehyde Control Additive is a process aid for PET and rPET preforms that can also reduce AA by up to 80% in the preform. As a process aid, the additive helps overcome the risk of blowouts, so higher levels of rPET can be used. The additive is commercially available in major global markets and meets direct food contact regulatory requirements, the company says.

Avient's Colormatrix Smartheat RHC was introduced in September last year to improve the quality of PET bottles contained recycled resin. The liquid dispersion processing aid is intended for use by rPET producers and manufacturers of preforms for injection stretch blow moulding and is claimed to improve rPET processing and product quality. The company says the additive helps improve thermal stability and reduce yellowing and provides a more effective alternative to the addition of toners or colorants to mask yellowing caused by heat exposure. The company suggests that a wider uptake of the additive in the rPET chain would eventually improve overall quality of the recycle stream.

A new addition to Avient's ColorMatrix Lactra light blocking additive technology family for PET dairy packaging is also said to be compatible with PET

**Below: Avient's**  
**ColorMatrix**  
**AAzure process**  
**aid can reduce**  
**acetaldehyde**  
**content by up**  
**to 80% in the**  
**preform to**  
**tackle off-taste**  
**issues**



IMAGE: AVIENT

recycling streams (there have been concerns that mineral modifiers may have a negative effect on the rPET stream for fibre). The new additive contains less than 1wt% titanium dioxide (TiO<sub>2</sub>) and less than 4wt% inorganic content; it is also available as a TiO<sub>2</sub>-free version. According to the company, tests show that the Lactra additives are suitable for closed-loop bottle-to-bottle recycling. The low levels of TiO<sub>2</sub> in the products also helps packaging products comply with new European TiO<sub>2</sub> restrictions (EU Waste Framework Directive 2008/98/EC), it says.

A new impact modifier masterbatch from **Sukano** allows use of virgin or rPET in monomaterial, recyclable packages for cold, flash-frozen, and room-temperature food trays, replacing specialised copolyester resins or other hard-to-recycle film structures. The company offers several other masterbatches to improve rPET, including anti-yellowing, melt enhancing, and NIR-detectable colours and blacks (the latter have been tested using the French COTREP protocol and found suitable for recycling).

### Targeting HDPE

After PET, HDPE is the second most widely sorted PCR stream in most material recycling facilities (MRFs). Some of the primary challenges with recycling HDPE are retaining its physical and rheological properties, says Paul Albee, Consultant for **Addisperse** (AFI Global). A lack of understanding in the recycled compound industry regarding formulation technology, which can help solve these problems, is a further challenge.

Addisperse introduced its NC203C stabiliser, which is based on reactive chemistry, to rebuild molecular weight and boost physical properties in reprocessed and recycled HDPE compounds. The additive also improves process stability during extrusion and increases "melt uniformity and hot strength, dramatically improving foaming," says Albee. For example, in a PCR HDPE milk bottle resin the addition of 2% NC203C allows foam density to be reduced from 0.89 to 0.61 gm/cc



IMAGE: AVIENT



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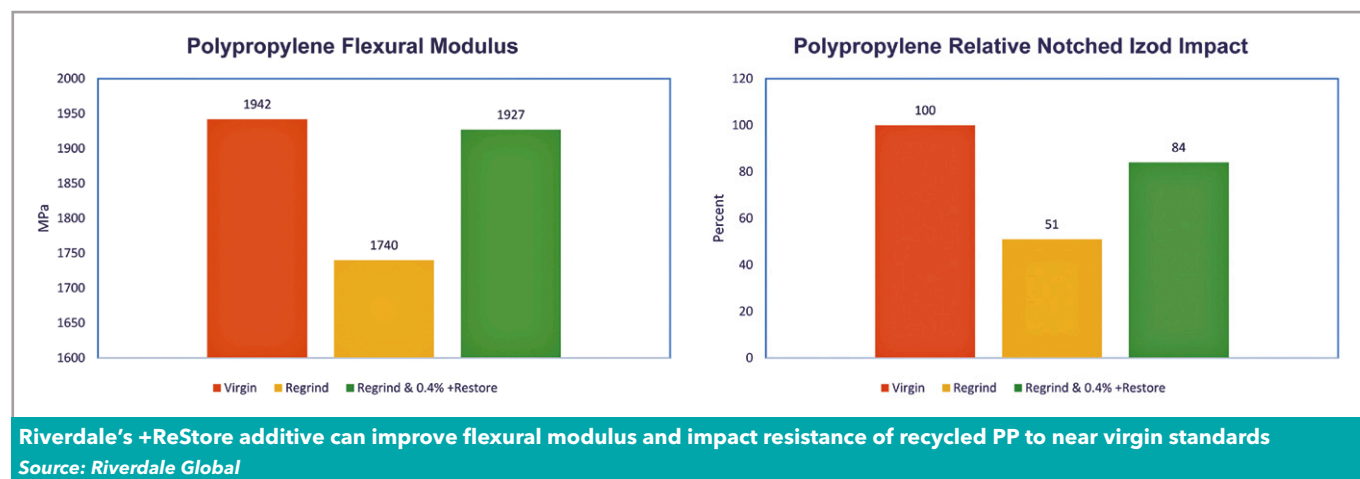


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while reducing cell size and improving process stability, he reports. The NC203C additive also increases the strength and tensile properties of foamed or unfoamed extruded parts.

Addisperse is currently developing custom blowing agent concentrates containing NC203. A new nucleating agent concentrate is also in development based on a halloysite mineral filler. It is intended to allow shorter cycle times for injection moulding of recycled HDPE compounds and recycled polypropylene (PP).

**Riverdale Global's** +ReStore Additive is being used to improve properties of PP and HDPE PCR. Tests using regrind have shown that virgin-like properties can be obtained with 100% recycled PP or HDPE and a low level of the liquid additive (typically 0.1 to 0.5%). "Because the additive has an affinity for the base polymer, it acts as a lubricant, enhancing melt flow. In addition, the +ReStore molecule has a functional group that readily reacts with pigments, fibres, or fillers in the resin, while a different segment of the same molecule is designed to couple with the polymer; as a result, it forms a strong bond between resin and filler without compromising flexibility," said Jared Arbeter, Technical Sales Manager at Riverdale Global.

**Britec Solutions** has developed BTec REA360 Regrind Enhancing Additive, which the US additives company says improves physical properties, reduces odour and enhances processing performance of regrind and recycled resins. The additive (available in liquid and pellet forms) can be used by processors such as injection moulders and blow moulders with process scrap, and by recyclers that process mixed-melt grades and industrial feedstocks. "Data supports that physical properties of regrinds and recycled resins are replaced to levels similar to that of virgin grades in both polypropylene and polyethylene at very low use rates of 0.1 to 0.5%," says the company.

Britec illustrates the benefits of the additive with the example of an unnamed recycler in Texas reprocessing HDPE PCR waste, which consisted of mixed colours and mixed MFIs along with 2% carbon black. It says: "Testing concluded that with addition of 0.03% BTec REA360 to their regrind feedstock, critical physical properties were improved dramatically. The Izod impact strength showed a vast improvement of 37% and the flexural modulus was improved by more than 30%. Melt flow was enhanced and stabilised, contributing to more than 18% increase in production output."

**Völpker Spezialprodukte** bases its plastics additives on montan waxes and develops grades to deliver specific solutions for producers of virgin and recycled plastic compounds. The company's Cevo range of additives has been developed to solve processing and application-related issues in many processing areas, with Cevo-process B-3680 and Cevo-process B-3690 said to be particularly effective dispersion additives for recycling of PCR HDPE/LDPE.

"Post-consumer HDPE/LDPE waste in most cases contains unwanted polymer particles and mineral – or other – contaminations that prove to be disruptive in the production of recyclates and that reduce the quality," the company says. "Their proper dispersion as well as the dispersion of fillers – for example, carbon black – is mandatory in order to produce adequate recycling qualities, for example for injection moulding."

The company says that tests have shown that carbon black can be "excellently dispersed" when Cevo-process B-3680 or Cevo-process B-3690 is added at 0.5% loading in virgin HDPE and at 2.0% in recycled HDPEs. "This was proven by a classical filter pressure test: the results show that the increase in pressure is significantly reduced. This proves the dispersing effect of these additives in the post-consumer compound," says the company.



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## Boosting PP

While PP is a widely used polymer, it is not so widely recycled. However, initiatives are underway to change that. In July 2020, The Recycling Partnership in the US launched the Polypropylene Recycling Coalition, which aims to improve PP recovery and recycling in the country. The Coalition says PP holds a higher volume in the US recycling stream than HDPE and it hopes to improve capture and use of this. **Milliken**, which offers several PP additives for virgin and recycled PP, joined the Coalition in September.

"We are actively participating in initiatives that support broader use of polypropylene—especially recycled content—in packaging and other industries. Our additives already help enhance the quality and performance of recycled polypropylene, and membership in the coalition will add a new dimension to our multi-pronged approach to circularity," said Allen Jacoby, Senior Vice president, Plastics Additive, Milliken & Company. Milliken's DeltaMax Performance Modifiers are being used to improve impact resistance and melt flow properties in recycled PP.

Separately, Milliken's Millad NX 8000 clarifier for



IMAGE: MILLIKEN

PP received APR's Critical Guidance Recognition, which recognises it as recycling-friendly, in July 2020. The company is building a manufacturing facility in South Carolina that it says will increase its clarifier capacity by 50% to meet fast-growing demand.

The VMO additive line from **Struktol** is designed for modifying melt flow of polypropylene. Available as a masterbatch that can be easily incorporated into the polymer or compound, the VMO products include a neutraliser to reduce odour in the final compound. "This VMO series can be very useful for manufacturers that want to reduce the amount of virgin or recycled PP of differing MFIs they keep on

**Above:**  
**Flowerpots**  
**produced in PP**  
**containing**  
**Milliken's**  
**Deltamax**  
**impact and**  
**melt flow**  
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hand. Having one type of PP resin of low MFI would allow for any number of higher MFI possibilities," the company says.

Struktol says the VMO series products have been designed to allow for some PE present in the PP, in some cases upwards of 35%, adding that PE contamination is a common issue that PP recyclers encounter.

The grades in the series - VMO 058, VMO 108, VMO 208, VMO 308 and VMO 408 - range in activity from low to high. Struktol says the range of activities is helpful for recyclers as it allows for high percentage dosing in cases where weighing or dosing small quantities could be problematic.

### Compatibiliser update

Compatibilisers are key for effective recycling as, after sorting, a recycle feedstream may still be contaminated with materials that are incompatible with the main polymer. These incompatibilities can cause problems, such as delamination or poor physical properties, when the recycled plastic is processed into a new part. Compatibilising additives improve interfacial adhesion between, for example, a mineral filler and the polymer matrix, or between two incompatible polymers, resulting in a polymer blend with more uniform and better strength properties. Compatibilisers can also be used to improve recycle from mixed plastics streams, such as where it is difficult to mechanically separate polymers.

Ampacet's ReVive compatibiliser masterbatch contains a blend of additives designed to enable film manufacturers to re-use in-house scrap generated from edge trim of multilayer films as well as recycle from post-consumer barrier films (these films contain multiple materials, such as PA,

EVOH, and PE, and would not typically be recycled). The additive technology, however, allows the material to be recycled and reprocessed in the PE layer of film construction, explains Doreen Becker, Sustainability Manager at Ampacet. The company says independent tests have demonstrated improved optical properties using ReVive compared to PE/PA recycle without the additive. The masterbatch is part of the company's R3 Sustainable Solutions portfolio.

