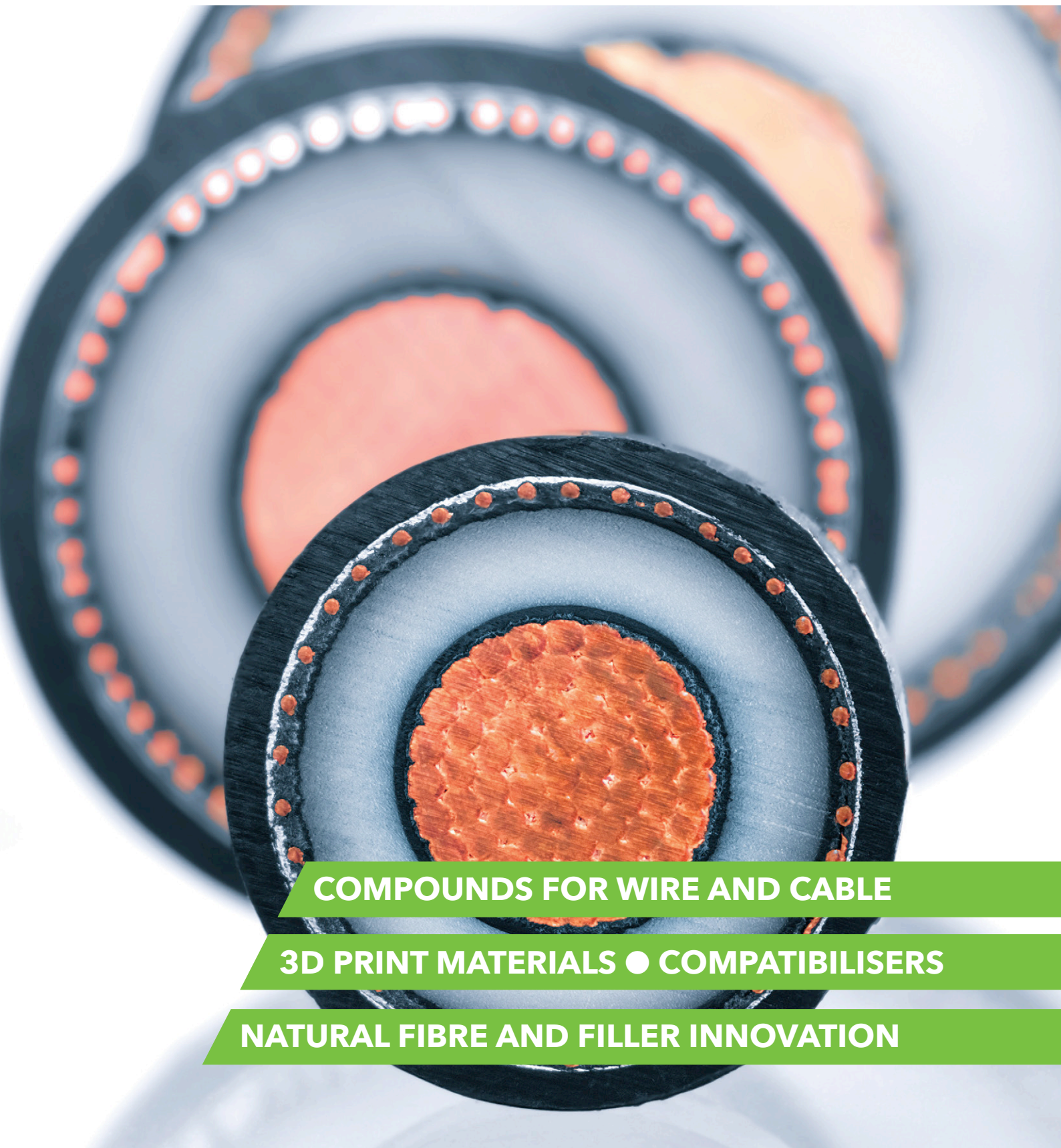


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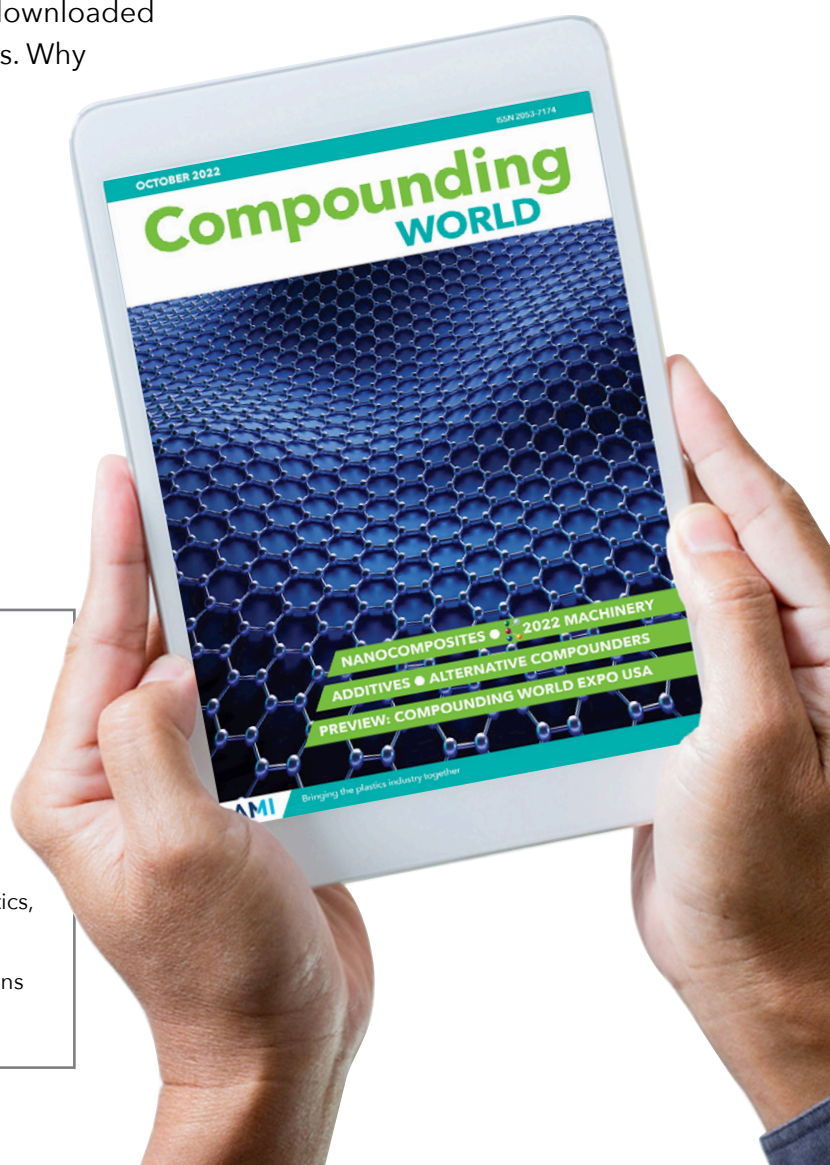
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# Compounding WORLD

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COVER PHOTO: SHUTTERSTOCK

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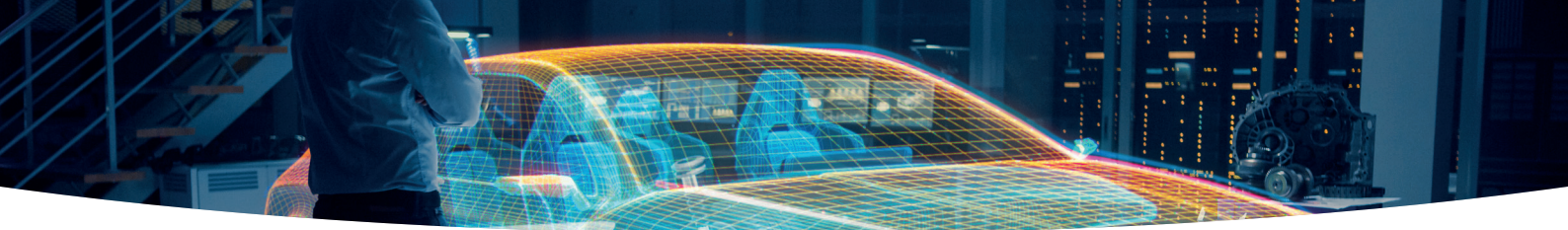
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# Envalior – a new name in ETPs

Envalior is the name chosen for the combined Lanxess High Performance Materials and DSM Engineering Materials joint venture, which is owned by private equity firm Advent International and Lanxess.

With a turnover of around €4bn and a workforce of some 4,000 worldwide, Envalior ranks among the top engineering materials companies globally with a footprint covering Asia, Europe, and the US. Its materials are supplied to industries including

automotive and new mobility, as well as electronics and electrical.

"Our new company's product portfolio includes some of the most recognisable product brands in our industry, and we are a leading supplier to a number of key industries," said Envalior CEO Calum MacLean, who has held posts at SABIC, Clariant, Synthomer and Ineos.

That product portfolio includes: Durethan, Akulon and Novamid PA6 and PA66; Fortii PA4T PPA;



Envalior CEO Calum MacLean

Stanyl PA46; EcoPaxx PA4,10; PXytron PPS; Pocan and Arnite PBT; Arnite PET; and Arnitel TPC. It also

includes Tepex continuous reinforced thermoplastic composite sheet, raw glass fibre, and caprolactam (a PA6 raw material).

Lanxess and Advent announced the intention to acquire the DSM Engineering Plastics business and merge it into a new materials joint venture (60% owned by Advent) at the end of May last year. The two partners paid around €3.7bn for the DSM EP business, which has sales of around €1.5bn.

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

## Gelest growing in biocides

Gelest has "significantly upgraded and expanded" manufacturing and formulation capabilities for its Biosafe organosilane antimicrobial product line.

"In response to the surging demand, we've refocused our efforts to make the synthesis and formulation of organosilane

antimicrobials competitive at scale," said Daria Long, Gelest Vice President of Consumer Care and Life Sciences.

The company claims its silicon-based antimicrobials perform differently to traditional types. Rather than poisoning bacterial cells from the inside, Biosafe

is claimed to create a surface layer that ruptures the cell wall. With the rise of multi-drug-resistant microbes, Gelest says this is a preferred mode of action.

Biosafe is EPA/FIFRA-registered for food contact and carries an FDA exemption from tolerance.

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

## China to compound Ecovio

BASF is to establish compounding capacity for its compostable Ecovio polymer in Shanghai, China, with commercial quantities of material expected to be available from mid-2023.

The first compound products will include film grades for applications such as compostable shopping and organic waste bags, soil-biodegradable agricultural mulch films, and packaging.

Ecovio compostable polymers comprise a blend of BASF's petrochemical-based Ecoflex PBAT and renewable polymers such as PLA. They comply with all requirements of both EU and US food contact regulations.

➤ [www.basf.com](http://www.basf.com)

## Covestro stretches circular PCs

**New PIR PC grades offer flame retardance and whiteness**



IMAGE: COVESTRO

Covestro has introduced a halogen-free flame retardant polycarbonate with 90% recycled PCR content for use in consumer electronics, among other applications.

Carbon footprint of the new Makrolon PCR grade, part of the company's CQ portfolio, is said to be 70% lower than a comparable fossil-based virgin plastic. It is also said to offer exceptional whiteness, made possible by optimal selection of high-quality recyclates.

Covestro is currently building a dedicated compounding plant for PCR polycarbonates at its integrated site at Shanghai in China.

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

## Polykemi grows in Mexico

Swedish plastics compounder Polykemi has opened a new sales subsidiary in Mexico City. Polykemi Mexico will be run by its former local partner Fernando González.

The move follows the start-up earlier this year of the company's first production site in North America. "For many years, we have been supplying Mexican customers with high quality plastic raw materials both from our production facility in Ystad, Sweden, and from our partners in the USA," said Mattias Persson, Polykemi Sales Manager.

"Now that our new production facility in Gastonia NC, USA is operational, it is a natural step in the globalisation of the company to also establish a new Polykemi subsidiary with a sales office in Mexico," Persson said.

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

## Teknor Apex buys Nu-Pro

Teknor Apex has announced the acquisition of US-based recycled PVC compound producer Nu-Pro Polymers.

The company, based at Wheeling in Illinois, converts post-industrial (PIR) waste to new compounds that are said to match prime performance. It specialises

in clear, natural and black grades covering a range of durometers and containing up to 90% recycled content.

Following the acquisition, Nu-Pro will continue to make products for Teknor Apex under the Cycle-Tek brand name.

"The acquisition of the

Nu-Pro business is another step in ensuring vinyl continues to be a sustainable option in the plastics manufacturing market," said Sunny Mahajan, Senior Technical Manager at Teknor Apex and Business Manager for Cycle-Tek.

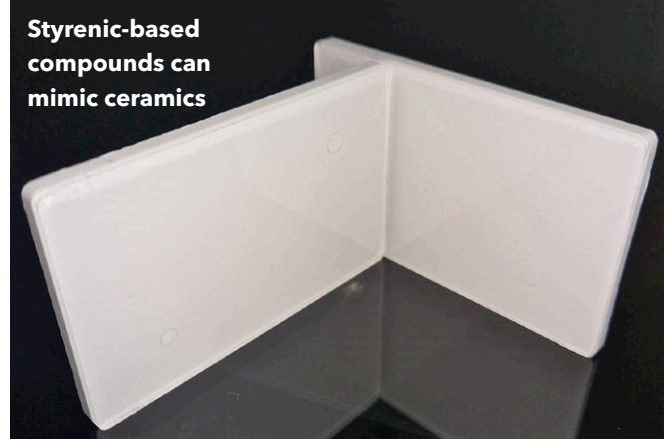
➤ [www.teknorapex.com](http://www.teknorapex.com)

## Styrolution and Microfol target ceramics with styrenic alternative

Ineos Stryolution and German compounder Microfol have been evaluating a range of PS and SBC-based solutions in a bid to find an effective and sustainable alternative for ceramics.

Results are said to deliver ceramic-like characteristics in terms of appearance, feel, and weight. However, the styrenic-based approach allows for easier recycling. Energy consumption during production is also lower.

Peter Hofmann, Microfol Managing Director, said: "We are excited to be part of a development that may



Styrenic-based compounds can mimic ceramics

IMAGE: INEOS STYROLUTION

change how we work with ceramics, a material that has been around for almost 30,000 years."

Styrolution said a number of producers of consumer

hygiene items, including bath tubs, basins and soap dishes, have shown early interest in the project.

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

## Universal Matter buys Applied Graphene

Canada's Universal Matter, through its UK subsidiary, has acquired UK-based Applied Graphene Materials (AGM) and its US subsidiary for a total consideration of \$1.3m.

Universal Matter was established in July 2019 and aims to upcycle a range of carbon-based materials, including waste streams, to high quality turbostratic graphene (TG). It claims its proprietary Flash Joule Heating (FJH) process can transform a wide variety of feedstocks into high value graphene materials.

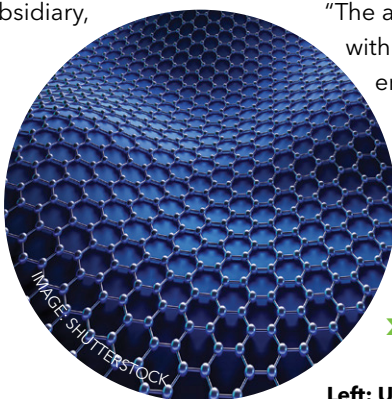


IMAGE: SHUTTERSTOCK

"The acquisition of AGM fits exceptionally well with UMI's growth strategy by significantly enhancing our dispersion and application capabilities for advanced paints and coatings. Moreover, it will provide UMI with an important European footprint for strengthening our growth potential," said Universal Matter CEO John van Leeuwen.