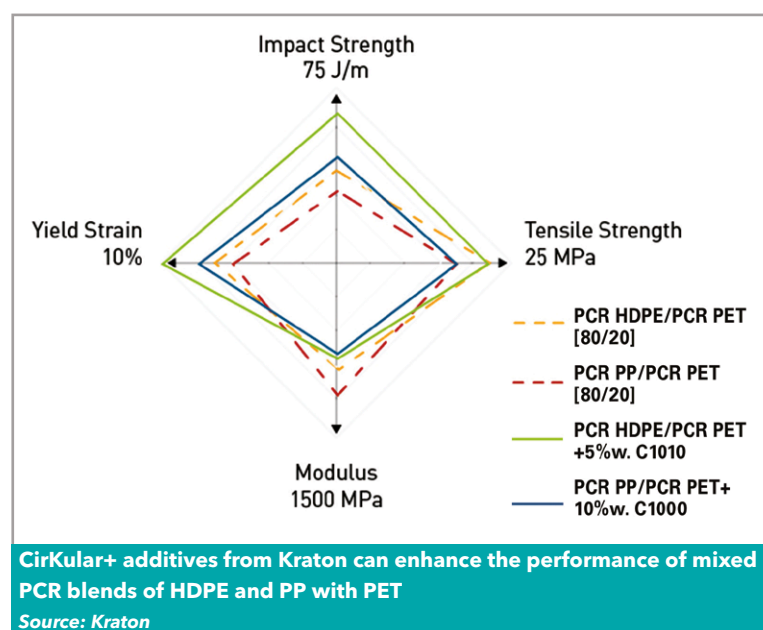
Building on its long experience in styrenic block copolymers as compatibilisers and modifiers, **Kraton** has launched its CirKular+ portfolio of additives for use in PCR and post-industrial recycle. Three products in the compatibilisation series and two products in the performance enhancement series are already commercially available, with samples currently being tested in potential applications, says Yuliya Streen, Global Marketing Manager at Kraton Corporation.

The new additives are designed to improve processing and properties of mixed-material recycle streams. For example, the C2000 and C3000 additives can enhance properties such as stress cracking and impact strength in polyolefin PCR streams in which, particularly in the US, PP and HDPE are frequently commingled. The C1000 and C1010 compatibiliser additives are useful in polyolefin blends contaminated with PET, as well as for improving processability and properties of the mixed PCR stream (resin codes 3-7). The additives are also said to improve processability of recycled PET carpet fibres, which may contain PET, PA, PP, and fillers.

"The CirKular additives allow mechanical recycling of mixed PCR, which can increase circularity by reducing the amount of material going to incineration or chemical recycling," says Streen. "We understand that the balance of performance and value is critical in recycle because it competes with the low cost of virgin resin," she adds.

Kraton's C1010 is available in a grade that contains 50% post-industrial recycled block copolymers; this grade is a more affordable option but does not have the FDA clearance that the other grades offer. As compatibilisers, the additives are typically used at approximately 3-5wt% in the formulation but in some cases only 1-2% is needed to improve homogeneity of the blend, according to Streen.

**Kenrich Petrochemicals'** neoalkoxy titanate additives achieve compatibilisation through a different method to the more commonly employed silanes, maleic anhydride modified polymers, or block copolymers, claims President Salvatore J





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Monte. He says the additive allows in-situ organo-metallic polymer catalysis that also couples and compatibilises interfaces.

The catalysis effect increases polymer flow and creates new co-polymers, rather than just alloys, Monte says. These copolymers have better mechanical strength than polymer blends, which allows use of higher levels of PCR.

The Ken-React additive is available in a masterbatch pellet or powder form. Monte says that when compounding with the concentrate, melt temperatures should be maintained at about 10% lower than normal to regain the shear energy needed for reactive compounding. The additive can compatibilise any post-consumer recycle mixture, even with the typically wide mix of fillers, carbon black, and other contaminants.

"Any organic materials remaining after washing, such as oils, are compatibilised through proton coordination. And any calcium carbonate in the

mixture is coupled to the polymer, which improves properties," says Monte. The additive is said to work with any mix of polymers, including polyolefins, PA, and PET, which means it can be used to compatibilise a mixed PCR stream.

**Imerys** offers an extensive portfolio of mineral additives for plastics compounds and, for the recycling sector, has developed ImerLink, which is described as an engineered mineral specifically designed to compatibilise recycled blends of PE and PP. However, the company says that its talc products can also be added to recycled plastic compounds (as well as virgin compounds) to restore mechanical performance. "As talc is chemically inert, thermally stable and is not affected by multi-pass extrusion, it can be recycled indefinitely without losing its initial properties," says the company.

Adding talcs to recycled PP increases composite stiffness, according to Imerys, which says that ultra-fine talcs can be used at lower incorporation rates and provide the added advantage of increasing impact and scratch resistance. The company says it has a full range of talc grades with different fineness, enabling recycled plastics producers to select a grade that provides the optimum cost/performance ratio for their requirements.

### Maximising value

One of the challenges in extracting maximum value from most post-consumer recycle (PCR) is in the process of separating the mixed incoming stream – which will typically contain PET, HDPE, PP, PE, and other materials – into purer streams that can be processed and re-used. Many material recovery facilities (MRFs) are set up to sort out PET and

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IMAGE: SHUTTERSTOCK



**Above: Innovations in sorting technology from Polysecure, Nextek and Digimarc aim to use markers or machine-readable labels to enable higher quality recycle**

HDPE using automated near infrared (NIR) detectors. In the past, MRFs had difficulty sorting out PET and HDPE containing carbon black as it prevented NIR identification; now a range of new, black and dark coloured pigments that are transparent to NIR allow these containers to be recycled using existing NIR optical sorters.

A recent masterbatch line from **Ampacet**, called Silky Bliss because it provides a delustering effect, includes both darker and lighter colours that are transparent to NIR. Ampacet has also launched its AfterLife line of recycle-friendly colour masterbatches with a range of dark shades, including purple and dark blue, that are also NIR transparent. Its NIR-transparent black masterbatches – Rec-NIR-Black 1900302-EA and 4900147-E for rigid polyolefins – recently received the French COTREP certification for use in PP and HDPE. The company has also successfully completed third-party testing in the US with several grades of Rec-NIR Black using APR's standards.

"We are aware of the pain points of our customers, and we're offering solutions to make recycling more viable for them," says Becker, who says sorting is just one issue they face. "Mechanical recycling compromises properties, can cause off odour, and causes optical issues, such as visible contaminants, haze, yellowing, and colour variation."

In addition to odour scavenging masterbatches and off-the-shelf colour-correcting masterbatches for post-consumer recycling (such as the company's masterbatches for green or blue-tinted PET), Becker says Ampacet offers colour-correcting masterbatches customised for each batch of PCR so companies can retain the colour integrity of their brand in formulations with PCR.

## Alternative options

An alternative way to sort recycle is to embed a tracer into polymers that can later be detected in a recycle sorting facility. **Polysecure**, for example, uses fluorescent markers and a specially-designed machine for tracer-based sorting.

Fluorescent marking is also used in **Nextek's** NextLoop system, which aims to produce food-grade recycled PP from post-consumer packaging using markers in labels to improve sorting. The PRISM [Plastic Packaging Recycling using Intelligent Separation technologies for Materials] technology employs a high-speed sorting system with UV light source to read the printed code.

The "Holy Grail" project, a collaborative venture promoted by P&G and supported by the European brands association AIM, use a digital marking technology from **Digimarc** to allow individual items of packaging to be identified and sorted by high speed vision cameras. The latest version of the technology was demonstrated last year by sorting technology specialist **Tomra** at its recycling plant at Mülheim-Kärlich in Germany. The intention is now to move to an industrial pilot to prove the viability and business case for digital watermarking as a tool for larger scale sorting of packaging for higher-quality recycling.

In February 2020, **BASF** expanded its reciChain pilot project that uses blockchain technology and a digital tracer embedded in the polymer to track recycled material through the value chain. The pilot began in Brazil, and was expanded to British Columbia, Canada.

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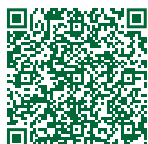
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# VISCOSPEED in HFFR compounds: Big impact with minimal dosage

## INTRODUCTION

Demand for halogen free flame retardant cable materials (HFFR) has grown consistently over the past few decades, due largely to the reduction in smoke and the absence of toxic and corrosive fumes in the event of fire when compared to traditional halogenated flame retardant materials. These HFFR materials are typically polyolefin compounds with a high loading of inorganic flame-retardants such as aluminium hydroxide (ATH) and magnesium hydroxide (MDH).

A new harmonised European Construction Products Regulation (CPR) came into effect in July 2017 with the aim of further reducing fire risk. It requires that cables should delay the outbreak of fire and cause minimal smoke emissions. This goal is generally achieved by increasing the inorganic flame retardant filler content. For the most demanding applications it may be necessary to add as much as 65-80% of appropriate filler. This, of course, has challenging consequences with regard to processability and mechanical properties for both producers of cable compounds and for cable manufacturers.

In VISCOSPEED, Innospec Leuna GmbH has developed a halogen-free, low-dosage, organic processing aid that minimises the

negative impact of increased filler loading on processing without negatively affecting flame retardant properties. VISCOSPEED has been shown to improve the dispersion of ATH and MDH, as well as carbonates and silica-based nano-materials, across many different cable compounds, demonstrating improved flow during processing and manufacturing.

VISCOSPEED, which is polar by nature, enables fast wetting and dispersion of inorganic filler particles in the polymeric matrix. Moreover, it prevents fine filler particles re-agglomerating during processing, which ensures the filler makes the maximum contribution to flame retardancy. This is especially useful where milled natural fillers are deployed, such as milled MDH, and where inorganic synergistic additives such as nano-silica, sepiolite and nanoclays are used. Ultimately, the interaction between the polar filler and the VISCOSPEED additive results in optimised dispersion and char formation and reduces dripping tendency.

## VISCOSPEED IN SHEATHING COMPOUNDS

The sheathing of the cable is a critical component in terms of protection from mechanical shocks and flame retardancy.

Addition of VISCOSPEED to highly flame retardant sheathing compounds has been shown to significantly improve processability without negative effect on elongation at break, aging behaviour or flame retardancy. Data for an EVA-based cable sheathing compound (Table 1) shows that, despite a reduction in the level of maleated coupling agent in the formulations using VISCOSPEED (compounds 1B and 1C) the tensile strength is maintained above the critical value of 10 N/mm<sup>2</sup>.

Due to its polarity, VISCOSPEED acts as a co-compatibiliser and can partially replace the maleated coupling agent. As the data in Tables 1 and 3 show, replacing 2% LLDPE-g-MAH with the same level of VISCOSPEED allowed a substantial increase in flowability (MFI) to be achieved without affecting elongation at break. The improvement in processability means that costly synthetic fillers can be replaced by much less expensive natural milled materials (Table 2).

VISCOSPEED can also be used to advantage in sheathing compounds based on POE (polyolefin elastomer) resins. POE is of interest to cable producers for its excellent combination of mechanical properties, flexibility, and very wide application temperature range (extending from -60°C to 125°C). However, standard POE cable sheathing formulations tend to drip when burning (see results for compound 3A in Table 3).

A number of studies have been carried out by Innospec Leuna to explore the effect of the addition of VISCOSPEED to POE-based formulations containing both coated and uncoated natural MDH. All have shown similar results in that processing was improved without deterioration of the most important performance parameters. Data in Table 3, for example, shows that the introduction of VISCOSPEED both eliminates burning drops during vertical fire tests and improves elongation. These effects are attributed to the ability of VISCOSPEED to allow a finer dispersion of the natural filler in the compound.