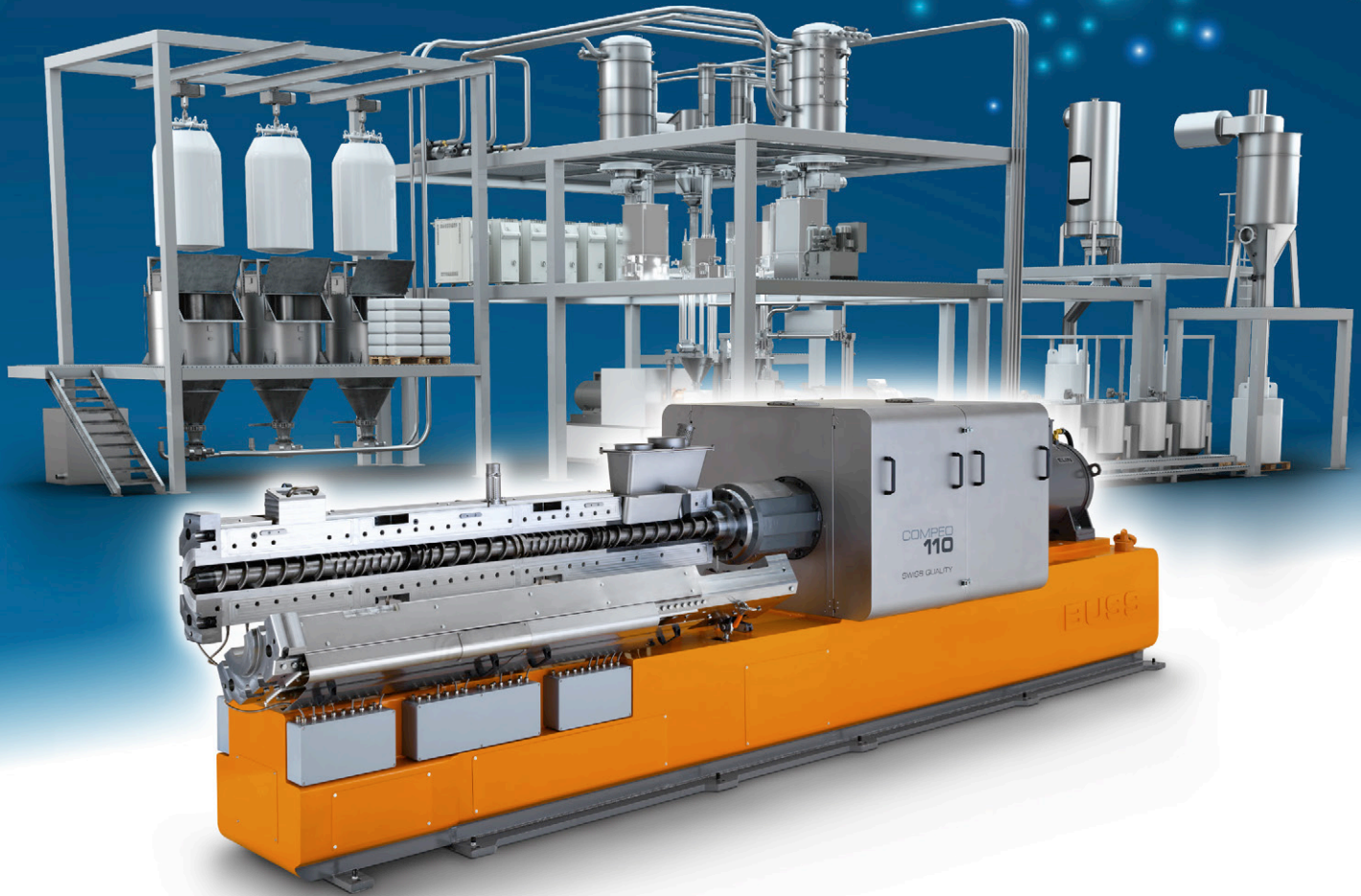
➤ [www.universalmatter.com](http://www.universalmatter.com)  
➤ [www.appliedgraphenematerials.com](http://www.appliedgraphenematerials.com)

Left: UMI sees Applied Graphene as a good fit



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# Europe takes aim at greenwashing claims

The European Commission has unveiled proposals for a Directive aimed at addressing 'greenwashing' – the use of misleading or inaccurate environmental claims on products marketed to consumers.

The **Green Claims Directive** proposal follows a study the Commission carried out in 2020 that found that more than 53% of environmental claims were either vague, misleading or unfounded and 40% were unsubstantiated.

The Directive, which requires approval from the European Parliament, aims to ensure that all "voluntary" green claims (it excludes



IMAGE: SHUTTERSTOCK

Above: European Commission wants to stop 'greenwashing'

those covered by existing EU rules) are accurate and backed with independently verified scientific data that details both benefits delivered and any trade-offs.

It includes rules to ensure claims are communicated

clearly. In particular, it highlights aspects such as off-setting and claims of recycled content, even suggesting further and more specific regulation may be required in those areas.

## Recycled FR PC from Mocom

Thermoplastic compounder Mocom, part of Otto Krahn Group, has added a recycle-based and flame-retardant

polycarbonate containing a mix of post-industrial and post-consumer recycle to its Altech ECO portfolio.

Altech ECO PC contains 76% recycled content and passes the UL94 5VA test with a simultaneous high

glow wire temperature. This test not only evaluates flame resistance of the materials, but also dripping behaviour.

"Flame retardancy as a property is a common requirement in the electrical and electronics segments [and] due to the expansion of the mobility sector, it is becoming an important requirement in the automotive industry," said

Stefan Zepnik, Director Technical Service Centre at Mocom.

"Using more sustainable materials has become standard practice. It is therefore a logical step to combine both properties in one compound to design products with special requirements for the future," he said.

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

## IN BRIEF...

Following its acquisition last year of the performance technology and industrial chemical business of Croda, **Cargill** has renamed the Crodamide range of antiblock and slip agents Optislip.

[www.cargill.com/bioindustrial](http://www.cargill.com/bioindustrial)

Engineering compounds specialist **Lati** has been named among the 1,000 Champions companies by the Italtypost Research Centre in collaboration with Italian newspaper Corriere della Sera.

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

**Helian** is to distribute **CJ Biomaterials'** PHACT A1000P amorphous polyhydroxyalkanoate (aPHA) biopolymer in Europe. The move is part of the Korean company's plans to expand into new markets.

[www.cjbio.net/en](http://www.cjbio.net/en)  
<https://helianpolymers.com>

UK-based **Matrix Plastics** has added an all-electric KraussMaffei injection moulding machine to its Matrix Medical Plastics compounding unit to extend its medical device development capabilities. The company set up the ISO Class 9 cleanroom operation in 2020.

[www.matrix-plastics.co.uk](http://www.matrix-plastics.co.uk)

## Orion debottlenecks its facility in Germany

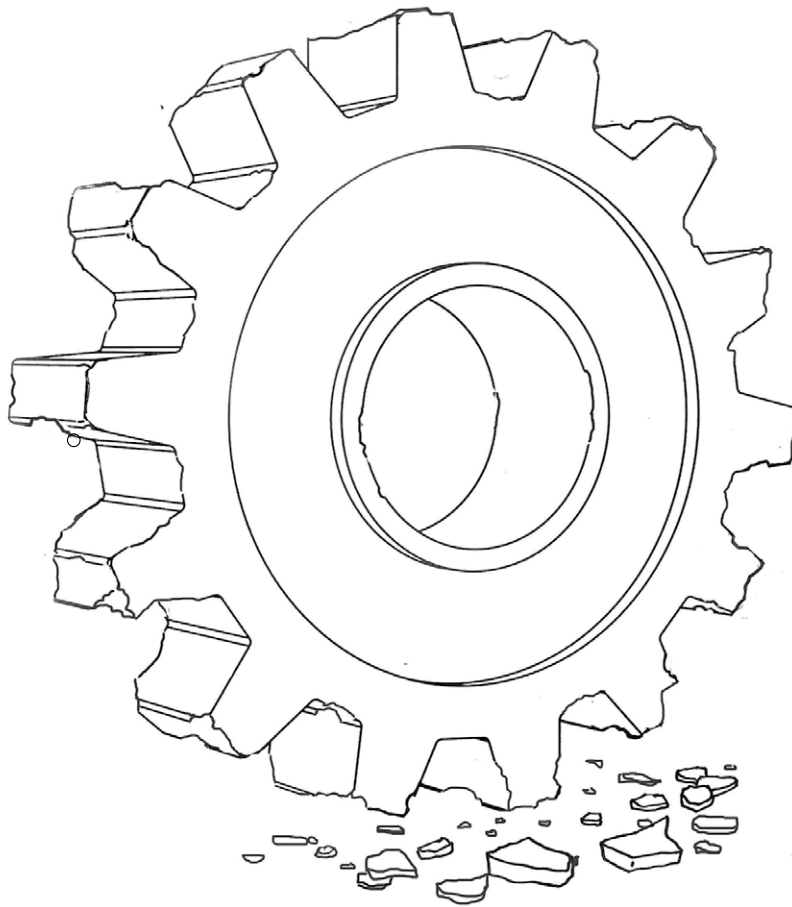
Orion Engineered Carbons (OEC) has debottlenecked a post-treatment unit at its high-jetness speciality carbon black production plant at Cologne in Germany.

The debottlenecking will enable the company to increase production capacity. It also allows it to produce products in bead format in addition to powder grades.

Orion said it also has plans to install a second post-treatment unit at the facility to meet demand for premium grade carbon blacks.

> <https://orioncarbons.com>





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



# Radici inaugurates Chinese plant

Italy's Radici Group has officially opened its new factory at Suzhou in China. The company said the €35m investment will double its engineering polymer production capacity in the country and will significantly step up its regional Asian presence.

Radici has had production operations in China since 2006, when it opened a small factory in Jiangsu Province. This was relocated to a larger site in 2012.

"Since starting up manufacturing operations in China more than fifteen years ago we have grown immensely, together with the local market," said Angelo Radici, President of RadiciGroup.

The new facility is built on a 36,000m<sup>2</sup> site and incorporates the latest green building technologies, including continuous energy monitoring, rooftop solar panels, and rainwater recycling.

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



IMAGE: RADICI GROUP

Above: Radici's new plant at Suzhou in China

## Rowa adds a new line

Rowa Masterbatch has completed the commissioning of the first of three planned new lines as part of a significant upgrade of its production site at Pinneberg in Germany.

The new compounding line, which comprises a Coperion ZSK 45 MC18 twin screw compounding extruder with associated container mixers, gravimetric feeders, side feeder, and strand and underwater pelletisers, is installed in a refurbished 700m<sup>2</sup> building on the Pinneberg site.

The company said the line has been configured for maximum masterbatch production flexibility, including the ability to handle and effectively disperse shear sensitive functional additives and pigments.

➤ [www.rowa-masterbatch.de](http://www.rowa-masterbatch.de)

## Versalis eyes up Novamont

Versalis, the chemical business division of Italy's Eni, said it is the "final stages" of negotiation that could shortly see it take full control of Italian bioplastics technology specialist Novamont.

Versalis already holds a

36% stake in Novamont. The remaining 64% is held by Mater-Bi, which is controlled by Investitori Associati II and NB Renaissance.

Novamont is heavily involved in the chemistry from renewables business, particularly in the develop-

ment and production of biodegradable and compostable bioplastics, while Versalis is committed to a future strategy that is strongly focused on chemistry from renewables.

➤ [www.versalis.eni.com](http://www.versalis.eni.com)

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

## Evonik expands PEBA capacity

Evonik is doubling global production capacity for its Vestamid E polyether block amide (PEBA) through a major expansion of its Multi-User Site China (MUSC) in Shanghai and an

optimisation project at its facility at Marl in Germany.

Construction of additional polymerisation capacity at the Shanghai site will commence later this year while Marl optimisation

projects are already underway.

Vestamid E is a long-established compound with properties that make it well suited for use in high-performance athletic shoes.

"This latest investment in Shanghai will significantly increase Evonik's PEBA production capacity, expand our regional presence, and put us in an optimal position to address the global market that is centred primarily on local manufacturing in Asia," said Ralf Düssel, Head of Evonik's High Performance Polymers Business Line.

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

Evonik is adding PEBA polymerisation capacity at its Shanghai site

IMAGE: EVONIK





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[MIXACO.COM](http://MIXACO.COM)



## Formerra buys in Ireland

Engineered materials distributor Formerra has acquired Dublin-based polymer distributor Total Polymer Solutions (TPS).

Formerra, formerly Avient's distribution division, has worked with TPS for more than a decade serving Ireland and UK-based manufacturing operations of multinational healthcare customers. TPS distributes a broad product portfolio and has built up in-depth technical and regulatory expertise in this area.

"This acquisition enables us to better serve our global healthcare customers in Europe with streamlined supply chain management and faster go-to-market support, driving significant value for all stakeholders," said Cathy Dodd, Formerra CEO.

TPS co-founders and owners Ronan Kennedy and Eamonn Keane will join the Formerra team post acquisition.

> [www.formerra.com](http://www.formerra.com)  
> [totalpolymer.com](http://totalpolymer.com)

# EU urged to harmonise mass balance concept

The European Chemical Industry Council (Cefic) and 30 other industry associations representing major markets along the plastics value chain have sent a joint letter to the European Commission calling for adoption of an EU-harmonised rule for calculating chemically recycled content through mass balance in 2023.

The letter emphasises that urgent legal certainty on mass balance chain of custody is indispensable in order to unlock investments required to meet the EU's 2050 climate and circularity targets.

Annick Meerschman, Cefic's Innovation Director, said: "We urge the EU to adopt a mass balance chain of custody approach for

calculating chemically recycled content in plastics, which is crucial for achieving the 2030 recycled content targets. Moreover, supporting chemical recycling as a complementary solution to mechanical recycling could attract more investments in this technology and help the EU achieve its targets."

> <https://cefic.org>

## Sinopec starts up SBC plant

Production has started at Sinopec's \$280m styrene-butadiene copolymer (SBC) plant at Hainan in China, which is expected to produce around 170,000 tonnes/yr of SBS and SEBS products.

The Hainan plant uses Sinopec's proprietary SBS and SEBS full solution sets, which is said to include a clean manufacturing method for production of custom SBCs.

The facility will make use of local styrene and butadiene and its location in

the Hainan Free Port will keep raw material and transport costs to the minimum. Sinopec's

intention is to export its SBC products to Europe and Asian markets.

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



Sinopec's 170,000 tonnes/yr SBC plant is operational at Hainan

IMAGE: SINOPEC

# Eastman completes car residue recycling study

Eastman said it has successfully completed a collaborative closed-loop recycling project for automotive mixed plastic waste with partners including United States Automotive Materials Partnership (USAMP), automotive recycler Padnos, and interior systems supplier Yanfeng.

When automobiles reach the end of their life 80%-90% of the materials can

be recycled through traditional streams. The other 10%-20%, referred to as automotive shredder residue (ASR), consists of mixed plastic and other nonrecycled materials that typically end up in landfills or waste-to-energy plant.

The project saw Padnos supply a plastic-rich fraction of ASR as a sustainable feedstock to Eastman, which used its carbon renewal

technology (CRT) to convert it to a synthesis gas that was subsequently used in the production of polyester and cellulosic thermoplastics. Resins from this production process were further formulated and before being supplied to Yanfeng.

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

> [padnos.com](http://padnos.com)

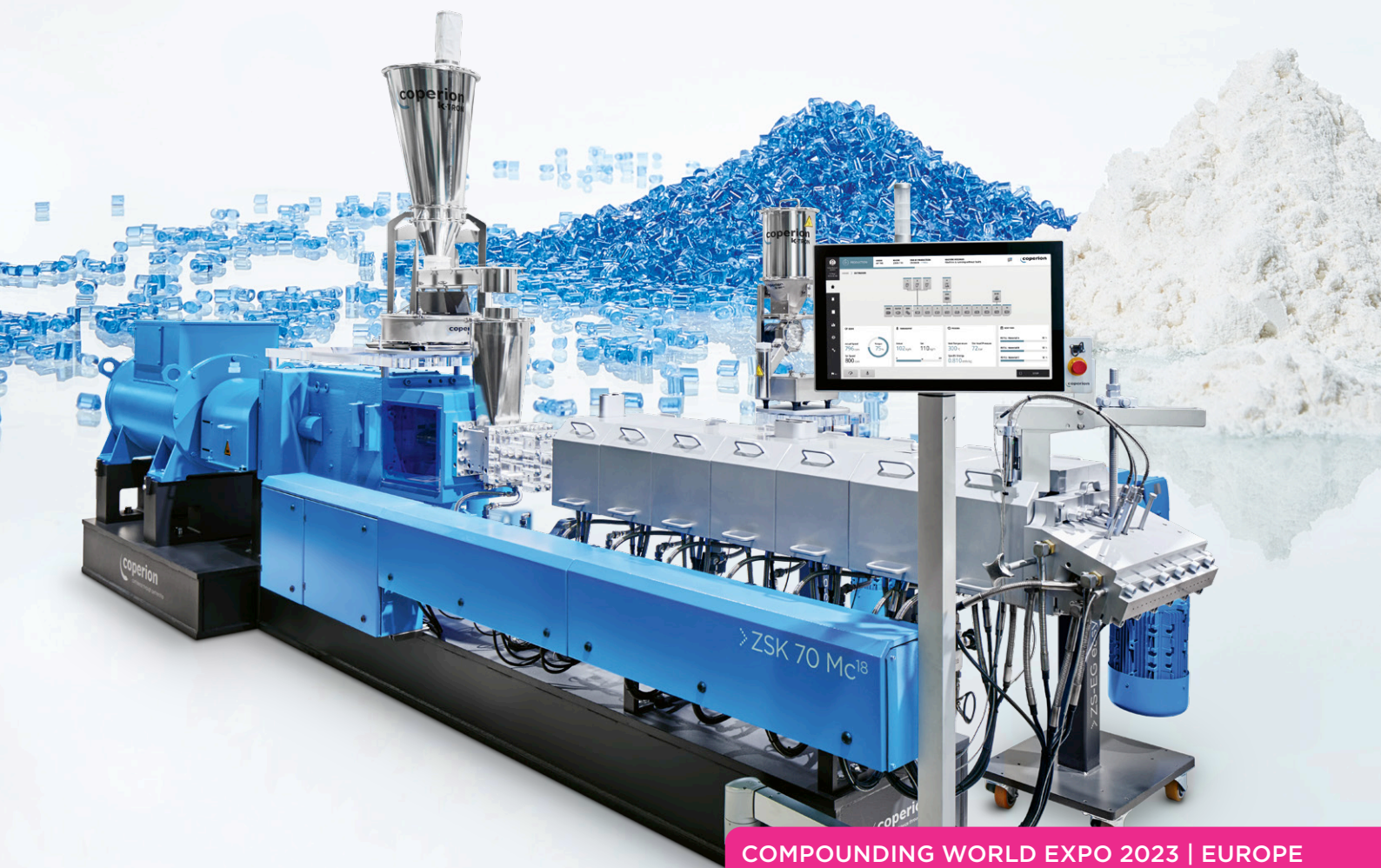
> [www.yanfeng.com/en](http://www.yanfeng.com/en)



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*New developments in additive manufacturing – 3D print – materials include easier processing, higher performance, and improved sustainability. Mikell Knights reports*

IMAGE: FINKE

# 3D printing technology builds on innovation

The increasing breadth of the current portfolio of polymer materials for additive manufacturing underlines with certainty the continuing transition of 3D print from prototyping solution to production technology. This transition is highlighted by UK-based market research company IDTechEx, which says increasing the available polymer materials portfolio for additive manufacturing and reducing materials cost are two key market forces influencing polymer materials development.

With this in mind, more thermoplastic powders, thermoplastic resins, thermoplastic filaments and photopolymers are being developed, including new grades formulated with properties that improve flexibility, reinforcement, and toughness. And these materials are designed for a broader array of applications, including medical, industrial, and dental, according to IDTechEx.

3D printing technologies also continue to expand to suit the wider materials and application requirements, with reactive thermoset extrusion, selective thermoplastic electrophotographic

process (STEP) and others being developed. New 3D technology approaches incorporate additive design techniques such as generative design and lattice structuring to reduce materials consumption compared to traditionally manufactured parts, so reducing the total materials cost per part. Other solutions to address material costs include development of less-expensive feedstocks by incorporation of waste or recycled material.

Japan's **Toray Industries** has launched a series of spherical PA6 particles for powder bed fusion 3D printers that reduce the need for polishing and post processing of printed shapes created from PA12 polymer particles, which tend to be irregular in shape. Surface roughness, which can be created in moulded objects that have microscopic peaks and troughs, affects part precision, surface feel, sealing and coating performance, according to the company.

The new Toraypearl PA6 material is said to have truly spherical-shaped particles that can produce complex and precise 3D printed parts displaying a smoother surface. The shape ensures the fluidity

**Main image:** Developers of 3D print materials such as Finke are addressing every user demand, extending from performance to aesthetics



IMAGE: EVONIK



**Above:**  
**Sustainability is a key focus for Evonik, which aims to reduce the carbon footprint of its Infinam PA12 powder**

needed for 3D printing, even when blended with reinforcing glass fibers. Toray developed the material by applying its proprietary polyamide particle technology, which creates spherical particles when PA is polymerised.

Toraypearl PA6 is said to offer high strength, heat resistance and good mechanical properties. Toray says it is targeting prototype applications that require such performance, which includes automotive parts, power tools and other equipment. The company says its particle technology can be applied to other PA grades, including PA66 and PA12.

Tokyo-based 3D printer company Aspect has obtained conformity certification for Toraypearl PA6 for its AM-E3 300 HT and 550HT additive manufacturing printers. Toray says Toraypearl PA6 will augment its Toraymill polyphenylene sulphide (PPS) resin milled powder to expand its lineup of materials to 3D printers. It says the production facility for this material should be fully operational by the fiscal year ending March 2026.

### A lighter footprint

Specialty chemical company **Evonik** has recently introduced new grades of its Infinam polyamide 12 (PA12) powders for 3D printing that are claimed to

offer a significantly reduced carbon footprint. The new sustainable grades are produced using renewable energies at the company's Marl Chemical Park facility in Germany, which is certified by TÜV Rheinland to have a carbon footprint improvement of almost 50%. Evonik is replacing its current castor-oil based Infinam PA12 products with the new alternative for all common powder-based 3D technologies, including SLS, HSS and MJF.

Evonik is also developing a new Infinam eCO product line, which avoids high greenhouse gas carbon dioxide emissions by using renewable or circular raw materials via mass balance. Evonik plans to launch the product line in 2023.

The company has also added three new additions to the Infinam photopolymer line for common UV-curing printing processes such as SLA or DLP. Infinam RG 2000 L is a clear liquid photoresin that cures quickly, is easy to process, and has a low yellowing index. The high-performance material is suitable for production of additive manufactured eyewear frames, as well as microfluidic reactors. Its good light transmission properties make it suitable for lenses, light guides and illumination covers.

Infinam RG 7100L is developed for DLP printers and can be used to produce parts with isotropic properties and low moisture absorption, or for applications that require high ductility combined with high impact strength. Printed parts can be machined and remain fracture resistant even when subjected to high force. Mechanical properties are said to be comparable to ABS and the black coloured formulation exhibits a smooth and glossy surface.

Infinam TI 5400L is formulated to satisfy additive manufacturer demands for a PVC-like resin for the rapidly growing Asian market for limited-edition designer toys. The fully cured white-coloured material combines good impact strength with high elongation and exhibits long-lasting

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**Right: A number of parts in the OreSat CubeSat satellite are produced by CRP Technology in its Windform carbon fibre reinforced PA**



IMAGE: CRP TECHNOLOGY

thermomechanical performance.

Evonik is also collaborating with industrial 3D print manufacturer **Farsoon** on a new high-performance, flexible thermoplastic co-polyester for powder bed fusion 3D printing. This Infinam thermoplastic copolyester (TPC) has been trialed using Farsoon's powder bed fusion technology at its Americas Demo Center at Austin in Texas, US, and is said to have yielded printed parts with very good tear strength, elongation at break, impact resistance, rebound and elasticity. The material processes easily on Farsoon equipment while its properties make it suitable for a wide range of automotive, medical, and sporting goods applications, according to Dr Arnim Kraatz, Evonik's Director of Powder Bed Technologies.

Materials supplier **TotalEnergies Corbion** has been working jointly with thermoplastics filament producer **ColorFabb** to develop a new generation of lightweight, heat resistant polylactic acid (PLA) filaments for 3D printing. The Light Weight (LW)

PLA high-temperature 3D filament incorporates TotalEnergies Corbion's Luminy PLA technology into ColorFabb's existing lightweight PLA filament, with the resulting formulation offering improved temperature and heat resistance while still delivering good 3D printability, low weight and easy processing. In addition, the filament is said to offer an improved carbon footprint when compared to competing filament technologies.

The two companies originally developed the material for production of remote-controlled 3D planes that needed to withstand high sun temperatures without deforming. However, the Luminy PLA technology is suitable for a broad range of applications where heat resistance is required. It could, for example, be used to print furniture, automotive parts, or components for construction applications.

ColorFabb claims the LW-PLA filament is the first to use active foaming technology to achieve light weight, low density PLA parts. The material starts foaming at around 230°C, increasing its volume by nearly three times. During processing, users can choose to decrease material flow by 65% to achieve lightweight parts or use the expansion to reduce print times through larger layer heights or extra thick perimeters.

Also new from ColorFabb is allPHA, a 100% biobased plastic 3D printing filament comprised of polyhydroxyalkanoates (PHA). The 100% biodegradable bioplastic filament is intended for use in projects that require a more sustainable approach. Physical properties include a tensile modulus of 2510MPa, yield strength of 26MPa and tensile strength of 26MPa (ISO 527 testing). The material displays a Charpy notched impact strength of 3.4 kJ/m<sup>2</sup> and a heat deflection temperature of 153°C. ➤

## Xtellar – where Braskem meets Taulman3D

Brazilian polyolefin producer **Braskem** has expanded its additive manufacturing business with the acquisition of Taulman3D, a manufacturer and distributor of advanced thermoplastics for additive manufacturing based at Linton in Indiana, US.

Taulman3D supplies a range of PA, recycled PETG, and PET filaments to 3D print operations serving aerospace, automotive, healthcare, and industrial professionals. Its offering includes a 100% recycled 3D print filament.

Braskem says the acquisition complements its existing portfolio of

filaments, which includes PE, PP, carbon and glass fibre, and recycled pellet and powder polymers specifically designed for 3D printing applications. It offers grades for several 3D technologies including FFF, SLS and High-Speed Pellet Extrusion.

"With projections for the 3D printing industry to grow from \$15bn today to \$78bn by 2030, growing at an estimated 20% Compound Annual Growth Rate (CAGR), we see enhanced opportunities to serve this rapidly growing demand," says Jason

Vagnozzi, Global Commercial Director of Additive Manufacturing at Braskem.

Vagnozzi has been named CEO of Xtellar, a new US-based venture that combines Braskem's specialty additive manufacturing materials division, which it launched in 2020, with newly acquired of Taulman3D. Xtellar is being launched in collaboration with Oxygea, a corporate capital venture firm focused on sustainable innovation and digital transformation. First products and services will be available officially from June 2023.

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



ColorFabb says allPHA materials are best printed on to a cold plate as a heated plate will induce crystallisation, leading to the risk of warping in the bottom layers. The plate is then heated to 90°C for 15 minutes at the end of the build prior to removal of the 3D printed part, inducing crystallisation and easing release.

### Space programmes

Aspirations run high at Italy's **CRP Technology**, manufacturer of the Windform portfolio of carbon or glass fibre reinforced PA-based sintering powders. Its material has been performing well in a low earth orbit satellite application engineered by the Portland State Aerospace Society.

CRP USA, the Americas partner of CRP Technology, manufactured several essential subsystems for the OreSat CubeSat using its Windform LX 3.0 laser sintering process. These included a turnstile antenna assembly, star tracker camera lens and sensor assembly, and a battery assembly. All met the extreme vibration, outgassing and thermal performance requirements for the low earth orbit project when they were first put into use in March 2021, and have been successfully operating since then.

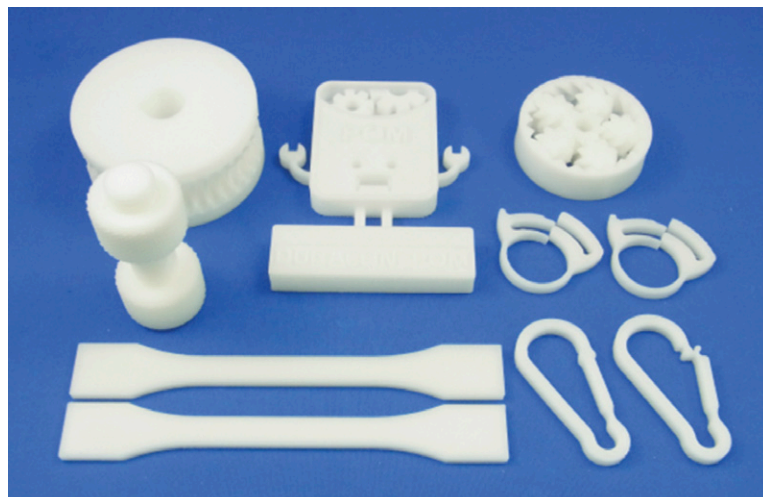


IMAGE: POLYPLASTICS

Japanese engineering thermoplastics supplier **Polyplastics** has developed a 3D printing technology that allows for additive production of parts made using its Duracon polyoxymethylene (POM) materials. The new Material Extrusion (MEX) technology was introduced at the K show last year and uses thermoplastic resin filaments to produce three-dimensional structures by repeatedly tracing and layering melted material extruded through a small nozzle. The 3D printed POM parts are said to

**Above: MEX is a new 3D print technology from Polyplastics that uses POM resins**



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**Right: 3D print filament production on a small scale extrusion machine at US-based Insight Polymers**

yield properties close to that of an injection moulded equivalent.

The company says that, typically, only amorphous resins or resins with low crystallinity have been considered suitable for use with extrusion 3D printing processes, such as ABS or PA. POM grades were unsuitable due to their high crystallinity and rapid rate of crystallisation. It says it has overcome this through more appropriate POM grade selection and optimised printing conditions.

Polyplastics says it is seeking a patent for the Duracon POM 3D printing technology and is developing additional filament materials for use in 3D printing applications, including reinforced grades.

### Improving colour

German colorant and colour masterbatch maker **Finke** has developed its new Fibacomp-3D compound series specifically for 3D print production of parts direct from pellets. The new colour compounds combine easy processing with individual colouring and are available in small batch sizes or in small series.

Fibacomp-3D overcomes the unsatisfactory colour results that can result in pellet-based 3D printing using conventional masterbatch colouring. This is due to the extruders used in pellet-based additive manufacturing systems, which are designed for plasticising the material rather than mixing different components. Fibacomp-3D is a consistently dyed granulate that only needs to be plasticised in the extruder for processing, the company says.