## VISCOSPEED IN BEDDING COMPOUNDS

Finally, the use of VISCOSPEED has also been investigated in several different bedding compounds. Similar to the earlier examples, VISCOSPEED has been demonstrated to maintain easy processing

**Table 1. EVA-based sheathing compound**

Ingredient	(1A) Standard	(1B) 1% VISCOSPEED	(1C) 2% VISCOSPEED
EVA VAc=28% MFI=3	19,5	19,5	19,5
C <sub>8</sub> -POE d=0.868 MFI=0.5	5	5	5
mLLDPE MFI=3-5	5	5	5
LLDPE-g-MAH	5	4	3
<b>VISCOSPEED</b>	-	<b>1</b>	<b>2</b>
Fine pp ATH BET=4 m <sup>2</sup> /g	52	52	52
Coated milled MDH 3.5µm	12	12	12
Silicone Masterbatch	1	1	1
Stabiliser	0,5	0,5	0,5
<b>TOTAL</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>PROPERTIES</b>			
MFI – 21,6kg@190°C	4	7	12
Tensile strength [N/mm <sup>2</sup> ]	14,5	13	11
Elongation at break [%]	190	190	190



# VISCOSPEED

By Innospec



Table 2. Natural MDH, EVA-based sheathing compound

Ingredient	(2) ATH-free
EVA VAc=28% MFI=3	15
C <sub>8</sub> -POE d=0.868 MFI=0.5	15
LLDPE-g-MAH	4,5
<b>VISCOSPEED</b>	<b>2</b>
Uncoated milled MDH 3.5µm	62
Silicone masterbatch	1,5
Hydrophobicity MB	0,5
Stabiliser	0,5
<b>TOTAL</b>	<b>100</b>
<b>PROPERTIES</b>	
MFI – 21,6kg @ 190°C	2
Tensile strength [N/mm <sup>2</sup> ]	>13
Elongation at break [%]	>150

of bedding compounds even with filler loadings up to, and in some cases extending beyond, 80%.

The resulting optimal filler dispersion achieved using VISCOSPEED is also the reason for the enhanced mechanical properties evident in drummable bedding compounds (Table 4). This data shows that exchanging EVA28 MFI=3 in compound 4A with 2% or 4% of VISCOSPEED (compounds 4B and 4C) results in a big increase in MFI as well as almost doubling elongation at break values. The findings indicate that filler content can be further increased without sacrificing mechanical properties, so allowing further optimisation of flame retardance performance.

## SUMMARY

The new VISCOSPEED processing aid for halogen free flame-retardant compounds from Innospec has shown in all the compounds tested that it can optimise filler dispersion and so ease processing. It has also been demonstrated that VISCOSPEED achieves these positive results with no adverse effect on aging, flame retardancy or mechanical properties. In fact, in the case of POE-based formulations, elongation at break and flame retardancy can be improved.

Low dosages of VISCOSPEED will help

Table 3. POE-based ATH-free sheathing compound

Typical Composition	(3A) Standard coated MDH	(3B) VISCOSPEED coated MDH
C <sub>8</sub> -POE d=0.868 MFI= 0.5	19,5	19,5
PP Plastomer MFI=8	9	9
POE-g-MAH	5	3
<b>VISCOSPEED</b>	<b>-</b>	<b>2</b>
Stearic coated milled MDH 3.5µm	60	60
Aluprem TB 1/t	5	5
Silicone masterbatch	1	1
Stabiliser	0,5	0,5
<b>TOTAL</b>	<b>100</b>	<b>100</b>
<b>PROPERTIES</b>		
MFI – 21,6kg@190°C	2	4
Tensile strength [N/mm <sup>2</sup> ]	12	10
Elongation at break [%]	215	>250
Presence of burning drops	yes	no

Table 4. Drummable bedding compounds

Typical Composition	(4A) Standard	(4B) 2% VISCOSPEED	(4C) 4% VISCOSPEED
C <sub>4</sub> -POE d=0.868 MFI<0.3	15	15	15
EVA VAc=28% MFI=3	15	13	11
Stearic coated milled MDH 5,5 µm	70	70	70
<b>VISCOSPEED</b>	<b>-</b>	<b>2</b>	<b>4</b>
<b>TOTAL</b>	<b>100</b>	<b>100</b>	<b>100</b>
<b>PROPERTIES</b>			
MFI 160°C@21.6kg	1	3	7
LOI	36	36	36
Tensile Strength at break, MPa	5	6	7
Elongation at break [%]	<50	>60	>100

to maintain stable production in high productivity compounding equipment by accelerating the incorporation of fillers into the polymeric matrices. The incorporation of VISCOSPEED improves and accelerates the dispersion of flame retardant mineral fillers (milled ATH, milled MDH, kaolin, silicates, etc.) and additives (nanoclays, nanosilica, sepiolite, etc) into polymeric matrices with associated benefits in terms of rheology and flame retardancy.

To learn more about VISCOSPEED

and review test results obtained in cable compounds, Aluminium Composite Panels (ACP) and TPO-roofing membranes, contact Dr. Christoph Bornschein at Innospec Leuna.

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# Calm returns to TiO<sub>2</sub> market

*Slower demand seems to have eased TiO<sub>2</sub> pricing fluctuations a little and delayed some capacity expansions but newcomers are still eyeing market opportunities. Peter Mapleston reports*

The titanium dioxide pigment market has certainly had its ups and downs in recent years – significant price fluctuations, substantial M&A activity, and new players coming and going. The situation today appears to be a little calmer, due in part at least to the damping effect that COVID-19 has had on activities of all sorts. In development terms, activity in pigment grades for plastics has continued and some increased capacities are in the offing. Providers of complementary technologies that help ‘stretch’ TiO<sub>2</sub> in formulations are also upping their game.

“During the pandemic, global producers have reduced production, stabilising the price of their products and maintaining manageable inventory levels. Conversely, Chinese producers have increased exports while decreasing price, increasing the price differential to near record levels,” says Gerry Colamarino, Managing Director of **TiPMC Consulting**.

Major producers have been pushing for price increases in recent months. Venator, for example,

announced global increases of \$120/tonne to come into effect in March and April. In late August this year SK Capital said it will purchase 80% of Huntsman’s 49% stake in Venator, with an option to purchase the remaining 20%. SK owns assets producing other pigments – it acquired Clariant’s Textile Chemicals, Paper Specialties, and Emulsions businesses in back in 2013 and renamed them Archroma – but the stake in Venator will be its first involving TiO<sub>2</sub>.

TiO<sub>2</sub> feedstock prices have continually increased, with some stabilisation for both chloride and sulphate slag products, according to Colamarino. “Increased feedstock costs are impacting margins for all producers, including Chinese producers. The margin depletion is increasing costs, as well as impacting reinvestment economics,” he says.

## Slowing expansions

**Chemours** is one of the world’s largest manufacturers of titanium dioxide, vying for the top position with Tronox. Speaking in May, Chemours CEO Mark

**Main image:**  
The Covid pandemic has dampened the TiO<sub>2</sub> price fluctuations of recent years and delayed some capacity expansions

IMAGE: LOMONS BILLIONS



**Above: Julie Reid, Lomon Billions Marketing Director, says company has opened more European warehousing this year**

Vernano said the company is extending the timeline for planned capacity expansions into 2021 and 2022, as it cuts capital spending on growth projects this year due to slowing consumer demand. Its long term aim is to add more than 200,000 tonnes of annual capacity across various plants.

Before the coronavirus pandemic emerged, the TiO<sub>2</sub> sector had largely de-stocked through 2019 and was just beginning to turn up, Vergnano says. He says the company's Chemours' Ti-Pure Flex online portal has helped it increase its market share over the last 12 months. That was introduced to allow qualified customers to lock-in prices through a "buy-as-you-need" approach (it was covered in *Compounding World* August 2019, page 42).

### Tracking capacity

**Lomon Billions**, which operates five TiO<sub>2</sub> pigment production sites and also owns titanium-rich ilmenite mines in China, is now the world's third largest TiO<sub>2</sub> pigment producer. The company currently has capacity to make 650,000 tonnes of sulphate-process TiO<sub>2</sub> pigment annually and has added 360,000 tonnes/year of chloride-process TiO<sub>2</sub> pigment capacity since 2018.

TiO<sub>2</sub> pigment is manufactured using either the sulphate or chloride process. Compared to the sulphate process, TiO<sub>2</sub> pigment produced via the chloride process has distinct properties and performance characteristics that make it the preferred choice for some applications, including plastic compounds.

Commercial production from the first of Lomon Billion's two new chloride lines began in 2019 and from the second line in the first half of this year. The company further expanded its chloride TiO<sub>2</sub> manufacturing capacity in June 2019 with the acquisition of a plant at Chuxiong in the south west of China from Xinli Titanium. This has since been refurbished extensively and was restarted in January of this year, adding around 60,000 tonnes of additional annual capacity.

Lomon Billions has a technical cooperation contract with Ti-Cons, a Germany-based consultancy specialising in TiO<sub>2</sub> pigment manufacturing technology and with special expertise in the chloride process.

The company plans to construct more chloride-process TiO<sub>2</sub> production lines at Chuxiong. These new lines, along with some debottlenecking of current capacity, will eventually increase annual chloride-process TiO<sub>2</sub> capacity at the site to around 300,000 tonnes, pushing the company's chloride-process TiO<sub>2</sub> production capacity to around 600,000 tonnes a year.

Aside from the capacity expansions, the company opened a new sales and technical centre in Shanghai in May of this year. It has also been expanding its European operations. "We opened our European office in Stockton On Tees in the UK in 2014," says Julie Reid, Lomon Billions Marketing Director. "This year the European team has grown significantly. We've employed more people from the area to help us with sales support, finance, and regulatory affairs. We've also added new warehouse facilities in Europe so that we can deliver from local stock with short lead times."

Lomon Billions now has European warehouses in the UK, France, Italy, Spain, Germany, and Poland and says that more locations are under review. The company makes no secret of its strategic investment plans to grow its business and to strengthen its competitiveness through vertical and horizontal integration.

"The company has vigorous development plans," says Lomon Billions Chairman Gang Xu. "They include investment in innovative TiO<sub>2</sub> pigment manufacturing technology, increasing vertical integration into feedstock, and expansion of our chloride TiO<sub>2</sub> pigment manufacturing capacity still further. We aim to become the global market leader in the TiO<sub>2</sub> manufacturing industry by the mid 2020's."

The company is also making substantial

**Below: The Lomon Billions Technology Centre at Jiaozuo in China. The company says it has "vigorous development plans"**