Each compound is tailored to the planned application, with the material, colour and additives configured in close cooperation with the processor. Additive options can include UV and thermostabilisers, antistatics or lubricants. The compounds can



IMAGE: INSIGHT POLYMERS & COMPOUNDING

be based on post-consumer recyclate (PCR) or virgin material. Use of compounded materials is said to make it possible to 3D print large objects, such as pieces of furniture or toys, without variation in colour.

### Compound investments

US-based polymer processor and custom compounder **Insight Polymers & Compounding**, recently purchased a ZSE-40 Maxx twin screw compounding extruder from Leistritz that it plans to use to expand its capability in production of compounds for additive manufacturing, as well as thermoplastics, elastomers, and reactive extrusion processes such as graft polymerisation and nanoparticle dispersion and exfoliation.

The company already produces fully formulated systems and proprietary masterbatches on its 16mm and 27mm compounding extrusion lines; the new larger 40mm unit will allow for specialised services such as additive manufacturing compounds and conductive polymers, says Director of Operations, A J Pasquale. The company also has a small-scale filament maker and two 3D printers for testing and prototyping.

Insight compounds for additive manufacturing include grades for FDM, SLS and BAAM 3D printing processes. The latest addition to the range is a low-gloss PETG compound that offers 3D part makers the opportunity to manufacture parts where aesthetics are a primary consideration. The low gloss PETG formulation is designed for FDM processing and can be used to produce pellets or, more typically, filaments. The company says it plans to extend the low gloss development to PLA materials, according to Pasquale.

The company is also involved with some applications using PETG and carbon fibre and is examining performance levels of 3D print compounds

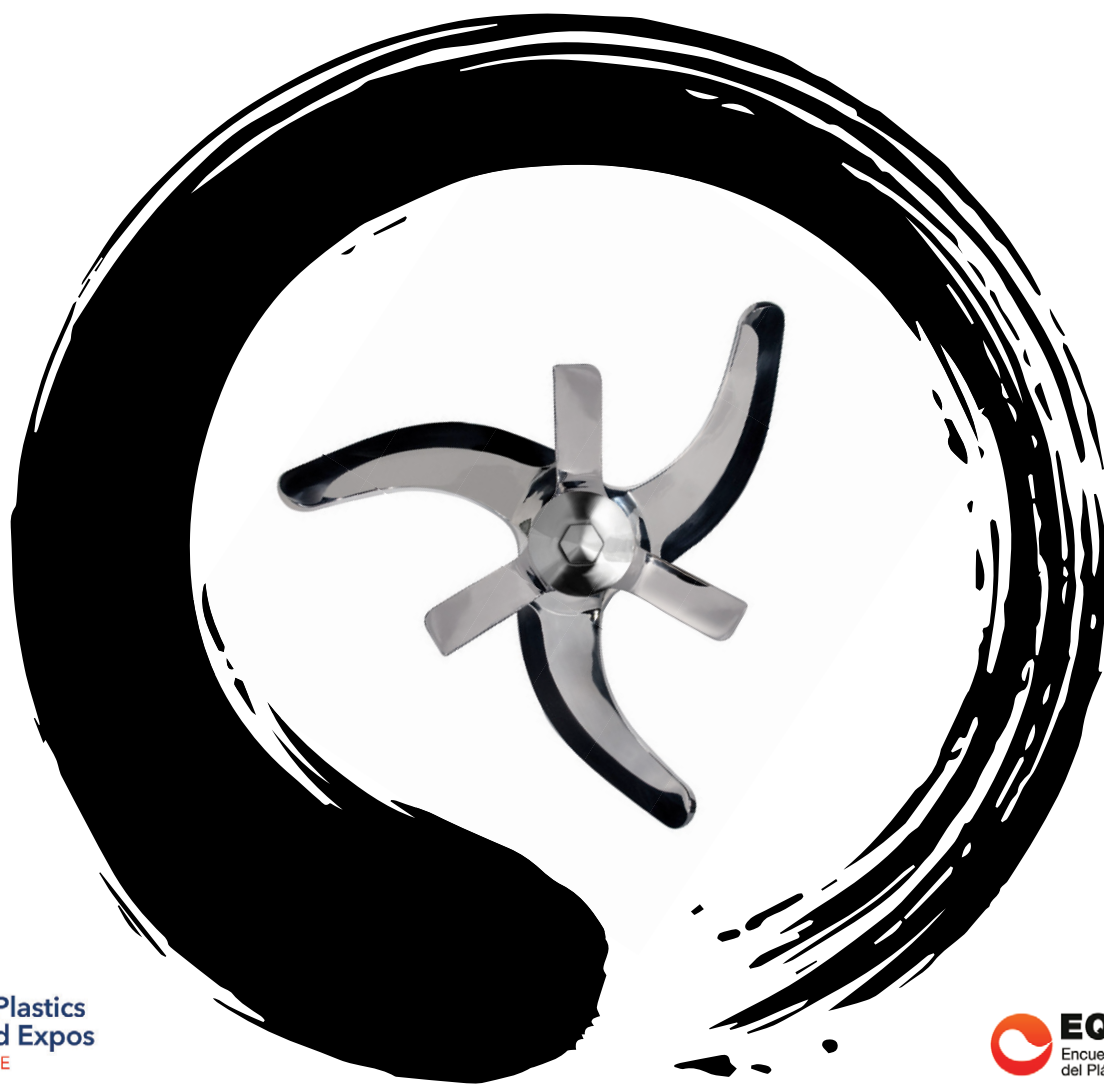
**Below: Up to 40% of Insight Polymers compounding throughput is targeted at additive manufacturing materials**



IMAGE: INSIGHT POLYMERS & COMPOUNDING

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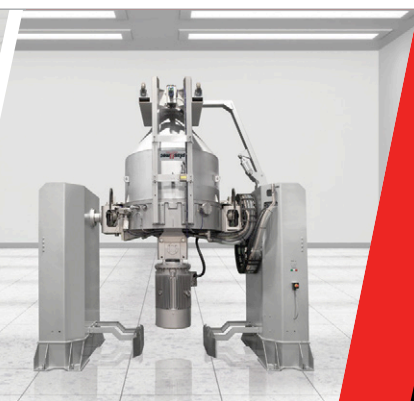
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# Stratasys adds Covestro products

**Stratasys** announced in April that it has completed the acquisition of the additive materials business of Covestro, which includes R&D facilities and activities, global development and sales teams across Europe, the US and Asia, a portfolio of approximately 60 additive manufacturing materials, and an extensive IP portfolio of hundreds of patents and patents pending. It paid around €43m for the business.

On the materials side, the deal includes the Somos photopolymers for stereolithography and DLP, Addigy powders for Selective Laser Sintering and High-speed Sintering and Addigy filaments. According to Stratasys, the IP portfolio and talent acquired will help it address new applications in key technology categories including



**Left: Covestro's 3D print materials business expands Stratasys' AM materials portfolio**

SLA, P3/DLP, and powder bed fusion including Selective Absorption Fusion (SAF). It says it complements its expertise in PolyJet and FDM.

Days after the Covestro acquisition completed, the Stratasys board rejected an unsolicited acquisition proposal by **Nano Dimension**, a rival 3D print systems developer that

already holds a 14.5% stake. The Stratasys board said the \$1.2bn proposal undervalues the company, while Nano Dimension's pending court litigation with its largest investor raised questions over its ability to progress it.

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

➤ [www.nano-di.com](http://www.nano-di.com)

using recycled PETG or recycled carbon fibre material. It is also examining different material types for SLS and BAAM platforms, although those compounds are still in the early developmental stage. Pasquale says that, overall, compounding for 3D print now accounts for 25-40% of its revenue.

LNP Thermocomp AM DC0041XA51, from **SABIC**, is a 20% carbon fibre reinforced flame-retardant compound for 3D printing of parts using Pellet-Fed Additive Manufacturing (PFAM). According to the company, it is the first PFAM non-halogenated compound to comply with both EN45545 and US NFPA 30 standards for interior and exterior railway applications. The compound is said to process at high printing speeds and moderate tem-

peratures, maintaining its structural integrity during printing while delivering a finished part with good dimensional stability and low warpage.

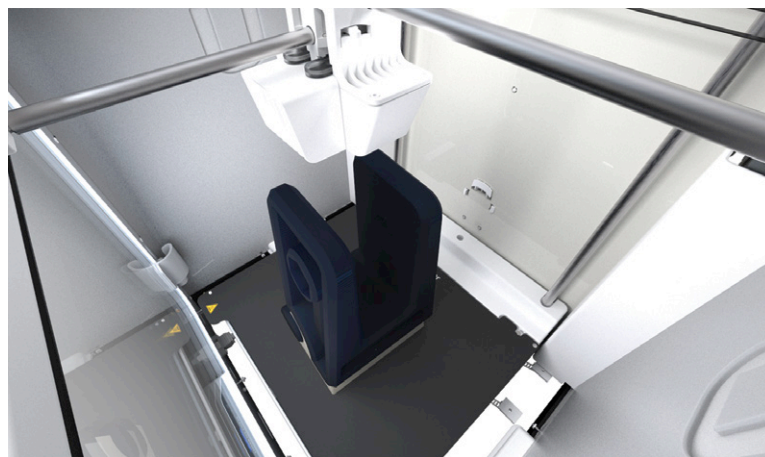
The lower density of carbon versus other structural fibres enables the design of thinner parts that can contribute to net-zero carbon goals, according to SABIC. Compared to thermosets formulated with halogen-based flame-retardant additives, the new LNP Thermocomp AM compound offers greater design flexibility and eases recycling, it says. It is well suited for printing medium-sized and large parts in small build numbers, making it suitable for production of rail guards and bumpers as well as interior claddings, side panels, partition walls, ducts, and seating components.

SABIC says that CAF, a multinational supplier of comprehensive transit solutions for railway networks, is using the new Thermocomp material to 3D print large replacement parts such as hatches. This enables the company to minimise lead times and reduce inventory.

Also new from Sabic is LNP Thermocomp 6C004XXAR1 PC/PBT, a compound with 20% carbon fibre that delivers improved chemical resistance compared to ABS/PC. It also offers good sag and warpage resistance and has been printed successfully on large-format additive manufacturing machines.

SABIC has also extended the colour options for

**Below: Internal view of the build chamber in UltiMaker's new S7 FDM 3D additive manufacturing system**



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**Right: Arburg's large capacity Freeformer 750-3X uses pellet materials and is especially suited to hard/soft combinations**

its LNP Thermocomp AM glass-filled 3D print materials beyond black and natural. Customers can now select from a broad range of colours, with the ColorXpress service providing custom colour matches for the grades. SABIC has also launched the Material Finder website to assist customers in exploring and selecting additive manufacturing materials. The company says it is focusing this initiative on medium-format printers and new use cases.

### Technology moves

Stratasys group company **MakerBot**, producer of the Method and Method X line of 3D printers, merged with 3D FDM print machine producer **Ultimaker** to form a new entity called UltiMaker. The collaboration seeks to advance easy-to-use desktop 3D solutions for professional, industrial applications. The new company will maintain headquarters in both the Netherlands and New York, US.

The new UltiMaker has developed its first machine, the UltiMaker S7 FDM 3D, with a print volume of 330mm by 240mm by 300 mm. Print cores, motion system and materials are similar to the preceding Ultimaker S5 model but the new machine features an air manager that improves temperature control in the print chamber by regulating exhaust fan speed based on a thermometer reading. Air filtration is also incorporated in the new machine design.

UltiMaker has also replaced the glass plate in the print chamber with a steel sheet with a PEI coated surface to eliminate incidences of part failure due to poor first layer adhesion. The company says this has been reduced by 50%.

Solutions provider **9T Labs** has completed a second composite technology project with Oris, a Swiss manufacturer of luxury mechanical watches, in which its Red Series Additive Fusion Technology (AFT) was used to produce the case for Oris' ProPilot Altimeter wristwatch model.

The companies previously worked together on the Coulson watch case.

9T Labs applied its Red Series AFT platform to produce the carbon fibre reinforced composite watch case based on a 70% continuous carbon fibre reinforced PEKK polymer. The case is 70g lighter and 1mm thinner than the original stainless-steel case.

➤ [www.9tlabs.com](http://www.9tlabs.com)



IMAGE: ARBURG

Other features include an updated and expanded materials library and capability for wireless communication. A built-in camera allows for remote viewing of the build.

Injection moulding and additive manufacturing machinery maker **Arburg** last year introduced its largest ever industrial 3D printer and will premier it in North America at the Rapid+TCT exhibition in Chicago later this month.

The Freeformer 750-3X model is designed to print industrial parts quickly, precisely, and economically using pellet materials. It is suitable for manufacturing parts for applications including aerospace and medical and is especially suited to the production of functional components in hard/soft combinations.

The Freeformer 750-3X has a build chamber area of 750cm<sup>2</sup>, which is around 2.5 times larger than the Freeformer 300-3X but in the same external dimensions. The larger build chamber area enables the unit to produce larger functional components or to manufacture small batches industrially. Arburg says the data processing and its Gestica controller have been further optimised in terms of process stability, component quality and build time.

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# EHV PEX-a process claims green gains

*A new PEX-a compound technology aims to deliver new levels of cleanliness and cost effectiveness for the latest generation of HV and EHV power cables. Chris Smith reports*

The world is electrifying rapidly. According to International Energy Agency **predictions**, electricity's current 20% share of total global final energy demand will rise to near 30% by 2030 as Net Zero Scenarios are adopted – an annual average growth rate of 3.5%. This will mean considerable investment in global power grids.

PEX-a (peroxide crosslinked XLPE) is a proven option for production of insulation for medium, high and extra high voltage (MV, HV and EHV) AC and DC cables. However, while trusted and established, PEX-a compound production is not a simple process as the peroxide crosslinking agent will decompose (activate) at temperatures above 130°C or so. Ensuring this limit is not exceeded becomes increasingly difficult with cable compounds for use at higher voltages, as fine filtration is required to ensure the required purity levels.

## Traditional routes

The traditional route to production of HV and EHV cable compounds avoids the risk of peroxide decomposition by separating compounding and peroxide addition. It uses a compounding extruder, most commonly a twin-screw machine but also other continuous mixers and kneaders, to incorporate additives such as antioxidants into a base compound. This is then passed through a fine melt filtration system to a pelletiser. The cool pellets are directed to a batch mixer, where they are warmed and surface-coated with peroxide before entering a vertical "soaking" chamber.

Maintaining the warm coated pellets in the soaking tower for an extended period of time – more than 10 hours in some cases – allows the peroxide to diffuse from the surface into the pellet without decomposing. The pellets are then cooled, inspected, and packaged.

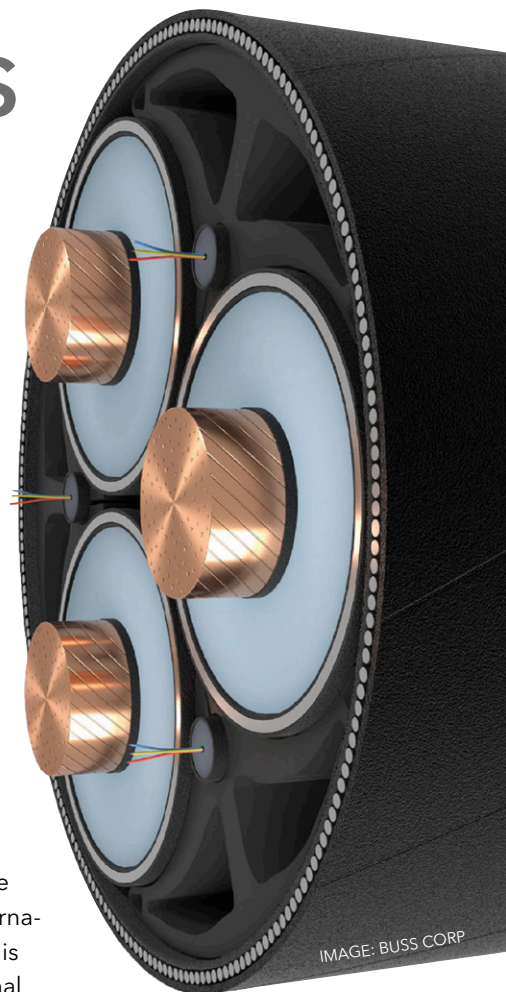
The capacity of the soaking system is matched to the output of the compounding extruder, which

means towers can be as high as 50m or more for the largest throughputs of more than 3.5 tonnes/h. The system also needs to be clinically clean, which means high capital costs, while the cooling and reheating of the pellets adds to energy usage.