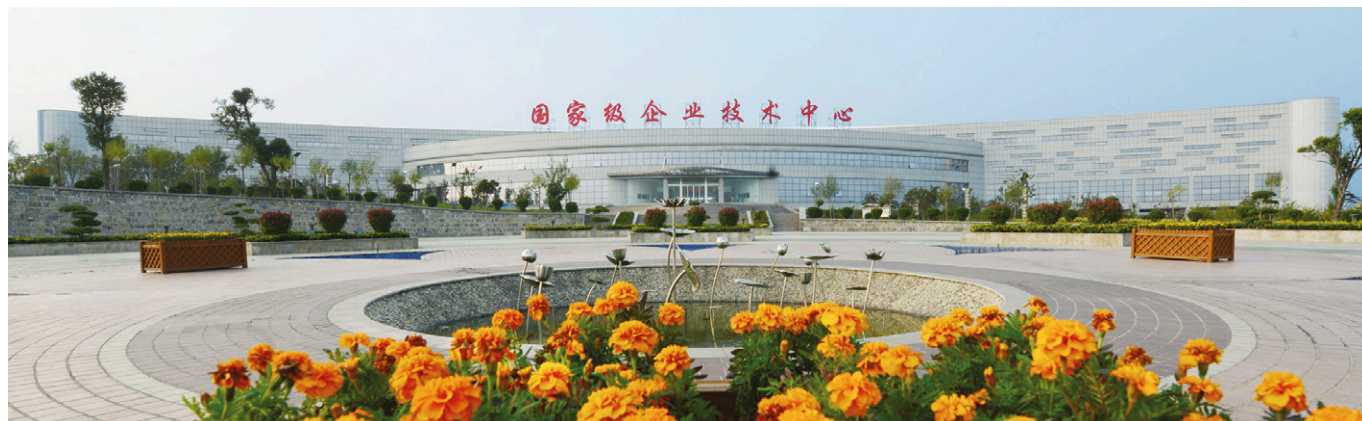


IMAGE: LOMONS BILLIONS



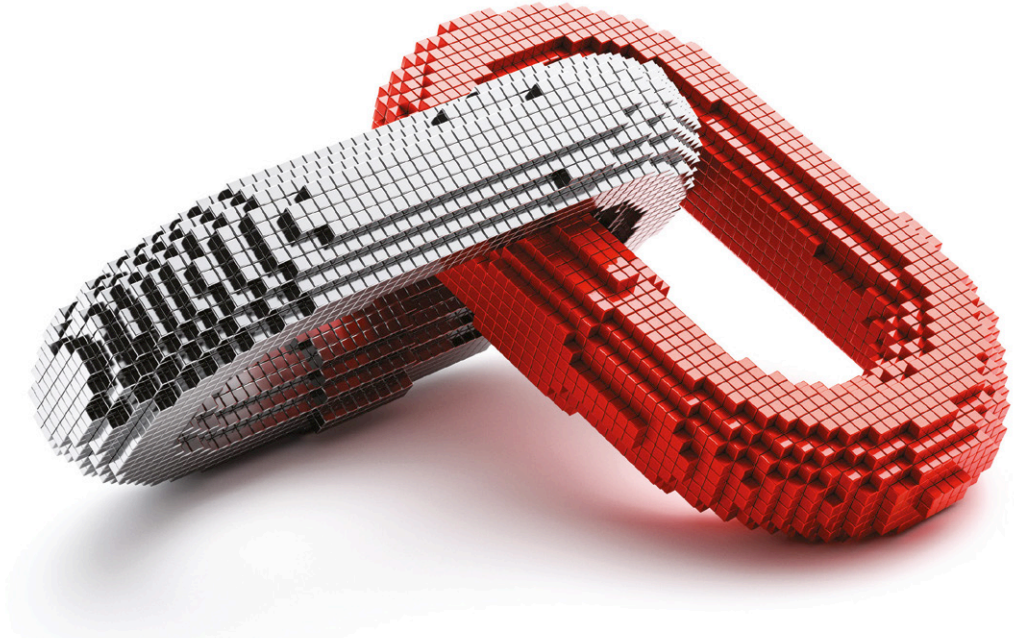
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**Right: A plastics pigment grade is on the target list for TiO<sub>2</sub> industry newcomer TNG**

investments in mining and upstream manufacturing. Over the next five years, the company says it plans to invest \$2bn in a large-scale development project to help transform vanadium-titanium magnetite mining technology and expand ilmenite mining operations at Panzhihua City, China.

### Plastic products

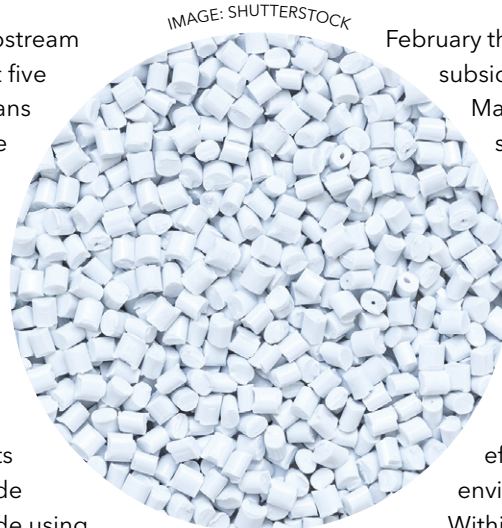
Lomon Billion's TiO<sub>2</sub> pigments for plastics applications include Billions BLR-886, which is made using the chloride-process. "BLR-886 is particularly suitable for polyolefin masterbatch, high-temperature extrusion coatings, cast films and engineering plastics. It's designed to deliver bright, white colour with excellent processability and lacing resistance. It also has excellent dispersion with minimal effect on melt-flow," says Reid.

"We're currently developing a super-durable chloride-process TiO<sub>2</sub> pigment for plastics. We've optimised its alumina and silica coating to provide superior durability, while also delivering excellent optical and dispersion performance for superb visual appearance and formulation efficiency," she adds.

Reid says the company has a full product development pipeline with more new chloride-process TiO<sub>2</sub> pigments expected within the next five years. "We're aiming to make our chloride-process TiO<sub>2</sub> pigment the 'pigment of choice' for a wide range of applications worldwide," she says.

### International plans

Another Chinese company with its eyes on international markets is **Fujian Kuncai Material Technology**. A relatively young company - it was founded in 1999 - its main activities revolve around special effect pigments such as pearlescents. However, in



February this year it established two new subsidiaries - Zhengtai and Fushi Material Technology - which it says will enable it "to pursue two fresh strategic directions in its further development. One objective is to extend the product portfolio to include different types of pigment, another is to build and strengthen an integrated supply chain for the existing effect pigment production environment."

Within this plan, Zhengtai in Fuzhou will eventually produce around 500,000 tonnes of high-quality TiO<sub>2</sub> annually using proprietary extraction technology. The first production line, with an annual capacity of around 100,000 tonnes was scheduled to start up in the middle of this year with production aimed at the Asian market. That has been delayed.

Fujian Kuncai Material Technology Global Marketing Director Corinna Ludwig says: "We are planning to produce TiO<sub>2</sub> and iron oxide qualities there for use in plastics, but we need more time for the finalisation of the plant and the implementation of the innovative production process. We are now planning to have everything set up by end of the year. For now, we cannot report on specific quantities or qualities for the plastics industry."

### New additions

Also preparing an entry into the TiO<sub>2</sub> market is Australian company **TNG**. It says it is on-track with its project to produce 100,000 tonnes of TiO<sub>2</sub> pigment by early 2023. "Our first grade will be a highly durable pigment for architectural coatings; it will be followed by a plastics grade, but it is still too early to talk about it," says Philippe Guillemaille, Paris-based General Manager Sales & Marketing at the company. ➤

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EU classification of certain forms of  $\text{TiO}_2$  as a Cat 2 carcinogen comes into effect in October 2021

IMAGE: SHUTTERSTOCK

## The EU position on $\text{TiO}_2$

The EU harmonised classification of certain forms of  $\text{TiO}_2$  as a suspected carcinogen (Cat 2) is due to come into force on 1 October 2021. The Brussels-based Titanium Dioxide Manufacturers Association (TDMA, part of CEFIC) provided *Compounding World* with the following update on the situation as it sees it.

"Since the publication in the Official Journal on 18 February 2020, the Titanium Dioxide Manufacturers Association and its members have attempted to find a practical and defensible interpretation of the classification to enable meaningful and consistent compliance given the uncertainties and ambiguities created in the classification.

In June 2020, the TDMA's interpretation was made available for downloading by businesses manufacturing, importing, or using  $\text{TiO}_2$  and products containing  $\text{TiO}_2$ . It expresses the TDMA's interpretation of the scope and application of the new classification in order to help manufacturers, importers, and downstream users in applying this classification to the extent possible. However, considering the uncertainties inherent to this classification, alternative interpretations may exist. Ultimately only the Court of Justice of the European Union is competent to authoritatively interpret Union law. The document is available for download [here](https://www.tdma.info).

In addition, TDMA and its members have made their expertise available in multiple other areas that may be affected by the classification for instance, in relation to waste, cosmetics and updated safety data sheets.

The TDMA continues to disagree with the classification of  $\text{TiO}_2$  as there is no reliable, acceptable, or available data to suggest that  $\text{TiO}_2$  causes cancer. The Member Companies of the TDMA as a part of a wider group of  $\text{TiO}_2$  producers and users submitted on 13 May 2020 an action to the General Court of the European Union seeking annulment of the harmonised classification.

The decision of the General Court is expected to take two to three years and therefore will be after the classification comes into force on 1 October 2021. In the meantime, TDMA and its members will focus on finding a way to implement the regulation from that date despite the uncertainties of the classification."

➤ [www.tdma.info](https://www.tdma.info)

Explaining its technology, TNG says the traditional sulphate route typically uses an ilmenite feedstock, which has a high content – typically 47% – of iron oxide. The rutile feedstock used in the more modern chloride process contains around 10% iron oxide. TNG uses a pigment production process based on the sulphate route, but has developed a hydrometallurgical process that creates a feedstock that is low in iron oxide – just 2.3% – making the overall process much more sustainable.

Another newcomer is **Avertana** in New Zealand. Founded in 2012, it has developed technology for extracting mineral and chemical ingredients – including  $\text{TiO}_2$  – from waste slag created during steel manufacturing. "Avertana's technology not only consumes the solid by-products of steelmaking but also avoids mining and further waste generation by conventional industrial processes," the company claims. It says it has brought together the necessary capital and expertise with the proven skills required to scale its industrial process from laboratory to commercial production.

Working with slag from BlueScope New Zealand Steel, as well as samples obtained from steel mills in China, Russia, and South Africa, Avertana has now confirmed that its process could be applicable to more than 200m tonnes of slag globally, providing a global platform for technology deployment.

Last November, Avertana won the Sustainability category at the Institute of Chemical Engineering's IChemE Global Awards for its process, which consumes 4-6 tonnes of slag to make a tonne of  $\text{TiO}_2$  pigment. The remaining balance is converted into chemicals used in water treatment and fertilisers, as well as inputs to make building materials such as cement and wallboard.

The road to success can not be guaranteed though. Several years ago, *Compounding World* reported on a development at Canadian start-up company Argex Titanium that promised improved economics for high-quality  $\text{TiO}_2$  pigment (October 2015). Things appeared to be going well and, in June 2019, the company announced a strategic agreement for a multiplant development deal with a major Chinese engineering procurement and construction company that it said would address growing demand in China. But, just a few days later, Argex Titanium filed for bankruptcy, saying it was unable to raise sufficient funds to complete construction of its own production plant. The company is no longer trading.

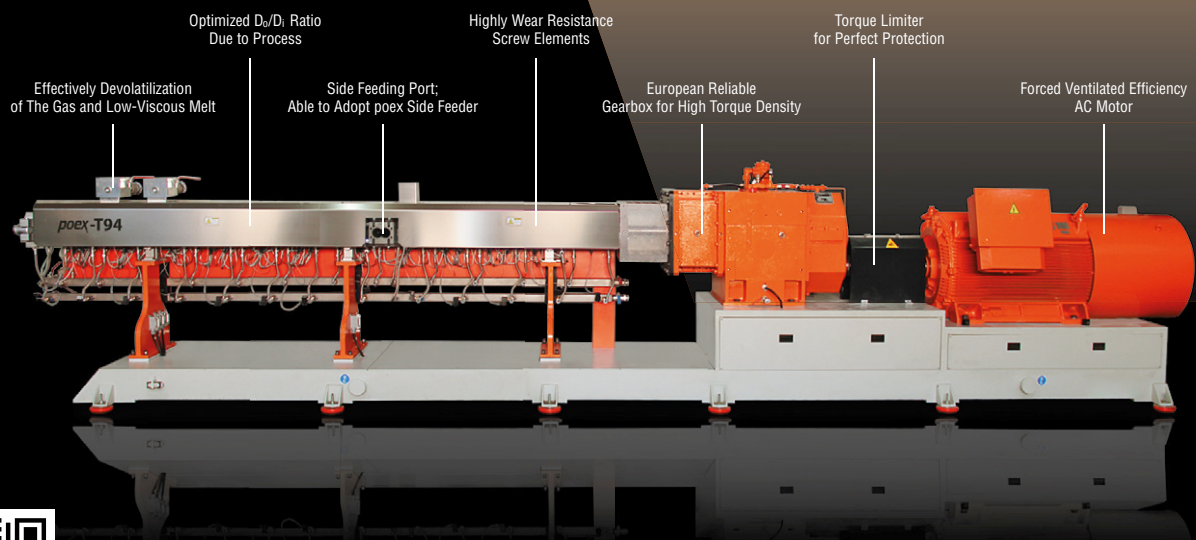
### New introductions

New  $\text{TiO}_2$  pigments for plastics are not thick on the ground at the moment, but there are some. Tiona



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IMAGE: VENATOR

**Above: The latest addition to the Venator product line is Tioxide TR29, an ultra-low moisture pigment grade**

244 is a high-performance chloride product from **Tronox** intended for use in a wide range of masterbatch applications. The company says the grade "has been designed to deliver the best balance of opacity, processability and consistency. Tiona 244's excellent dispersion characteristics maximise efficiency and performance in plastic processing."