Over the past few years, cable industry technology firm PM Cable Consulting has developed an alternative compounding technique that is claimed to address these traditional challenges. It has partnered with compounding machinery maker Buss to roll out the LSHC (Linear Short Hyper Clean) technology globally. Last year, Spanish petrochemical company Repsol became the first to commit to it, placing a contract with Buss for installation of a 27,000 tonnes/yr plant with a planned start-up in 2024.

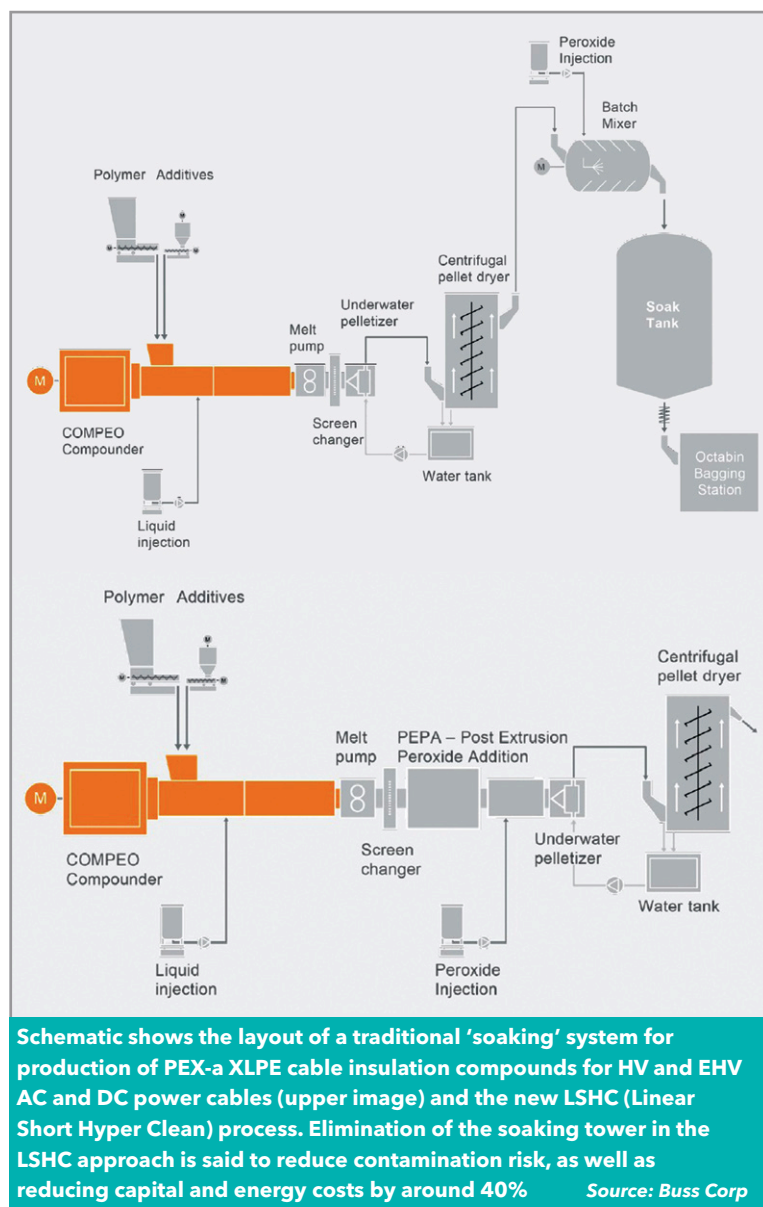
The front end of the LSHC process is similar to the traditional process up to the fine melt filter (it uses a Buss Compeo kneader extruder rather than a twin-screw machine). However, from there the process differs. After filtration the molten compound is fed into a Post Extrusion Peroxide Addition unit (PEPA), where the temperature is regulated so a liquid peroxide can be metered and incorporated without risk of decomposition. No soaking is required; after passing through the PEPA unit the compound is simply pelletised, dried and classified, 100% inspected and directed to a clean room packaging unit.

Temperature control is critical, something the Buss Compeo kneader compounding extruder is very well suited to, according to Denis Labbé, Managing Director at PM Cable Consulting. "Twin-screw extruders are violent in terms of shear and temperature – temperatures can reach 250°C. This generates carbonyl groups, which are detrimental to the



**Main image:**  
The Swiss-developed LSHC PEX-a compound technology is intended for production of high performance HV and EHV AC and DC power cable insulation





electrical properties. The Buss machine is very mild so is much better for electrical properties," he explains.

According to Labbé, the polarity induced by carbonyl groups is thought to contribute to increased cable service temperatures, leading to higher electrical losses. This is problematic for MV and HV AC cables because of the frequency at which they operate but also for the EHV DC cables increasingly used to carry electricity over long distances.

Beyond the initial compounding step, it is also important that the temperature of the molten compound passing from the melt filtration system to the PEPA unit is tightly controlled. "We have a temperature window where we can inject the peroxide in the melt – it has to be below 135°C, or the peroxide will start to decompose, but above the LDPE melting point, let's say above 115°C," Labbé says.

Because the peroxide is added to the molten compound, rather than relying on diffusion into a solid pellet, Labbé claims the LSHC process achieves a much more consistent dosing level. "With soaking, if you measure the peroxide content pellet by pellet you will see you have some pellets almost without peroxide and some with 3 or 4%. The homogeneity is not there and if we have too much inhomogeneity in the XLPE we may have something like pumping in the cable extruder. This will translate to cable diameter variation," he says.

"The second thing is the peroxide we are using [dicumyl peroxide – DCP] has a tendency to exude at 4°C. With the traditional process a conditioned warehouse is needed to maintain temperatures between 15 and 30°C, otherwise the peroxide blooms out. With our new process the peroxide is

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so well homogenised this does not happen,” Labbé says.

PM and Buss claim the more simplified design of the LSHC system, together with the use of some upgraded components, means it can produce cleaner XLPE compounds. The liquid antioxidant, for example, is filtered to 2 microns, the compound itself to 10 or 20 microns according to the application, and the peroxide to 3 microns. Meanwhile, 100% of the pellets are inspected for inclusions down to 60 microns prior to packaging.

The closed nature of the LSHC process also contributes to cleanliness, says Labbé. “During the soaking with the traditional process there is more opportunity for contamination. Even if the inner pellet is really clean you can collect contaminants from the top of the soaking tower on the surface. With our process the peroxide is injected, then it goes to the boxing station and it is finished.”

Labbé says older traditional soaking lines can struggle to meet the cleanliness levels required for extra high voltage applications of 500kV or more. “Older plant may take a couple of days to reach the super clean level. The process will stay at that level for a week maybe, then contamination comes back and they have to stop and clean the filters. For a modern traditional process it is a couple of hours to super clean mode,” he says.

The LSHC system has not yet been validated at commercial scale but the developers expect it to reach super clean production at least as quickly as the best soaking systems and to hold that state for longer. Work to date also shows that recipes used on a traditional soaking system transfer readily to the LSHC process. However, most high performance cable compounds must be qualified and Labbé says homologation would be required.

Aside from the more homogenous and potentially cleaner compounds, the LSHC technology provides considerable cost savings due to simplification of the process. Replacing the batch mixer, soaking tower and associated materials handling and heating infrastructure with the PEPA unit reduces the capital cost by 40% or more, according to Labbé. He says LSHC also avoids reheating the pellets and maintaining them at an elevated temperature during the soaking cycle, which reduces energy usage from an estimated 0.35 kWh/kg of XLPE to around 0.2kWh/kg.

Users also gain from a more flexible production system that could, if required, be repurposed or relocated. “We say it is like Lego,” says Labbé. “If you go for the traditional process you have a 50m huge tower; this new process is just a compounding plant and you can do whatever you want with it.

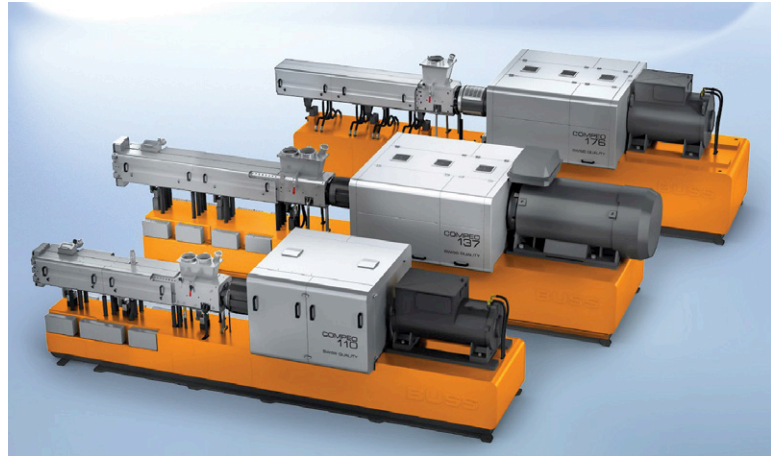


IMAGE: BUSS CORP

It is modular; you can transfer it from one location to another.”

Buss has a long association with cable industry. Its low shear kneader technology developed a leading place in PEX-b (silane crosslinking) compounding systems and the company has a strong position in the demanding semicon compound sector. It also supplies compounding extruders and engineers complete systems for use in single pass production of PEX-a compounds for LV cable insulation and for traditional soaking production of PEX-a HV and EHV cables. The company expects the new LSHC technology to help it make further headway in the new and growing market for extra high voltage DC XLPE cable compounds.

### Changing markets

“The market is going clearly towards extra high voltage DC and that wasn’t the case 15 years ago,” says Buss Head of Business Development, Innovation and Digitalisation Dr Krischan Jeltsch. “When someone is considering a traditional plant with a soaking tower, in terms of capex the price is very expensive. This new process is precisely developed for extra high voltage, AC or DC, and is more affordable in terms of money, people and maintenance.”

LSHC’s energy savings should also not be underestimated, says Jeltsch. “The desire for ‘greener’ technologies has arrived in the wire and cable industry,” he says. “While lower generation of degassing by-products, such as methane among others, are already being realised by XLPE producers, this new LSHC compounding process addresses the need for reduced energy and carbon footprint from an engineering perspective.”

**Above: The new LSHC technology is built around the latest Compeo 110, 137 and 176 kneader extruders, providing throughputs of 1,000, 2,000 and 4,000 kg/h respectively**

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# Delivering gains in cables



**Main image: Polymer and additive suppliers are developing new products to suit all types of cable, including specialties**

IMAGE: IMAGE: HEXPOL/ISTOCK

***Polymer and additive producers are developing new grades that allow cable producers to cut cost and improve product quality, writes Chris Smith***

As providers of critical infrastructure, electricity network providers are, perhaps unsurprisingly, a little conservative. But they are certainly not closed to new ideas and the need to both expand and rebalance grids to accommodate shifting energy generating locations and user demands intensifies the focus on cost, reliability and performance of cable systems, as well as sustainability. This article takes a look at some of the latest compound and additive innovations for production of wire and cable.

International polymer compounding group **Hexpol** has developed a comprehensive materials portfolio for the growing cable market covering thermoset elastomers as well as thermoplastic HFFR and TPE, EVA and TPV grades and colour and additive masterbatches.

According to Carsten Rüter, President of Hexpol Compounding Europe/Asia, the company sees big opportunities in the renewable energy sector, in particular. "Our cable compounds can be found in solar applications, wind parks and other decentralised power generations with cable networks on

land, offshore or underwater. They are highly resistant to extreme outdoor conditions and can be used for flexible or permanent installations," he says.

The company recently strengthened its capabilities in thermolastic HFFR cable compounds with the acquisition of Spanish compounder Vicom. With a capacity of around 30,000 tonnes/yr, it was acquired in 2021 and specialises in polyolefin HFFR and LSHF compounds.

Hexpol has also developed a methodology for calculating Product Carbon Footprints (PCF) of its materials to meet growing demands for sustainability data from customers. A recent study showed that a newly developed LSHF grade from its Dryflex Cable series offered a 24 % reduction in kg CO<sub>2</sub>e per kg of material compared with standard grades. The grade is suitable for cable insulation and sheathing applications.

PEX technology provides high levels of performance for cable applications but presents

**Below:**  
**Decentralised renewable energy is a key target sector for Hexpol**

IMAGE: HEXPOL/ISTOCK





IMAGE: AVIENT/GETTY IMAGES



**Above: ECCOH XL 8148 from Avient is formulated for photovoltaic cable applications**

challenges in terms of recycling. **Borealis** has been working to overcome this through the use of its Borcycle C pyrolysis chemical recycling process. The company says crosslinked polyolefins such as XLPE and PEX can be recycled back to feedstocks for the production of high performance PE grades for use in wire and cable applications using its pyrolysis technology. All Borcycle C polyolefins are ISCC PLUS certified using mass balance methodology.

Borealis is also looking to expand its mechanically recycled cable grades. Borcycle M grades will contain up to 50% recycled waste plastic content. The first product announced is Borcycle M ME7153SY, which is a natural fully formulated MDPE jacketing compound for low and medium voltage applications. The company says the grade is easy to colour and offers good processability and a smooth surface finish. Other characteristics include good environmental stress cracking resistance (ESCR), UV resistance, and low water permeability.

### Solar formulations

With heavy investment underway in solar photovoltaic (PV) generating capacity, **Avient** has developed a new line of cross-linkable cable insulation formulations. The new ECCOH XL cross-linkable grades are REACH compliant and rated for permanent outdoor use. According to the company, UV and weather resistance of the new materials passes IEC 60216-1 Arrhenius lifetime prediction tests. Electrical performance is suitable for both DC and AC power supplies, while flame retardant performance meets EN 50618 and IEC 60332-1 standards.

The new grades are manufactured in

Europe but available globally. Avient says that aside from the good performance, the new formulations can provide manufacturing efficiency gains for cable producers by allowing one grade to be used for both cable insulation and jacket coating. In addition, they are said to offer high processing speeds and up to 50% reduction in catalyst usage compared with typical technologies.

### Rapid degassing

Endurance HFDD-4201 is the latest addition to **Dow Chemical's** PE resin offering for production of HV and EHV XLPE cable insulation. A key benefit of the new grade is its rapid degassing in PEX-a cable production systems. The company says the new resin can cut the time required for removal of crosslinking by-product methane, which it says can take several weeks in current typical HV cable production systems, by up to 80%. It says this can help manufacturers to reduce manufacturing cycle times and inventory and energy costs.

Last year saw a number of new additions to **Evonik's** range of silanes for improving the processing and performance of wire and cable compounds, particularly halogen-free flame retardant grades. The company has extended both its Accurel DS line of dry silanes, which improve resin to filler bonding and includes AMEO, GYLMO, and VTEO types, and its Accurel CL cross-linker masterbatch family, which includes TMPTMA, TAIC, and TAC.