The Tiona 244 product is manufactured at Tronox's Stallingborough facility in the UK, using the company's proprietary chloride technology. "Consistency and quality are effectively managed through sophisticated control of surface treatment, advanced particle size testing and filter pressure testing," the company says. It adds that Tiona 244 is recommended for evaluation in custom colour concentrate, white concentrate, polyolefins, ABS, polystyrene, flexible PVC, PVC pipe and plastisols.

Meanwhile, **Venator** launched Tioxide TR29 – described as an ultra-low moisture  $\text{TiO}_2$  pigment – at the K2019 show in Germany last October. The company says it is its highest performing white pigment for low moisture applications and demanding processing conditions. The TR29 grade is

designed for use in manufacture of highly technical thin films and in engineering polymers where moisture sensitivity is a consideration. It can be used to create masterbatches with a very high  $\text{TiO}_2$  loading, according to Venator. Potential applications are said to include earphones and smartphone shells; ski masks; and air conditioning units.

The latest addition to the Ti-Pure product line from **Chemours** is TS-4657, a rutile pigment manufactured by the chloride process and focused on ink applications. The company says the product is brighter and whiter than competing sulphate products and that it combines high opacity and colour retention with low abrasion. The low abrasion characteristics may see the new grade win some applications in plastics, it is thought.

### Extender options

Development also continues on materials that offer the ability to "extend"  $\text{TiO}_2$ . The FP-Opacity Pigments are described by producer FP-Pigments as "the next generation development in  $\text{TiO}_2$  efficiency, moving forward from randomly distributed rutile into engineered composite pigment particles."

According to Andy White, Business Unit Director



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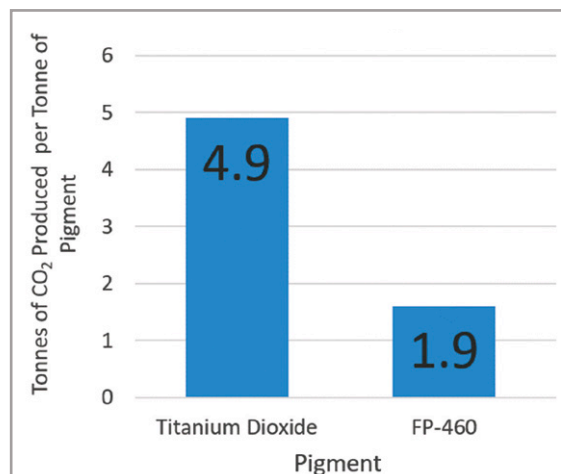
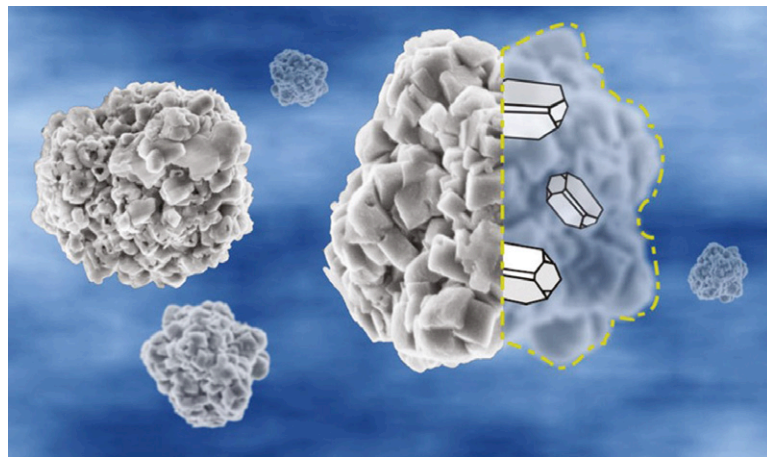
Paints and Plastics at FP Pigments: "Despite almost three years of falling  $\text{TiO}_2$  prices and the need for  $\text{TiO}_2$  replacements seeming to be going out of fashion, FP-Pigments business has gone from strength to strength. Our Opacity Pigment products provide significant cost saving opportunities through  $\text{TiO}_2$  optimisation (typically 10% to 20% reduction in  $\text{TiO}_2$  use) while maintaining performance characteristics."

White says that with  $\text{TiO}_2$  prices beginning to pick up again,  $\text{TiO}_2$  optimisation (and cost control) are moving back to the forefront of producer's priorities.

"Demands for  $\text{TiO}_2$  may well be compounded too by the probable infrastructure investments that all governments plan in the coming years in order to rebuild broken economies after the pandemic," he adds. "On top of this is also the rising issue of sustainability, becoming an increasing factor in the raw material choices made by producers and consumers."

White says that with these likely scenarios in mind, FP-Pigments is continuing to invest in its technology. Investments include a new online offering, which was developed as a result of the COVID-19 pandemic. "Our new website is now a comprehensive technical site," he says. Information

**Below:**  
**SEM images**  
**with cut-away**  
**schematic**  
**showing**  
**distributed**  
**rutile in**  
**FP-Pigment's**  
**FP-Opacity**  
**Pigment**



**Carbon footprint comparison fo FP-Pigments FP-510 pigment and  $\text{TiO}_2$**

Source: FP-Pigments

available to visitors includes application results and discussion articles, for example explaining the use of FP-510 as a partial  $\text{TiO}_2$  replacement in PVC pipe.

FP-Pigments will soon bring to market some new products such as ultra-high brightness pure PCC and further optimised FP-Opacity Pigments. "Initial evaluation of these concept products has shown positive results that should allow further formulating cost savings through  $\text{TiO}_2$  and functional extender replacement in plastic compounds; all while maintaining the original performance and providing a carbon footprint reduction," White says.

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

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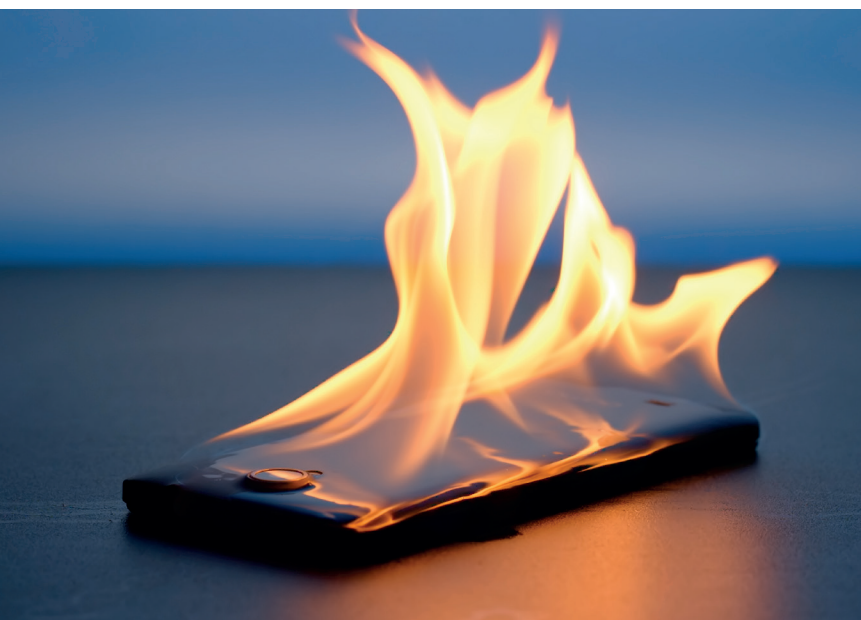


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*Suppliers of high-temperature resins and compounds are continuing to improve their materials, ranging from PA and PPA to PEEK and even crosslinked thermoplastics.*

**Peter Mapleston**  
*finds out what's new*

IMAGE: SHUTTERSTOCK

# Competition heats up in temperature resistance

When it comes to thermoplastics with high temperature resistance, processors and application specifiers have never had as much choice as they have today. Offerings in semi-crystalline and amorphous materials continue to improve and expand. That's especially true when it comes to polyphthalamides (PPAs), the so-called high temperature nylons, but not only these materials. Polymer producers and compounders have in recent months introduced new polysulphones, polyphenylene sulphides, polyesters, polyaryletherketones, and even crosslinkable thermoplastics.

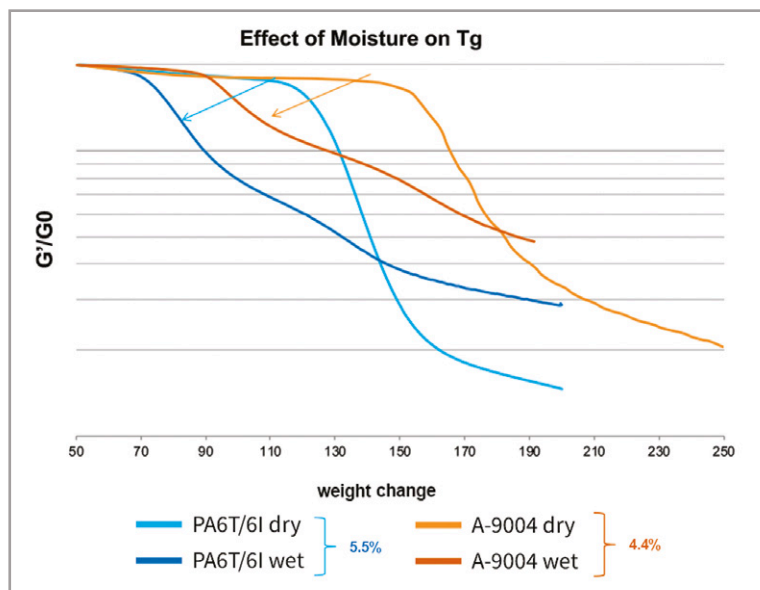
**Solvay** was the first company to market with a PPA, branded Amodel. Thirty years on, its newest material is Amodel Supreme, a PPA polymer that is claimed to offer the highest performance on the market. The original Amodel was based on polyamide 6T (the T stands for terephthalic acid). Solvay does not say what type of PPA the new Amodel is.

"Amodel Supreme PPA features the industry's highest glass transition temperature ( $T_g$ ) of 165°C, and it delivers superior mechanical performance between 140 and 200°C," says Brian Baleno, Head of Marketing and Business Development, Solvay Specialty Polymers global business unit.

The new polymer also improves electrical property performance, including volume resistivity and dielectric strength above 150°C. Solvay says this creates new opportunities for PPA to be used in higher voltage rotating electric systems, such as next-generation traction motors, inverters and power electronics.