It also introduced Dynasylan Silfin 301, a silane grade specially formulated for production of heavily filled PEX-b cable compounds for the two-stage Sioplas moisture-curing method. "Our new Dynasylan Silfin 301 is a ready-to-use system which makes it easier for cable manufacturers to process their products in an extruder and simplifies the subsequent crosslinking," says Helmut Büsser, Director Marketing at Evonik's Silanes business line."

The vinylsilane and peroxide formulation is said to be optimised for Sioplas crosslinking of heavily filled polyolefins. According to Evonik, it reacts up to ten times more slowly than typical vinylsilane alternatives, which means reduced moisture sensitivity so premature crosslinking is avoided. It is also said to improve the electrical and mechanical properties of HFFR compounds.

Evonik's organo-modified siloxane (OMS) chemistries, which are marketed under the Tegomer and Tegopren brand names, are also suitable for cable and wire applications, where they can enhance flame retardance, increase filler loading levels, and lift compound output on larger extruders.

Long known for its PVC compounds,

**Right: This Borcycle M cable sheathing grade contains mechanically recycled polymer**



IMAGE: BOREALIS





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**Right: Benvic's Linkflex products are developed to meet the latest EU CPR requirements**

European compounder **Benvic** responded to tighter EU regulation covering chlorine emissions from cables during burning with the launch two years ago of its polyolefin-based Linkflex HF HFFR and LSZH grades. Since then it says it has further expanded its Linkflex HF development team and invested in laboratory, pilot line and development equipment at its Montornes production site near Barcelona, Spain.

The Linkflex HF product family was initially designed to comply with the latest European Construction Products Regulation (CPR) requirements and early applications mainly targeted low voltage requirements in the building market. Benvic Product Marketing Manager Eric Grange says it now plans to extend into new and more demanding application areas. He cites the example of hi-speed internet data networks, where its Linkflex grades offer the fire resistance required for fibre optic installations. He also sees big opportunities in the fast growing renewable energy sector, where many projects are located in highly demanding climatic conditions. Other markets the company is targeting include industrial and transportation.

"Benvic is now a multi material company," says Grange. "But not just because it makes good theoretical sense. The fact is that we are using our core polymer compounding expertise to create and build a number of new businesses, custom-by-customer and from the ground up."

Last year **Teknor Apex** announced a number of new additions to its FireGuard PVC compounds, which are said to be suitable for applications ranging from copper data cable jackets to fibre optic cables and provide low smoke generation and low flame propagation performance that exceeds UL Subjects 13, 1424 and 444.

According to the company, the new grades offer lower smoke and higher oxygen indexes compared to current products, enabling production of larger,

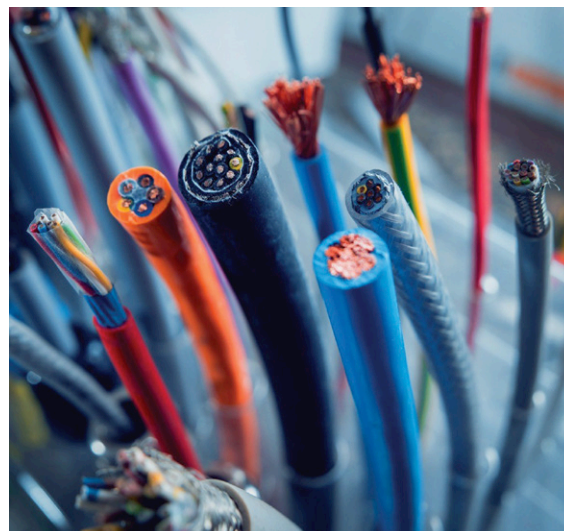


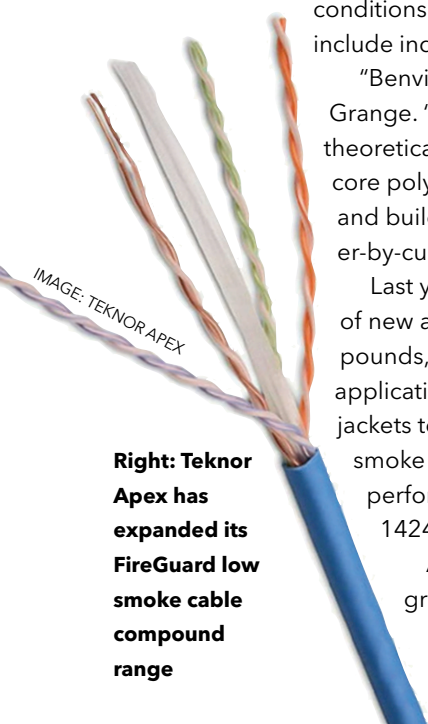
IMAGE: BENVIC

higher density cables that comply with the US NFPA 262 Flame Travel and Smoke requirements. "These features are critical in applications such as data centres, wireless infrastructure for buildings and campuses and security systems," says David Braun, Wire and Cable Industry Manager for the company's vinyl division.

### Cracking solutions

Resistance to cracking is particularly important in the production of sheathing for armoured power cables used in hot environments with long term exposure to strong sunlight. Under such conditions sheath temperatures can rise considerably, reducing tear strength and leading to higher risk of tear propagation. The different expansion rates of the sheath and the metal armour can further exacerbate the problem.

At the Cables Europe 2023 conference in Cologne in Germany in March this year (organised by *Compounding World* publisher AMI), **Innospec Leuna** Business Development Manager Dr Christoph Bornschein detailed the effect of its Vis-cospeed HP and strongly amorphous Viscowax 1440 polyethylene wax on crack resistant cable sheathing compounds.



**Right: Teknor Apex has expanded its FireGuard low smoke cable compound range**

## New name in HVDC subsea cable

XLCC is a UK-based start up that last year gained permission to build a production site for XLPE-insulated 525kV HVDC submarine cables on a 28ha former industrial site at Hunt-erston in Scotland.

Construction is expected to begin on the site, which will include a

production facility with a 180m high PEX-a extrusion tower together with R&D and testing labs, this year. The company hopes to start cable production in 2025.

XLCC is linked to the proposed Xlinks renewable energy project. This aims to connect a 3.6GW 200km<sup>2</sup>

solar facility in the Guelmin Oued Noun region of Morocco to the UK's National Grid.

XLCC will produce the four 3,800km long 525kV sub-sea cables required for the scheme.

➤ [www.xlcc.co.uk](http://www.xlcc.co.uk)

➤ [www.xlinks.co](http://www.xlinks.co)

The study compared a typical crack resistant sheathing compound against two alternatives where 1.5 % of the coupling agent was replaced by the Innospec waxes. The formulation containing Viscospeed HP proved to have the best flow and displayed acceptable mechanical properties. However, the semi-crystalline nature of the polar Viscowax 1440 resulted in a negative impact in the crack test at 50°C.

Bornschein says the formulation containing Viscowax 1440 also showed a positive impact on flow of the final compound formulation together with an improvement in tear strength. Oven tests show that the wax improves processability without negatively affecting crucial crack resistance.

### Shielding innovations

Turning to shielding solutions, Manel Miret, Area Manager and New Product Developer at master-batch maker **Delta Tecnic**, and Bruno Reis Figueiredo, Co-CEO at graphene specialist **Graphenest**, detailed work the two companies have undertaken to evaluate the use of graphene-loaded compounds to replace metal meshes, wires and braids as shielding elements in cables.



IMAGE: INNOSPEC

According to the researchers, the ability to use a polymer-based shielding layer would simplify manufacturing, increase production speed and result in a lighter and more flexible cable (important in mobility applications). Metals are also not very effective shielding options at GHz frequencies, they add, while conductive polymers have been shown to be effective at these frequencies (which will be used for 6G mobile networks).

The study has shown that graphene-loaded

**Above:**  
Innospec claims its wax additives can help reduce sheath cracking risk

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compounds can be produced that offer total shielding effectiveness of 34.4dB at 915MHz and 35.1dB at 2.45GHz. The researchers cite automotive and telecom among early target adopters for polymer based shielding systems, estimating that a 0.5-0.6mm layer in a typical automotive PVC twisted pair cable construction could realise a 75% weight saving and 20% reduction in production costs.

The compounds produced by Delta Tecnic incorporate total levels of graphene and other additives of close to 30%. However, the researchers say the level of graphene required to achieve the necessary shielding level in any particular cable application varies according to the type of cable, the level of electromagnetic shielding required, and the desired mechanical properties.

They also point out that achieving the required dispersion is a complicated and costly process that cannot be achieved during the cable manufacturing process but add that, once compounded, they are not difficult to work with. "Graphene-based conductive compounds can be easily incorporated into existing production processes, making them a practical and cost-effective solution for manufacturers looking to improve the properties of their products," they claim.

### Renewable demands

Growing demand for cables for renewable energy and electric vehicle applications is expected to present new opportunities for **BASF's** Irgastab Cable KV 10 premium multifunctional polymer additive antioxidant, according to the company. Developed for MV/HV XLPE cable insulation, KV 10 is a liquid-form primary antioxidant for XLPE that also acts as a heat stabiliser, providing superior long-term thermal stability. The company says the additive provides very good scorch protection while its high purity enables excellent long-term electrical performance and long service life of MV/HV power cables.



IMAGE: LAPP

**LAPP's Etherline ethernet cables can now be supplied with sheathing in BASF's part-renewable Elastollan N TPU**

Irgastab Cable KV 10 is included in BASF's Valeras portfolio, which aims to help customers develop more sustainable formulations and to keep pace with global regulatory developments. The latest addition to the Valeras toolbox is Product Carbon Footprint data covering a number of its antioxidant and light stabiliser products.

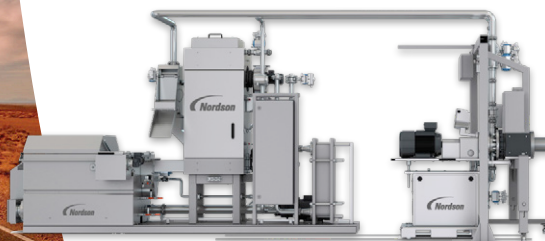
BASF helped cable maker LAPP improve the carbon footprint of its Etherline FD P Cat.5e industrial ethernet cables. The company now offers the products with a standard fossil-based BASF TPU sheathing or with its Elastollan N, which contains up to 60% renewable raw material derived from corn. Mechanical and chemical properties, UV resistance, and processability are retained.

The bio-based product achieves an improvement in CO<sub>2</sub> footprint of around 15%. "Using plastics from rapidly renewable raw materials with an organic basis is a great way for us to reduce the need for plastics from fossil raw materials and at the same time reduce the carbon footprint of our products," says Alexander Terpe, Head of Cable Product Development at Lapp. ➤

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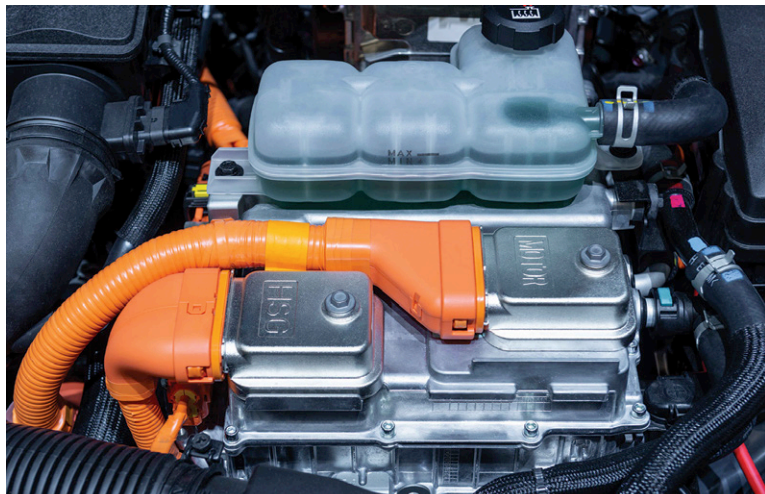
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IMAGE: AMPACET



**Above:**  
**Ampacet's new**  
**ELTech colour**  
**masterbatch**  
**range includes**  
**RAL 2003**  
**orange**

The ELTech range of colour masterbatches from **Ampacet** has been specifically formulated to meet the needs of the electrical and electronics market, including power and telecommunication cables.

"ELTech solutions, part of our diversification strategy, will further enrich Ampacet's wide portfolio of masterbatches and open opportunities for new markets," says François Thibeau, Ampacet Strategic Business Manager E&E.

"ELTech masterbatches are designed for colouring wire and cable jacketing and connectors, as well as other E&E applications, following the RAL colour standards."

The ELTech product range is based on carrier resins including PE, EVA, and PBT and are available as combination products with functional additives offering laser marking, UV stabilisation, flame retardance, process stabilisation and processing improvement.

The range includes ELTech Orange 2003 PBT, which is formulated for use in high voltage PBT applications such as medium and high voltage PBT connectors for EVs and PBT cable jacketing. The grade meets RAL 2003 Orange colour specifications and is said to perform well under thermal stress and maintains colour consistency after heat aging.

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

- > [www.hexpol.com](http://www.hexpol.com)
- > [www.borealisgroup.com](http://www.borealisgroup.com)
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## Borealis makes headway in HVDC

Borealis says its Borlink high voltage direct current (HVDC) XLPE cable compound technology has passed pre-qualification up to 640kV and has demonstrated a number of benefits for users, including good electrical performance and the ability to provide long lengths with minimal joints.

More than 8,000 cable kilometers has been laid to date, with projects including a large offshore wind farm in Jiangsu province of China and several offshore projects in the the North Sea in Europe.

The largest Borlink HVDC project currently underway is the German Corridors, a series of underground electricity transmission lines designed to carry energy from renewable sources, such as offshore wind farms, with minimal losses. When complete, the German Corridors will have capacity to transport 8GW of green energy from the north to the south of Germany.

Insulated XLPE underground cables made with a fully compounded Borlink HVDC cable material running at 525 kV will be used in the project's SuedLink and SuedOstLink sections. SuedLink comprises two 2GW power cable systems with a total length of more than 2,500 km while the northern stretch of the SuedOstLink corridor includes one 2GW circuit with around 500km of cable.

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

**Borealis's Borlink HVDC insulation technology is pre-qualified for application up to 625kV**



IMAGE: BOREALIS

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*Developments in compatibilising and coupling technology aim to enhance the performance of plastic compounds while expanding opportunities for recycled materials, writes Mark Holmes*



IMAGE: KRATON CORPORATION

# Making polymers more compatible

Compatibilisers and coupling agents have long played a key role in the compounding sector for their ability to improve the performance of virgin polymer compounds containing fillers. However, today they are also increasingly being used to help upgrade recycled materials – carefully selected compatibilisers can allow the successful combination of dissimilar polymers, overcoming unwanted negative effects on mechanical and physical properties.

Compatibilisers fall into three general categories, according to Salvatore Monte, President of **Kenrich Petrochemicals**, which manufactures the Ken-React range of coupling agents and compatibilisers, as well as plasticisers and other speciality chemicals. “Malleated polymers can couple polymers, but not fillers and non-polymeric materials found in recycled plastics,” he says. “In recyclates, they work best on sorted materials, particularly addition polymers such as olefins. However, they may cause depolymerisation of

condensation polymers such as PET and polyamides. Secondly, there are bi-polar polymers. These additives contain both polar and non-polar chemical structures to link polymers that would otherwise be incompatible, and work well with post-industrial recyclates. Finally, organometallic coupling agents can repolymerise polymers and couple fillers. They require reactive compounding in an extruder polymer melt and are synergistic with other compatibilisers.”