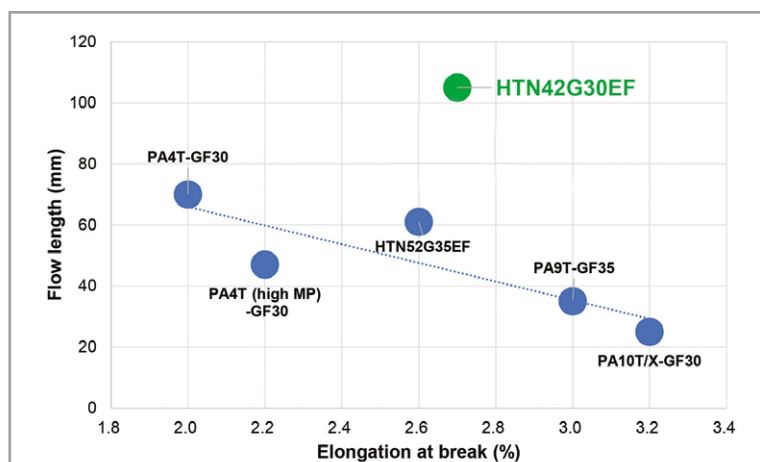
Amodel Supreme PPA products are built on Solvay's new 9000 Series base resin. They are available in 33% and 50% glass fibre-filled resins for standard grades (metal replacement), structural grades (thicknesses over 3mm) and grades targeting automotive electrification. All materials

**Main image:**  
**Ever-higher temperature demands are being made in automotive, E&E and aviation markets**



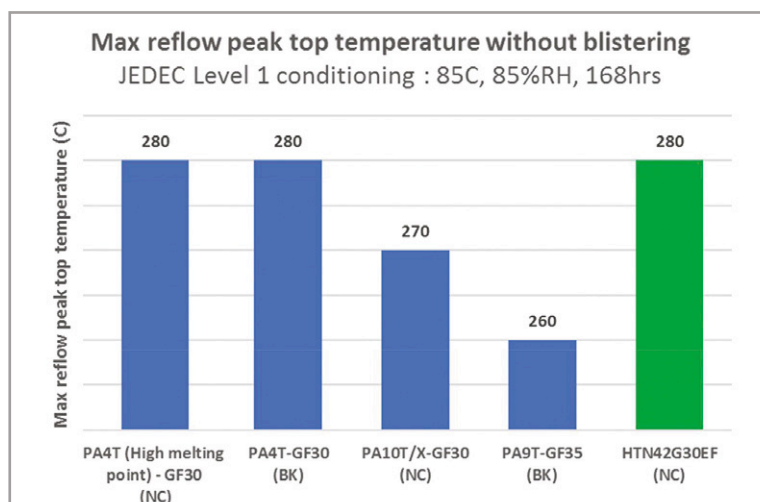
DMA analysis shows that Solvay's Amodel Supreme A-9004 has a much higher Tg than a PA6T/6I, before and after conditioning. Water absorption is 20% less

Source: Solvay



Comparison of flow and elongation at break of various PPAs

Source: DuPont



Comparison of maximum reflow soldering temperature that various PPAs can withstand without blistering

Source: DuPont

provide excellent glycol resistance.

As automotive electronics become more complex and compact, surface mount technology (SMT) and reflow soldering is growing in use, demanding connector insulation materials that can withstand higher temperatures than in the past. Another important requirement is the prevention of corrosion of the metal contacts in the electronics assemblies. To address these issues, several connector material suppliers have in recent years developed high-heat grades that prevent electric corrosion by using organic heat stabilisation additive packages.

DuPont is one of them, with its Zytel HTN Electrically Friendly (EF) portfolio, which continues to grow. Latest addition is Zytel HTN42G30EF, a 30% glass fibre-reinforced, PPA grade with 22% renewable content (the company does not divulge the exact nature of the polymer). "In addition to the signature electrochemical corrosion resistance and high temperature resistance of all DuPont's EF grades, this product features high flow and improved reflow performance," the company says. "Together, they enable thin-wall, miniaturised designs such as multi-pin, fine pitch and low height connectors, and contribute to accelerated cycle times."

DuPont also points to the ability of Zytel HTN42G30EF to withstand reflow soldering temperatures with minimal discoloration. "This can help automotive tier suppliers achieve greater outputs of high-quality PCB and FAKRA connectors," it says.

Other key properties of the materials include high impact resistance, which helps minimise breakage during assembly, and high weld line strength. The comparative tracking index (CTI) for both natural colour and black (laser markable) versions is 600V.

Also aiming at electronics applications is Kuraray. Several months ago, it expanded its Genestar E&E grade portfolio with halogen-free, UL94 V-0 30% glass fibre reinforced compounds based on PA9T. Kuraray says the grades combine a good processability with JEDEC MSL 1 blister resistance. In addition, they have high weld-line strength and a CTI of Performance Level Categories PLC class 0 (ASTM D3638) and Material Group I, of over 600V (IEC 60112).

Additions include Genestar GP2300S, which has V-0 properties for the thickness range from 0.15 up to 3.0 mm, and which Kuraray says "is the ideal solution for different types of surface mount reflow connectors that require V-0 flammability."

Laurent Hulpiau, Genestar sales engineer at Kuraray subsidiary Eval Europe, says recent studies using an adapted test set-up at Kuraray's R&D





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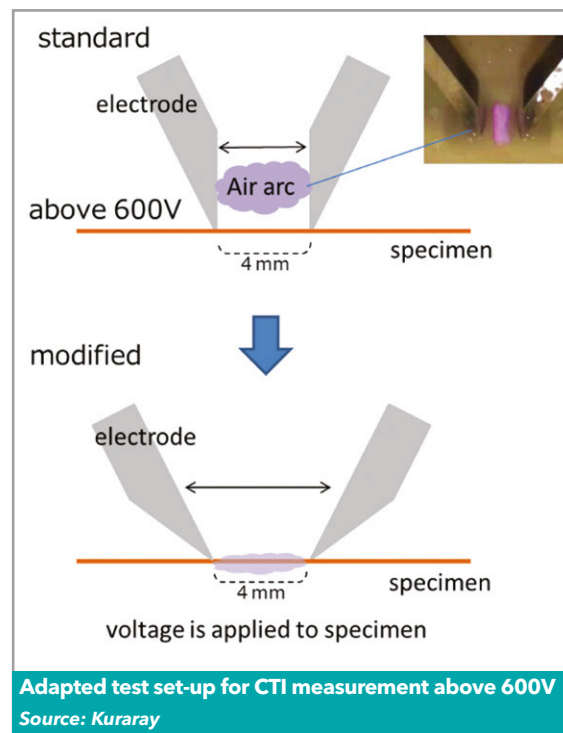
centre in Japan have proven that this grade can reach a CTI up to 1,000V. "The standard set-up (IEC 60112) can cause the creation of an air arc that inhibits the CTI measurement at voltages higher than 600V," he says. "Therefore, the electrodes were rotated through 180 degrees to prevent this air arc from being formed and to allow voltages up to 1,000V to be applied."

Different colouring options are available for Genestar GP2300S. As a first option, Kuraray has developed a UL-registered V-0 masterbatch together with what was Clariant Masterbatches, now Avient. This masterbatch is available for sampling in various colours, including RAL2003 orange for high-voltage applications. Kuraray has also developed an in-house coloured compound, available for sampling.

"This combination of CTI up to 1,000V and colour availability makes Genestar GP2300S the ideal solution for high voltage connector applications," says Hulpiau. "It solves problems like electrical breakdown due to tracking to prevent safety issues and will help to downsize parts by lowering the creepage distance, for low and high voltage connectors."

Independent compound producer **Akro-Plastic** has developed compounds of its own based on PA9T (it does not say which polymer supplier it uses). These are halogen-free, flame retardant Akromid grades, with various levels of glass fibre reinforcement and UL94 V-0 from 0.4mm and GWIT of 800°C from 0.4mm up to 3.2mm. The range includes a special grade in RAL 2003 orange. The colour shows no drift even after 3,000 hours at 120°C. "More important for the moulding process, the grade is not only showing a very easy flowability, it provides the processor a very wide process window with stable colours and good surface finish," says Tilo Stier, Global Sales Director & Innovation Manager.

For sensors such as Denox sensors used in automobile exhaust systems, which require housings with high dimensional stability and chemical resistance, the compounder developed Akromid T9 GF 40 LT black (7827). This grade has a very wide process window and, unlike PA6T, almost



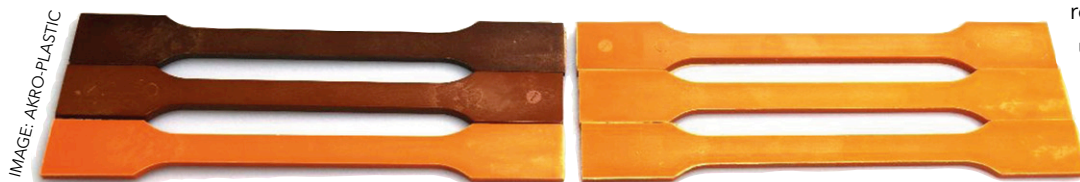
no deposit while moulding, Stier says. "Processors can run this laser-transparent black grade with higher output and better quality," he claims. "It enables complex welding geometries with very low scrap rates in the joining process." Akro has built up extensive know-how in laser welding, Stier says, and its grades enable very high weld line forces between the laser transparent and laser absorbing components.

PA9T has traditionally been quite an expensive polymer (over €10/kg), but this is changing as availability of the polymer from more than one source increases, notes Stier (BASF, for example, introduced its version, Ultramid Advanced N, at K2016).

### Options in PA4T

The **LehVoss Group** recently introduced the Luvocom 25 line, based on **DSM's** ForTii Ace PA4T-based polymer. "Luvocom 25 offers high glass transition temperatures up to 160°C, extreme stiffness and strength, low water uptake, excellent chemical resistance to moisture, salt, oils, acids and others," says the company. "Furthermore, it offers retention of performance in under-the-hood applications. The LehVoss Group offers compounds, including customised solutions, for demanding metal replace-

ment applications. To achieve outstanding properties carbon fibres, nano additives and tribological additives are added in the respective compounds."



**Results of heat aging different polyamides at 120°C. Left: Polyamide 66, Akromid A3 GF 30 FR orange (7871); bottom 0h, middle 1,500h, top, 3,000h, right: Polyamide 9T, Akromid T9 GF 30 FR orange (8104) (120°C)**





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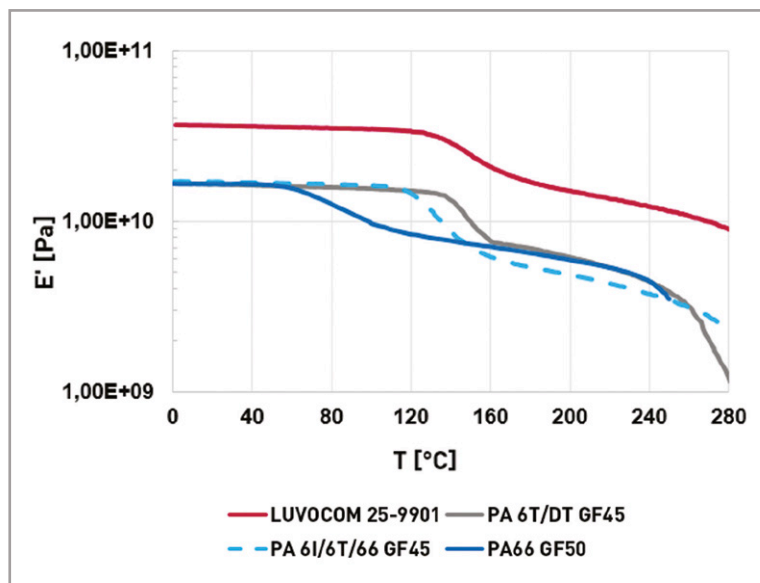
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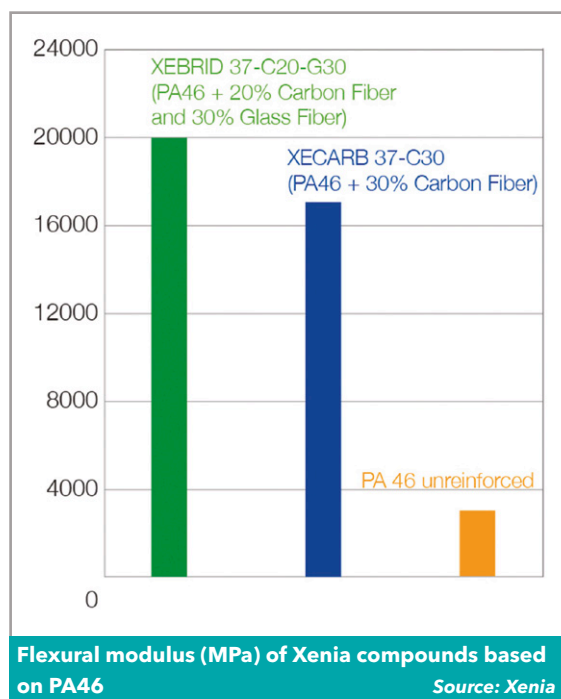
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LehVoss says customised Luvocom compounds based on DSM's ForTii Ace PA4T provide outstanding mechanical properties at high temperatures. Graph compares variations in shear modulus with temperature in one grade, Luvocom 25-9901, and compounds of other high-temperature polyamides.