Kenrich has developed compatibilisers and coupling agents for a wide range of applications. For virgin polymers, Ken-React CAPS L 12/L is a titanate coupling agent in a masterbatch pellet form. Coupling agents provide molecular bridges at the interface between two substrates, says the company, usually but not limited to an inorganic filler/fibre and an organic polymer matrix. Titanium-derived coupling agents react with free protons at the inorganic interface resulting in the formation of organic titanium monomolecular layers on the

**Main image:** Compatibilisers play a key role in lifting the performance of a range of virgin and recycled polymers, including TPEs





**Above: TPE compounds using Kraton's polymer compatibilisers are widely used in the automotive sector**

inorganic/organic surface. Additionally, the coupling agent may have up to six functions in the matrix – which include polymer catalysis and other heteroatom effects – independent of inorganic content.

Typically, titanate-treated inorganics are hydrophobic, organophilic and organofunctional. Fillers may be pre-treated or treated *in situ*, absent of water of condensation and the drying techniques needed with silanes. When used in polymers, the advantages of titanates are said to include increased adhesion; improved impact strength and mechanical properties; reduced embrittlement; higher filler loadings; optimised particulate dispersion; increased flow of filled and unfilled polymers at lower process temperatures; and prevention of phase separation.

For recyclates, Kenrich offers its Ken-React CAPS KPR 12/LV titanate coupling agent, which has been designed as an *in situ* catalyst for copolymerising recycled plastics in the melt.

According to **Kraton Corporation**, multiple end-use applications for thermoplastic elastomer (TPE) compounds are impacted by evolving market needs across different value chains. Some of these can be addressed by creating new compatibilisers. "Industry pressure to reduce carbon emissions has increased emphasis on sustainability and the circular economy," says Bas Hennissen, Kraton's Vice President, Sales & Marketing, Specialty Polymers.

"The downstream focus on sustainability-driven innovation and product redesign is among the key trends influencing new product development in TPE compounding," says Hennissen. "For example, the general automotive industry's focus on achieving net zero by 2050 and electrification create a need for a product redesign with alternative lower CO<sub>2</sub> materials, reducing the part weight through light-weighting and incorporating sustainable recycled or renewable materials to reduce the use of fossil-based resources."

Compatibilisers play an essential role in enabling TPE compounding innovation to meet evolving industry needs around sustainability and the circular economy, adds Hennissen. One of the significant challenges for new product design is achieving similar performance requirements such as durability, mechanical properties, low-temperature performance, and thermal stability, and preserving product aesthetics while maintaining a comparable system cost. Compatibilisers can effectively enable the use of recycled resins together with virgin plastics, enhance the compatibility of different materials and improve product performance for multi-resin design – for example, through increased adhesion between polar substrates.

TPE compounds made from Kraton polymers are used in a wide range of commercial and consumer products. These high-performance polymers are designed to improve a wide array of end-use products and applications. In addition to the multi-resin compatibility enhancement, Kraton compatibilisers enable multiple functionalities extending from high impact strength and elasticity, durability, transparency, and colourability to processing versatility through compounding, multi-substrate over-moulding, and engineered thermoplastic (ETP) modification.

In 2020, Kraton launched its CirKular+ solutions for plastics upcycling and the circular economy with the Performance Enhancement and Compatibilization Series. CirKular+ products are specifically engineered to address the three key industry challenges to promote end-of-life product recyclability, improve inferior PCR quality, and increase the limited reusability of mixed plastic waste.

Kraton's offerings to promote the circular economy have been strengthened with the release of the ISCC PLUS certified renewable CirKular+ ReNew series. "The CirKular+ ReNew series is made using ISCC PLUS certified butadiene enabling up to 70% certified renewable content in ReNew equivalents," says Hennissen. "Certified butadiene is made with a renewable source based on the mass balance approach. Certified renewable feedstock enables a significant carbon footprint reduction compared with fossil-based alternatives. Using certified renewable butadiene in our product formulations allows up to 65% carbon footprint reduction for Kraton hydrogenated styrenic block copolymers manufactured in our Berre facility in France."

Hennissen adds that the ReNew series products can offer a drop-in high-performance solution for users of styrenic block copolymers across various

end-use applications. "For example, the use of the CirKular+ ReNew series in TPE-S compounding can help incorporate ISCC PLUS certified renewable content and reduce the carbon footprint of the compound formulations," he says. "The mass balance approach supports ease of adoption with the ReNew series matching product specifications of equivalent conventional Kraton grades, enabling similar performance in an established end customer formulation. This approach can help our compounding customers cut the new product development cycle and increase differentiation with high-performance renewable-based alternatives."

German speciality chemicals maker **Brüggemann** recently acquired Italian company Auserpolimeri, a manufacturer of functionalised polymers, to expand its market presence in high-performance polymer additives including compatibilisers and coupling agents, in close cooperation with the Eigenmann & Veronelli Group.

"Auserpolimeri's chemically functionalised polyolefin-based polymers play a key role as impact modifiers, compatibilisers, coupling agents and adhesion promoters in improving the performance levels of engineering plastics for a wide range of applications," says Dr Klaus Bergmann, Head of Polymer Additives at Brüggemann. "They ideally complement and complete our existing range of high-performance additives."

According to **BYK**, changing environmental regulations are a continuous driver for new compatibilisation products. "The 13th Adaptation to Technical Progress (ATP) to the Classification, Label and Packaging of Substances and Mixtures (CLP) Regulations was published by the European Union at the end of 2018," says Jörg Garlinsky, Head of Global End Use Thermoplastics - Industrial Applications.

"Compounders and processors of thermoplastic materials are now impacted by changes in the

product classification for maleic anhydride (MAH). Products containing a free residual MAH content of as low as 10 ppm (0.001%) now need to be classified as skin sensitising," he says. "MAH is the most frequently used functional group of grafted polyolefin polymers. A vast majority of these products are used as coupling agents for fibre-reinforced thermoplastic materials, such as wood-plastic composites or glass-fibre reinforced polyolefins. What is needed is a label-free alternative and BYK has developed such a product, Scona TSPP 8219 GA, using alternative monomers."

BYK has developed a number of compatibilisers and coupling agents for both virgin and recycled polymers. For virgin polymers, the company says that the Scona TPPL product range offers tailor-made polylactic acid (PLA)-based polymer modifiers for PLA-based materials. Typical areas of application include viscosity modification with Scona TPPL 1310 PA and Scona TPPL 1214 PA, provision of compatibility in PLA with Scona TPPL 1112 PA, and blend fibre matrix bonding using Scona TPPL 5112 PA.

In the automotive industry in particular, plastic components have now replaced many traditional materials but, in Europe at least, car makers are obliged to manufacture an increasing proportion of these plastics from recycled materials. Bumpers are a typical example. The PP used is modified with EPDM for impact strength and fillers are added to achieve the desired price and strength level.

BYK says that its products can neutralise the negative effect of impurities and increase impact strength. The company says as little as 0.2% paint residue in recycle causes a significant drop in impact strength during ageing. After around 1,500 hours, an impact strength of approximately 15% of the original value can be measured. Its Recyclobyk 4373 compatibilises the paint impurities and restabilises the material so that after 1,500 hours,

## Dow claims first with Recyclclass approval

Last month Dow's RecycleReady compatibiliser technology secured Recyclability Approval for use in the European flexible PE packaging stream under the RecyClass evaluation scheme, which the company claims is a first in this sector.

RecycleReady is a PE coextruded film containing an EVOH barrier layer and Dow's Retain 3000 compatibiliser, which is said to both compatibilise the

recycled blend and to counter yellowing effects linked to EVOH degradation.

The Dow technology was evaluated by the Spanish plastics technical institute Aimplas in accordance with the RecyClass Recyclability Evaluation protocols.

The Aimplas results show the technology is fully compatible with both natural and coloured flexible PE recycling technologies when the

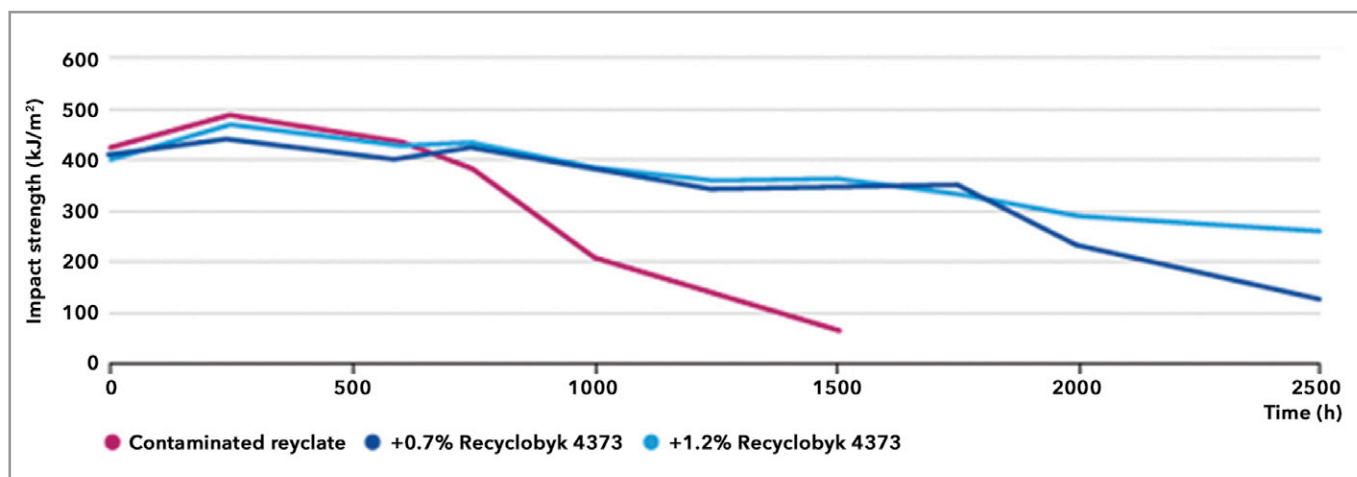
amount of EVOH does not exceed 4.75% and the amount of compatibiliser limited to 2.25%.

According to RecyClass, further assessment showed that recycled material containing up to 25% of film with RecycleReady technology can be used in high-quality applications such as PE blown films.

➤ [www.dow.com](http://www.dow.com)

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**Figure 1: Impact strength after ageing at 135°C for an automotive bumper TPO recyrate containing paint residues with and without BYK's Recyclobyk 4373 compatibiliser**

Source: BYK

90% of the original impact strength is still present (Figure 1).

BYK is also planning future developments for its Scona functionalised polymer product range. "These are mainly non-polar polymers modified by chemical grafting with additional functional monomers," says Garlinsky. "Typically, unsaturated monomers such as maleic anhydride (MSA), 2,3-epoxypropyl methacrylate (GMA), methacrylic anhydride (AA), which contain additional functional groups, are grafted onto the polymer by a radical addition mechanism. In this way, a large number of functional polymers with completely different properties can be created."

One of the new products BYK plans to launch is a grafted PET based on recycling feedstock. Garlinsky says it can be used as a novel high-performance polymeric modifier to improve the intrinsic viscosity of recycled PET.

Formed at Cornell University in the US, **Intermix Performance Materials** says it has successfully scaled up one of its materials that compatibilises virgin and post-consumer blends of polyethylene (PE) and polypropylene (PP). "We are currently working with four end-users of polyolefins to explore the use of their materials in a number of applications," says Geoff Coates, Co-founder of Intermix and Professor in the Department of Chemistry and Chemical Biology.

"These include recycling of post-consumer plastic packaging, development of polymer alloys for use in athletic gear, remediation of PE and PP rope recovered from the ocean, and reinforcement in composite pipe construction. Intermix is also investigating a new generation of compatibilisers with a major polyolefin producer and was recently granted STTR grants from the NSF (Phase 1) and DOE (Phase 2)," he says.

Intermix adds that its polymer additive enables

the valorisation of mixed plastics at low cost producing a higher quality resultant resin. PP and PE account for about two-thirds of all plastics in the post-consumer waste stream. However, due to their different structures they are not miscible, causing them to phase separate, somewhat like oil and water. This results in plastic mixtures with unacceptably poor strength.

Intermix has developed a multi-block copolymer (MBCP) that, when added to a stream of mixed PP and PE, enables these two polymers to be combined to yield a polymer alloy that is said to be mechanically comparable to pure PE and PP samples without laborious and expensive sorting. The MBCP additive can compatibilise mixtures of PE and PP with as little as 0.5% of the additive and at contamination levels of up to 70/30.

Strong demand for compatibilisers and coupling agents for virgin and recycled polymers is reported by **Nordic Grafting Company** (NGC). "However, the lack of available post-industrial and post-consumer recycled (PIR and PCR) materials have pushed compounders, recyclers and converters further in their waste management and sourcing of plastic materials," says Quentin Le Piuoff, Market Development Manager.

"Many players involved with mechanical recycling have begun using previously rejected or challenging waste streams such as mixed polyolefins, highly contaminated polyolefins or flexible multi-layer packaging, enabled by improvements in machinery and by new compatibiliser solutions," he says.

"For mixed or multi-layer polymer materials from PIR and PCR, compatibilisation is an ideal solution. It is also good for reducing PIR generation, by enabling the use of in-house recycled plastic into existing products of converters, without lowering end-properties. There is also a demand for a higher

functionality rate provided by the additive to enable a low addition ratio, but with guaranteed low VOC and kept properties, which we are working on."

Acti-Tech compatibiliser 16MA11F, which is compliant with EU10/2011 food regulation, is the latest addition to NGC's range. The company says the technology offers recyclers and processors an easy-to-add and universal compatibiliser for polyolefins (PE, PP) and engineering plastic (PA, PET, EVOH) blends. It is said to be a good solution to upcycling mixed polymer feeds from PIR or PCR, enabling the use of these recycled plastics in new or existing products without lowering end-properties.

Acti-Tech compatibiliser 16MA11F is added at between 2-6 wt% into a mixed recycled polymer formulation. NGC says that its high ratio grafting technology enables easier dispersion of the compatibiliser, leading to better performance without affecting the recyclability of the final article. Acti-Tech 16MA11F can also be used as a coupling agent for bio-based (starch, cellulose), wood composite (WPC) and natural fibre (NFC) compounds.

NGC adds that the additive can also help reduce waste or support higher recycled contents in packaging products. "Acti-Tech compatibiliser



IMAGE: NORDIC GRAFTING COMPANY

**Above: Samples showing the impact of Nordic Grafting's Acti-Tech compatibiliser in PCR. The sample on the left has no compatibiliser, the centre sample 5% Acti-Tech; the right hand sample 10%**

16MA11F has shown improved dispersion and decreased domain size of polyamide or polyester particles in a polyolefin matrix, such as PA(40%)/PE(60%)," says Le Piouff. "Moreover, the addition of 5% of the compatibiliser in a recycled barrier film – PE(30%)/PP(40%)/PA(25%)/EVOH(5%) – demonstrated a high recovery of film and optical properties compared to non-compatibilised mixtures, as well as cost saving compared to virgin material.

"Various pre-consumer, post-industrial and



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**Right: Compatibilisers for mixed recycled plastics from Interface Polymers are designed to make packaging more sustainable**

post-consumer waste streams would benefit from this technology, such as multi-layer barrier film packaging, shrink sleeves, cosmetic or phytosanitary containers made by extrusion blow moulding, rigid packaging, reinforced/multi-wall tube and hoses, as well as fishnets, mats and carpets," he says.

Another company reporting high levels of interest in solutions to the problem of how to recycle mixed plastics is **Interface Polymers**. "As companies look to make their packaging more sustainable the option to recycle the packaging they already use, that has been optimised for performance and cost over many years, is the best solution," says Simon Waddington, Business Development Director.

"However, they are finding that the types of compatibiliser available is limited and therefore look to companies such as Interface Polymers with novel compatibilisation technology to solve problems. These are most often in processing the mixed plastic or cross contaminated waste, where di-block compatibilisers offer the best performance to eliminate gels, flow defects and create smooth printable surfaces," he says.