Source: LehVoss



Flexural modulus (MPa) of Xenia compounds based on PA46

Source: Xenia

LehVoss says that cooperation between it and DSM, together with automotive systems supplier CarNaTrix, is helping accelerate metal replacement in transmission components. "In this partnership materials and part designs have been optimised to enable new ground-breaking automotive systems," says Thomas Collet, Director 3D Printing Materials & Marketing, in the Customised Polymer Materials business unit at LehVoss. The latest development is material solutions for e-mobility. "In the powertrain

of electric cars, parts needed in decoupling units and the gearbox demand high-performance materials," Collett notes. "Luvocom 25 products have been customised and are available now for this area."

Based on DSM's Stanyl PA46 (not a PPA, but still with very good heat resistance), XECARB 37 and XEBRID 37 are two families of carbon fibre and hybrid carbon/glass fibre reinforced compounds launched last year by **Xenia** in Italy. The company says PA46 is known for its unmatched performance and value for demanding applications in which superior heat resistance, design stiffness, wear and friction, and process flow qualities are required.

"Thanks to the application of structural reinforcements the new grades XECARB 37 and XEBRID 37 exhibit high tensile modulus, tensile strength at break up to 275 MPa, improved HDT, good fatigue resistance, higher dimensional stability and better surface hardness. Furthermore, the use of carbon fibres within the XECARB 37 family provides improved electrical properties and better resistance to UV and chemical agents like oils and hydrocarbons."

Xenia says that with the development of the new grades XEBRID 37 hybrid carbon/glass reinforced compounds, the impact properties have improved, "always maintaining a high crystallinity level and a great flow behaviour, typical for the polymer's aliphatic molecular structure."

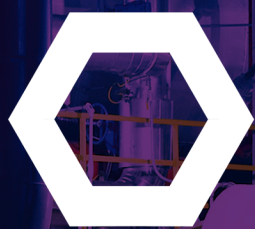
The company expects the new compounds to find use in a wide range of structural and conductive applications characterised by high operating temperature resistance, together with good chemical resistance and low friction.

Back at **Akro-Plastic**, another new high-temperature product is Precite E GF 50 natural (7300), a 50% glass reinforced crystalline PET. Thilo Stier says PET is "widely undervalued" for engineering applications. "This grade has extremely low creep and excellent mechanical properties," he says. "With a melting point of 255°C and a high Tg, Precite E can be a cost-efficient alternative to PPA grades. At 120°C, mechanical properties are just as good as PA6T, but at a much lower price."

He says: "Comparing the stress strain behaviour of PET and PA 6T, both 50% reinforced, shows almost equal values at 120°C. The flex modulus at room temperature reaches 21 GPa and tensile/flex strength is 225 MPa/350 MPa."

These impressive properties are independent from any moisture pick up – a big advantage versus conventional PPA grades, says Stier, who adds: "We will soon see some parts weighing well over 1kg in Precite substituting diecast magnesium." Akro is





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IMAGE: BASF



**Above: BASF's Ultrason P2010 (left) offers improved flow**

now promoting Precite for centre consoles. "It has really outstanding properties for this application," says Stier.

### PESU and PPSU

**BASF** is launching an engineering plastic that is particularly suited for automotive parts that come into contact with hot oil. Ultrason E0510 C2TR is a new polyethersulfone (PESU) that the company says shows very good tribological properties, high oil resistance and excellent dimensional stability,

even when temperatures fluctuate widely. The 10% carbon fibre reinforced grade can be used within a temperature range that starts at -30°C and goes all the way up to +180°C. "It is easy to process because of its low viscosity and therefore its very good flow properties," says BASF.

Ultrason E0510 C2TR is being pointed at the manufacture of various car parts that come into contact with oil: oil pumps, oil control pistons, pressure valves and high-speed components in automatic and manual gearboxes. It can also be employed in new applications for alternative drive technologies. "Due to its good flow properties, parts with wall thicknesses of less than one millimetre can be injection moulded without compromising on their stability, durability and oil resistance," says the supplier.

The material's low coefficient of thermal expansion ( $10.4 \times 10^{-6}/K$ ) makes possible parts that are dimensionally stable and that can withstand rapid temperature changes from cold to hot without any damage. Tests according to ASTM G137 have shown that the sliding friction performance outperforms that of other "tribologically optimised" high-performance thermoplastics, BASF says: Even

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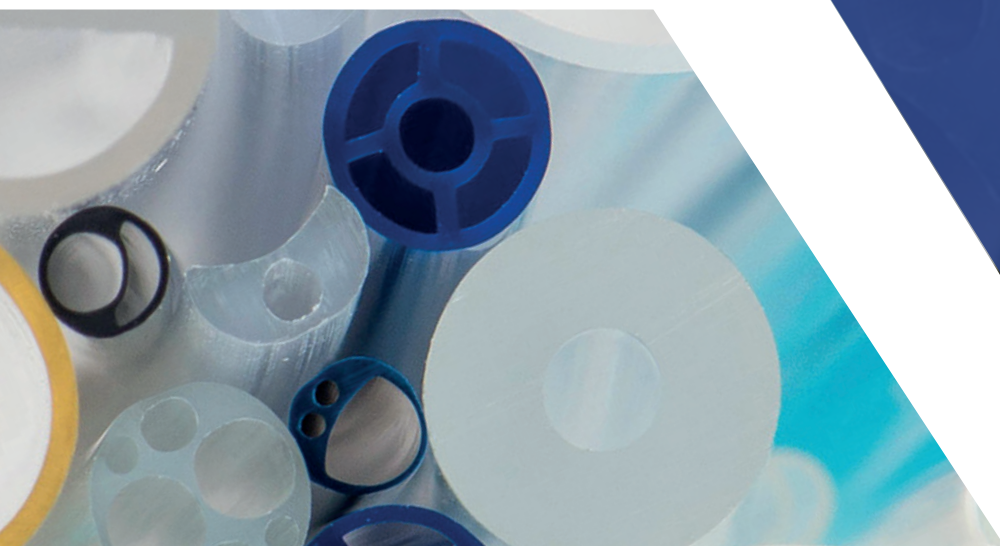
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# Carbon fibre PA wins against magnesium

The highly elaborate centre console for Porsche's new Taycan EV pictured below is made of Akroloy PA ICF 40, a 40% carbon fibre reinforced grade of PA6T/66/6I from **Akro-Plastic**.

After evaluating the mechanical

properties of different materials, Porsche chose the compound as a replacement for the originally intended magnesium die casting. Due to the density difference (1.35 g/cm<sup>3</sup> vs. 1.81 g/cm<sup>3</sup>), a weight saving of 25% in the

component could be achieved. The material retains a very high stiffness (>33,000 MPa) and strength (360 MPa) even after conditioning. Despite the thin-walled construction, this enables very high sustainable natural frequencies and dynamic load capacity.

ICF compounds are made using gravimetric feeding of short carbon fibres sourced from textile off-cuts. Gravimetric feeding provides much more precision in dosing of the fibres than rival systems, enabling Akro-Plastic to offer its material with the same specifications as compounds made using virgin carbon fibre.

IMAGE: SPE



at high wear rates, it says test components show only low wear with virtually unchanged mechanical stability and chemical resistance.

PESU is already known for its very high chemical resistance, inherent flame retardance, high rigidity and strength combined with temperature stability over a large operating temperature range and outstanding hydrolysis resistance.

BASF also recently announced that it was expanding its Ultrason P range of polyphenylsulphones (PPSU) with a particularly low-viscosity grade. According to the company, Ultrason P 2010 shows improved flow behaviour in injection moulding while maintaining the excellent mechanical properties of "regular" Ultrason P. BASF has largish, complex-shaped components in its sights, including catering dishes and heat-resistant containers with sophisticated, thin-walled geometries, for land-based and aircraft applications. Ultrason P 2010 comes in transparent and opaque grades.

The new material combines what BASF describes as the outstanding notched impact strength and stability of the already available Ultrason P 3010 with high chemical resistance, good steam sterilisation at 134°C and inherent fire resistance. The Charpy notched impact strength is said to be almost ten times higher than that of some current competitor amorphous high-temperature thermoplastics. "Even the combination of aggressive cleaning agents and disinfectants, water and extreme heat does not affect Ultrason P 2010," says the company. The material is approved for food contact in the EU and the US.

Catering and aircraft equipment are among the

most important application areas for Ultrason P 2010. In hotels, restaurants and canteens, containers and pans made of the BASF PPSU can be used to prepare food as well as to transport meals and keep them warm. Here the demands on sterilisation and resistance to cleaning agents are very high. In aircraft construction, fire resistance is of particular importance. Therefore the inherently flame-retardant specialty plastic, which in the event of fire releases little heat and hardly any harmful substances, offers optimal conditions, not only for serving dishes, but also for seat and lighting cladding, air vents and overhead luggage compartments.

Similar abbreviation, but quite a different polymer, polyphenylene sulphide (PPS) is the base for compounds widely used in metal replacement applications destined for challenging environments, as in situations characterised by permanent contact with hydrocarbons and solvents, or in the presence of strong inorganic aggressive agents.

"Few other polymers are able to offer the same level of resistance to such a wide range of chemical substances, even at high temperatures," says Luca Posca, Technical Service and Marketing Director at Italian compounder **Lati**.

"Another recognised advantage of PPS is that it can be used successfully even at operating temperatures touching 200°C, a circumstance that can arise both in the working environment as a whole and locally (for example, parts situated close to electric motors, or in the automotive and industrial applications)," he says.

According to Posca, moulded items in rein-





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**Right: Victrex CT was selected by Advanced Engineering Valves for use in cryogenic and severe service ball valves**

forced PPS, as opposed to other semi-crystalline polymers, "offer remarkable, even unique, dimensional stability, thanks to a very limited differential shrinking, and consequently minimal deformations, similar to those typical of amorphous plastics."

An interesting application cited by Posca for a PPS compound supplied by Lati is vanes injection moulded by VP Plast in Italy and installed on the rotors of rotary pumps built by the French company Mouvex, part of the PSG group and a leader in the construction of compressors and pumps for the handling of liquids.

In rotary vacuum pumps, the performance of the system depends largely on how well the vanes work. They have to guarantee a tight seal between the rotor and the internal jacket, so as to prevent fluid leaking into the pump chamber and causing a loss of pressure. Since they must also slide radially along the rotor without wearing the metal, the surface hardness and finish are crucial. Mouvex uses Lati's Larton G/40, a 40% glass fibre-reinforced PPS compound, in addition to stainless steel and PEEK.

**Polyplastics** in Japan counts PPS among a range of thermoplastics aimed at high-heat applications. Tunenobu Satoh in the company's sales planning department says Polyplastics' Durafile PPS "is used for more than 150°C of high-heat resistant purposes. Components which are mounted on the engine directly are targeted PPS applications. Examples include engine speed sensors, thermal management components, and inverter housings of EV components."

### PEEK for hot and cold

Belgium-based Advanced Engineering Valves (AEV), which is a leader for cryogenic and severe service ball valves, has selected a **Victrex** high



IMAGE: AEV

performance cryogenic PEEK polymer to help its customers operate applications more efficiently and safely. The company's 2XC\* C-ball valve products require zero maintenance in cryogenic service.

The cryogenic Victrex CT 100 polymer was specifically developed by Victrex for insert applications. After successfully passing Design Validation Testing (DVT) at AEV, the polymer is now used in the company's class 900 ball valves ranging from ½ through to 18 inches. It is specified for a temperature range of -196°C to +150°C and offers structural strength at elevated temperature without compromising low-temperature performance.

"Many sealing applications in cryogenic temperature ranges have typically been made with fluoropolymers. However, our polymer products such as the Victrex CT series provide a unique range of properties over a broader temperature range, from +200°C down to -196°C, which fluoropolymers cannot meet," says James Simmonite, Director Energy at Victrex. In this temperature range, chemical resistance is still important, but other aspects such as creep resistance, low temperature toughness and tribological performance, and thermal properties such as conductivity and expansion, are the most important to applications such as valve seats and packings.

Back in 2005, **Gharda Chemicals** (GCL) in India sold its polymers division to Solvay, giving Solvay an entry into the PEEK business. But GCL is still in the very high heat resistant thermoplastics arena: it claims to have pioneered manufacturing of ultra-performance and high temperature resistant polymers at competitive prices. Its commercial

## Evonik drops PPA

Evonik is another company well-known for its high-performance thermoplastics, including Vestakeep PEEK and Vestamid polyamides of various types. However, it recently stopped offering PPA as part of a reorganisation of its business for high-performance polymers within the polyamide group. Noting that it had begun construction of a new PA12 facility complex and is expanding its production of transparent polyamides, it said it would be concentrating its activities on high-performance materials for attractive growth markets such as the automotive, oil and gas, 3D printing, and optics industries. Ralf Düssel, the head of the High Performance Polymers Business Line at Evonik, says that for customers, the move will mean a more intense focus on developing sophisticated specialty solutions.





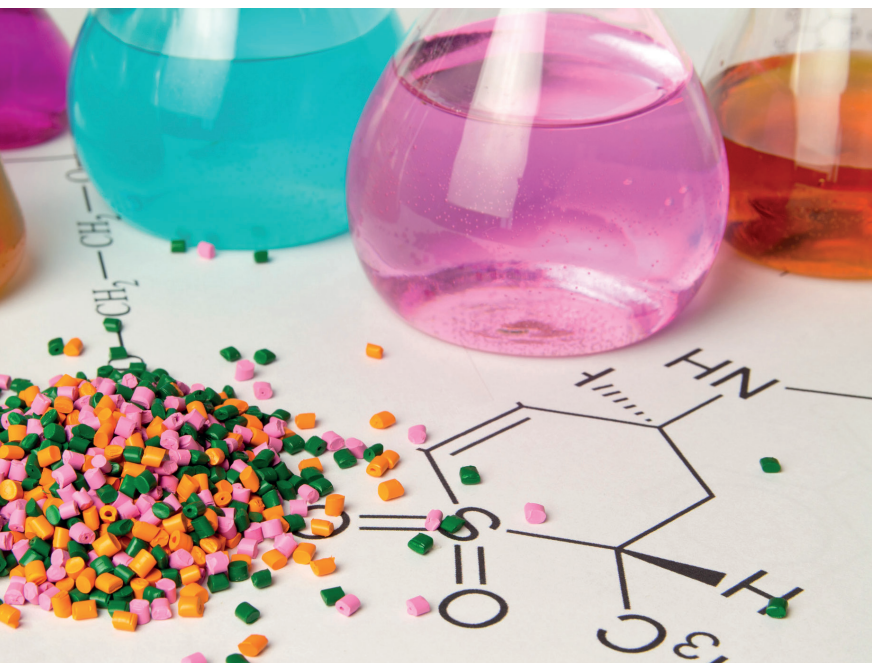
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offerings include PEK, PEKK, and poly (2,5-benzimidazole) (ABPBI), which can resist continuous temperatures from 250 to 300°C.

G-PAEK polyetherketone (PEK) has a glass transition temperature of 152°C and melting temperature of 373°C, offering extended high temperature performance together with toughness, strength, and chemical resistance. It is available in unfilled as well as filled forms. GCL says it crystallises quickly, so requires less cooling time than materials with comparable performance, reducing cycle time. Typical applications include gears, seals and connectors.

GAPEKK polyetherketoneketone (PEKK) combines high temperature stability, strength and stiffness, and ease of processing. It also has very high load bearing capacity, creep resistance, and inherent flame retardancy. GCL is the only company in the world that can offer PEKK with ratios of the two ketone monomers terephthaloyl and isophthaloyl (the so-called T:I ratio) starting at 60:40, passing through 70:30 and 80:20, to 100:0, according to Jaimin Zaveri, General Manager, Marketing and Application Development. PEKK can be injection moulded from 305°C to 400°C depending on the T:I ratio.

T:I ratio	Tm °C
100:0	390
80:20	369
70:30	335
60:40	305

**Melting point of PEKK varies according to the T:I ratio. Tgs are in the range from 160°C to 173°C**

**Source: Gharda Chemicals**

Zaveri says GAPEKK has the highest compressive strength of any polymer in the ketone family, while retention of mechanical and physical properties up to 300°C is higher than any other engineering polymer. Target applications include nozzles, powertrain components, aerospace parts, gears, and seals.

GAZOLE 6000 grades are ABPBI-based blends and alloys offering high mechanical performance up to 300°C, well above the glass transition temperature of 160-170°C. ABPBI is blended with PEK to make it melt-processable. Offered as replacements for metals and sintered carbons in parts requiring very high wear resistance, they are inherently lubricious, giving parts with a very smooth surface finish and exceptional abrasion resistance.

**Eurostar Engineering Plastics** has a unique

view on high-temperature-resistant injection-mouldable plastics, says Alexis Chopin, the company's head of technology. "We are converting an engineering resin into a high-heat resin," he says. "New applications are rising even for structural parts linked to engines and submitted to heat and mechanical stress." All developments are covered by NDAs.

For some time now, as an alternative to high heat plastics, Eurostar EP has been proposing speciality radiation-crosslinkable polyamide compounds with core products very well suited for demanding E&E applications such as circuit protection equipment or contactors for parts running in tough electrical arc environments.

"As part of this product line, Eurostar EP is now launching a new crosslinkable polyamide product line based on very high glass fibre content that is very well suited for metal replacement," says Chopin. These new grades (Staramide PF0012K with a glass fibre content of 60% is just one) offer extremely high rigidity (tensile modulus above 20GPa), good impact resistance (Izod unnotched impact strength above 50KJ/m²), outstanding dimensional stability, and very low creep in the temperature range of -40°C up to +130°C. "They can withstand peak temperature even above the melting points of standard high-heat polyamides such as PPA. These products are well suited for structural UTH automotive applications where all these requirements are needed."

Crosslinking is carried out (normally by a specialist external service company) on moulded parts via beta or gamma irradiation (typically 50-100kGy). Eurostar EP is also developing a new concept based on thermal crosslinking.

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**This article was first published in Injection World, September 2020**





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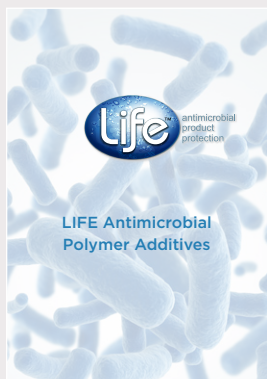
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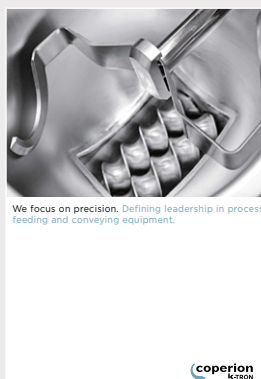
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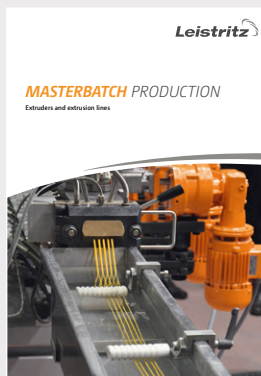
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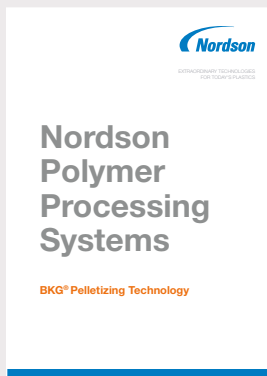
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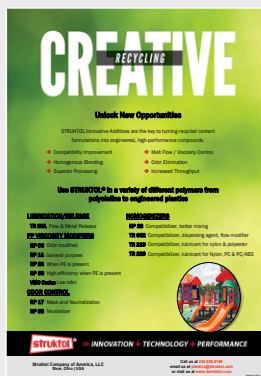
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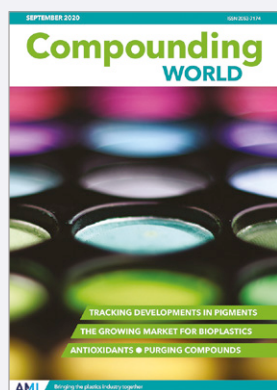
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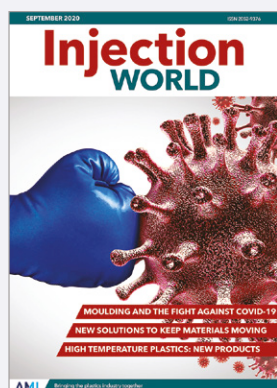
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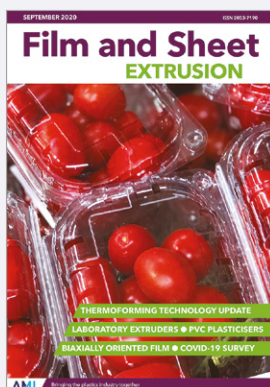
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	<b>4-6 May</b>	Kuteno, Rheda-Wiedenbrück, Germany <b>NEW DATE</b>	<a href="http://www.kuteno.de">www.kuteno.de</a>
	<b>4-7 May</b>	Plast 2021, Milan, Italy	<a href="http://www.plastonline.org/en">www.plastonline.org/en</a>
	<b>17-21 May</b>	NPE 2021, Orlando, FL, USA	<a href="http://www.npe.org">www.npe.org</a>
	<b>1-2 June</b>	Compounding World Expo Europe, Essen, Germany <b>NEW DATE</b>	<a href="http://www.compoundingworldexpo.com/eu/">www.compoundingworldexpo.com/eu/</a>
	<b>15-18 June</b>	FIP, Lyon, France <b>NEW DATE</b>	<a href="http://www.f-i-p.com">www.f-i-p.com</a>
	<b>29 June -1 July</b>	Interplas, Birmingham, UK <b>NEW DATE</b>	<a href="http://www.interplasuk.com">www.interplasuk.com</a>
	<b>14-18 September</b>	Equiplast, Barcelona, Spain <b>NEW DATE</b>	<a href="http://www.equiplast.com">www.equiplast.com</a>
	<b>12-16 October</b>	Fakuma, Friedrichshafen, Germany	<a href="http://www.fakuma-messe.de">www.fakuma-messe.de</a>
	<b>3-4 November</b>	Compounding World Expo USA, Cleveland, USA <b>NEW DATE</b>	<a href="http://www.compoundingworldexpo.com/na/">www.compoundingworldexpo.com/na/</a>

## AMI CONFERENCES

<b>19-22 October 2020</b>	Composites <b>VIRTUAL GLOBAL SUMMIT</b>
<b>26-29 October 2020</b>	Agricultural Film <b>VIRTUAL GLOBAL SUMMIT</b>
<b>2-4 November 2020</b>	Plastics Regulation Europe <b>VIRTUAL SUMMIT</b>
<b>3-4 November 2020</b>	Chemical Recycling Europe, Hamburg, Germany
<b>30 Nov-2 Dec 2020</b>	Fire Resistance in Plastics Europe, Dusseldorf, Germany
<b>26-28 January 2021</b>	Thermoplastics Concentrates 2021, Coral Springs, FL, USA
<b>2-3 February 2021</b>	Polymers in Cables America, Charlotte, NC, USA
<b>25-26 March 2021</b>	Compounding and Masterbatch Asia, Bangkok, Thailand

For information on all these events and other conferences on film, sheet, pipe and packaging applications, see [www.ami.international](http://www.ami.international)

**PLASTICS RECYCLING**  
WORLD EXPO

**POLYMER TESTING**  
WORLD EXPO

**1 - 2 June, 2021**  
**ESSEN, GERMANY**

**PLASTICS EXTRUSION**  
WORLD EXPO

**COMPOUNDING**  
WORLD EXPO

**3 - 4 November, 2021**  
**CLEVELAND, OHIO**

[www.ami.international/exhibitions](http://www.ami.international/exhibitions)