"The main trend influencing packaging is sustainability, so this is driving additive and polymer producers to divert significant efforts into solving the challenges," Waddington says. "When we started asking film producers what their issues were, they all stated that it was physical properties of the film. However, the polymer industry reacted quickly to demonstrate that this was not an issue, and we suspect that many companies were guessing at the problems. From actual trials now done with mixed or cross contaminated plastic



IMAGE: INTERFACE POLYMERS

packaging the major challenges faced are in processing and surface finish while the issues with physical properties can be easily overcome."

Interface says new technologies are required to overcome issues with traditional compatibilisers, such as the need to use them at addition levels greater than 10%. This can cause processing issues. Its new generation of products are effective at lower levels, often below 1%. Its Polarfin di-block compatibilisers are suitable for a wide range of mixed plastics, such as PE/PA, PP/PA, PE/EVOH, PP/EVOH, PE/PET, PP/PET, PE/cellulose and PP/cellulose.

Waddington cites the example of a customer producing multi-layer PE/PA packaging. It was recycling post-industrial waste with post-consumer waste at over 30%, resulting in a rough surface layer that led to high print head wear and loss of print definition. Incorporating a Polarfin di-block

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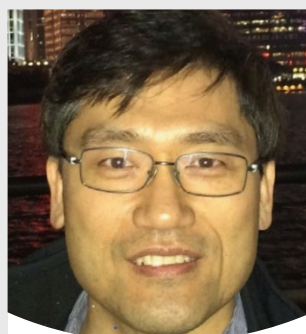
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IMAGE: SK FUNCTIONAL POLYMER



**Above: SK Functional Polymer says its compatibilisers can lower carbon footprint by enabling the use of recycled plastics**

into the original film at low levels meant the film could be recycled at more than 30% without any processing or surface finish defects.

Interface Polymers says that the key direction of its future developments is to have Polarfin compatibilisers for an increased range of mixed plastics. It is also looking to develop di-blocks for surface modification of PP and PE. This will generate a surface that can not only increase the bonding of the new generation of  $\text{AlO}_x$  and  $\text{SiO}_x$  barrier materials but will also increase flexibility and reduce failure due to surface cracking.

The company says it is on course to start up a commercial development plant in Q3 2023 to meet increasing industry demand for these di-block compatibilisers.

Earlier this year, **Evonik** announced it had invested in Interface Polymers through its Sustainability Tech Fund. "Many modern applications would be unthinkable without plastics, but recycling them is still a big challenge," says Bernhard Mohr, head of Venture Capital at Evonik. "Interface Polymers' additive technology offers a solution and is an excellent fit with Evonik's Circular Plastics Program."

The reduced performance and highly heterogeneous properties of recycled plastic is also being addressed at **SK Functional Polymer**. The company says its additives compatibilise plastic blends and act as coupling agents in the presence of fillers, as well as improving impact resistance and adjusting rheology – up or down – depending on the specifications.

"The main incentive for using mechanically recycled plastics is their lower carbon footprint versus virgin fossil-fuel based resins," says Richard Perrinaud, Director, Market Development. "Most companies have announced commitments to lower their carbon footprint and see the use of recycled plastics as one way to contribute to the achievement of their carbon footprint target. Regulators are also increasing the incentive to use recycled

plastics. These trends are forcing industry to use recycled plastics from lower performing and more contaminated sources."

According to Perrinaud, poor mechanical properties of recycled resins is the main issue. "However, in some industries, such as food packaging, aesthetics and the fact that mechanical recycled resins are not food contact compliant are also vital. To obtain compounds that meet industry requirements, impact performance and rheology are key. SK Functional Polymer has evaluated several solutions to improve both properties using high polarity and reactive functional polyolefins, such as Lotryl acrylate copolymer and Lotader reactive polyolefins."

The company says it has developed several compatibilisers that perform well in both virgin polymers and recyclates. Lotryl 29MA03T resin is the most recent introduction and is mainly used for styrenics, ABS and HIPS, but also for styrenic alloys such as PC/ABS. Lotryl 28BA700T copolymer has been designed to increase the fluidity of virgin and recycled technical resins, such as polyamides, thermoplastic polyesters and styrenics. And while already a well-established product, SK says Lotader AX8900 epoxide-modified resin is increasingly being used to fine-tune the rheology of recycled styrenics and thermoplastic polyesters used in extrusion applications.

Other recent successes include the use of Lotryl copolymers to improve the impact resistance of recycled ABS, even when contaminated with other resins such as HIPS, homo-PS or PP. The impact resistance can be increased by 50-100% depending on the initial recycled ABS and the loading of the Lotryl additive.

The company says its focus for 2023 is on recycled styrenics. In addition, there is a current significant effort on the recycling of PE/EVOH or PP/EVOH blends to provide solutions for recycling oxygen-barrier food packaging films. This is challenging because any solution must meet mechanical performance as well as aesthetic requirements, such as the absence of optical defects.


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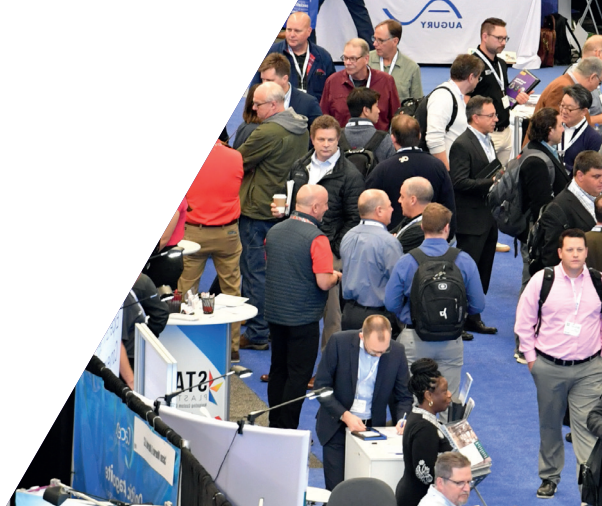






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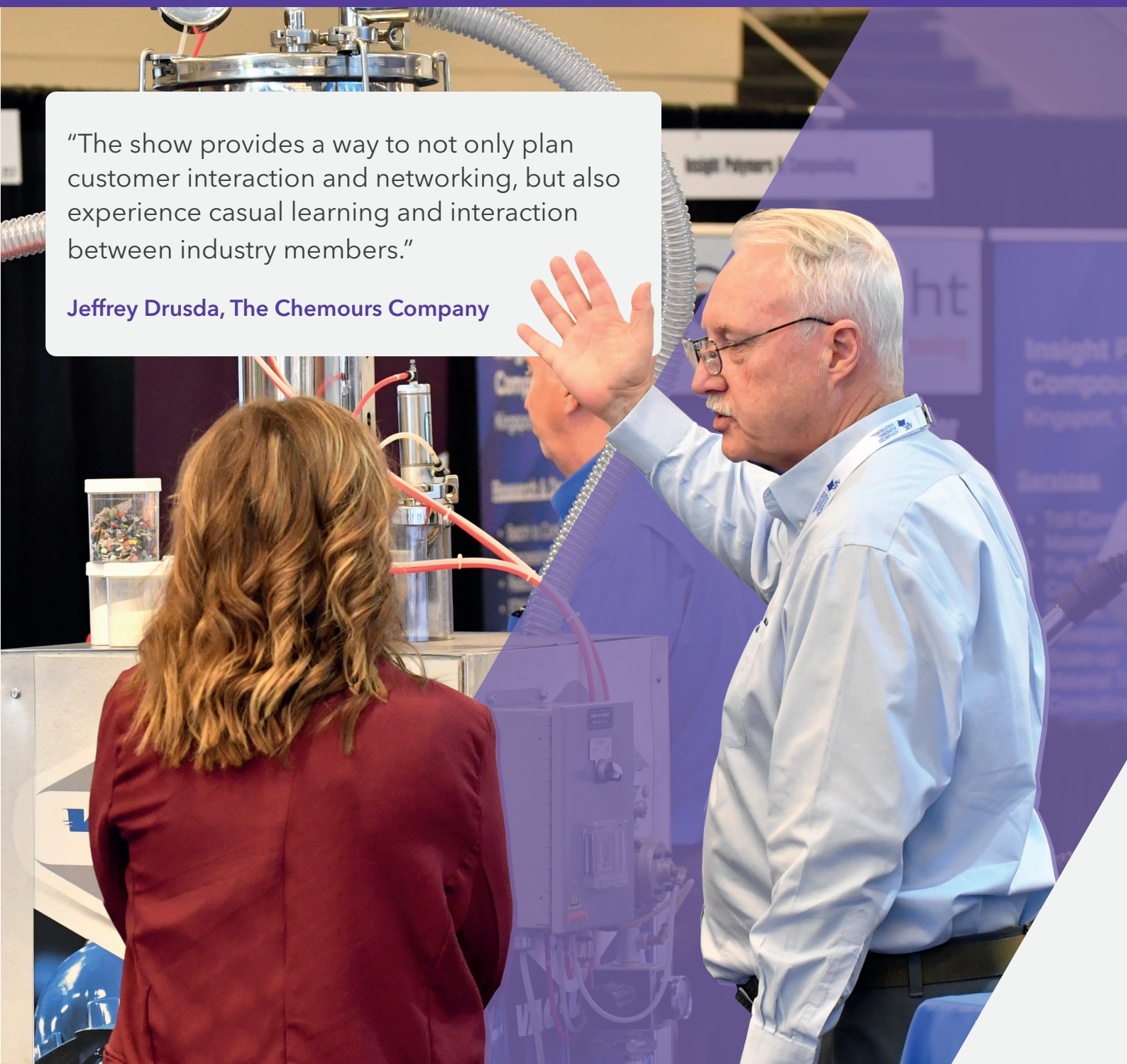
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SECURE YOUR PLACE TODAY

*Biorenewable fibres and fillers offer the potential to reduce product carbon footprint and the options available are growing, reports Jennifer Markarian*



GARY CHINGA CARRASCO, RISE PFI

# Natural routes to cutting product carbon footprint

Natural fibres and fillers for plastics, whether derived directly from plants or produced from other renewable bio-based materials, are attracting strong interest for the potential they offer to reduce product carbon footprint by replacing some of the polymer or traditional fibres and fillers in a formulation. In some cases, these renewable natural additives can also improve strength, reduce product weight, and help to optimise cost.

Headquartered in Detroit in Michigan in the US, **Heartland Industries** has an engineered hemp-fibre additive that is currently being trialed in a range of plastics applications, as well as in materials such as rubber, paper and asphalt. The company plans to have its first industrial-scale processing facility built by Q4 of this year in time for the hemp harvest. "We're receiving lots of requests from companies who are looking at ways to decarbonise the plastics and other materials they use," says John Ely, Heartland's Chief Marketing Officer.

Ely says Heartland has developed a processing method and formula that allows the hemp to be

consistently blended into a variety of polymers. It plans to offer the Imperium hemp-based additive as a filler (100% hemp), as a masterbatch containing 85% hemp, or as a filled compound with 40% or more hemp. He says that in polyolefins, Imperium can replace or augment talc and calcium carbonate, while in polyamides it can replace or augment glass fibres.

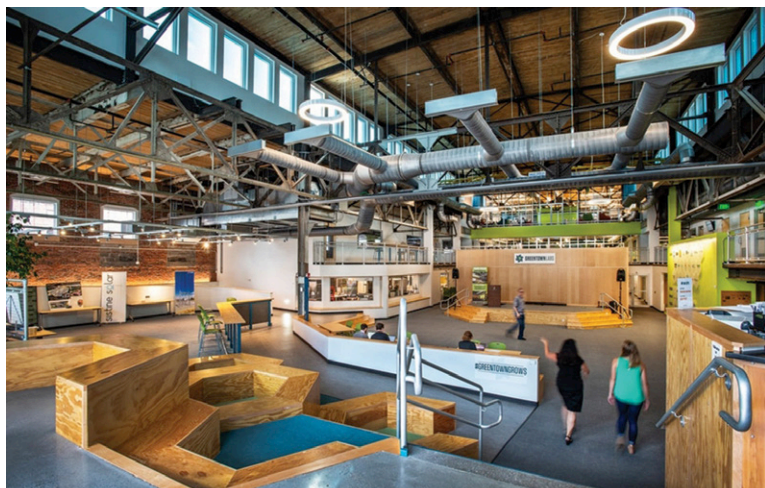
In December last year, Heartland was one of five startups selected for a six-month accelerator programme – Go Move 2022 – intended to develop solutions to reduce the lifecycle impact of automobiles and decarbonise automotive manufacturing. The initiative is a joint effort between BASF, Tier 1 automotive supplier Magna International, and climate tech incubator Greentown Labs and is intended to help move towards commercialisation.

Heartland says, as part of the project, it expects to identify potential applications and test its material in different formulations and polymer types, including glass-fibre reinforced formulas. It says hemp-based additives can be used either to reduce the amount

**Main image:** Wood fibres are showing promise as a reinforcement in thermoplastic bio-composites but are only one of a number of options under development



IMAGE: GREENTOWN LABS



**Above:**  
Heartland is working with BASF and Magna in the Go Move 2022 automotive decarbonisation programme at climate tech incubator Greentown Labs

of glass fibre or the amount of polymer resin. Tests with different loadings are underway, and initial results are promising, according to Ely.

In March of this year, Heartland was also selected to be a member of the Gener8tor program at 1915 Studios, a direct development partnership with Georgia Pacific corporation. This programme is designed to lower the carbon footprint of papers, corrugated materials, and plastics.

Heartland last year sponsored a third-party lifecycle analysis (LCA) of its hemp additive from cradle to gate completed. Ely says it found that in a 20% loading, a kilogram of Imperium filler sequesters 2.8kg of carbon dioxide equivalents, making it nearly 3:1 carbon negative. The company is now testing a carbon-footprint estimator on its website that allows customers to input material types, amounts and logistics to obtain a customised carbon impact report. "We're finding that customers who are selling into Europe, in particular, are requesting this type of data, and it's only a matter of time until companies here in the US follow that trend" he says.

Transportation is a significant factor in carbon footprint. "Hemp can grow almost anywhere, and ideally we want to have farms within 200 miles of our processing plants," says Ely. Currently, most of the

hemp acreage that Heartland plans to source from is in Michigan, where the company has a lab-scale facility and is building a commercial-scale plant. In the future, it plans to expand to other parts of the US.

Hemp was highly regulated in the US until 2018. Hemp farming is now starting up and is typically added to a crop rotation, where it grows quickly (in a 90-day cycle) and doesn't take away from land used for food, Ely says.

### Natural selection

During the past year, the Norwegian research organisation **RISE PFI** has been prototyping new biocomposite products for infrastructure and building elements using 3D printing, injection moulding and extrusion. "One important aspect in the development of biocomposites is the selection of the optimal biocomponent for the application and wood fibres have demonstrated good properties for biocomposite products," says Gary Chinga Carrasco, Lead Scientist for the Biopolymers and Biocomposites area within the organisation.

Wood fibres that can be used in biocomposites include thermo-mechanical pulp (TMP) fibres and kraft pulp fibres. "TMP fibres can be used directly in thermoplastic biocomposites, while kraft pulp fibres have proven to be an excellent source for production of cellulose nanofibrils (CNF)," says Chinga Carrasco.

CNF is promising when it comes to reinforcement ability in thermoplastics. However, there are still challenges to overcome, such as drying the CNF without causing agglomeration as well as the dispersibility of the CNF in the polymer matrix.

RISE PFI claims to be making advances in compounding CNF with polyolefins. "The compounding strategy we are exploring focuses on avoiding agglomeration and securing good CNF dispersibility in the thermoplastic polymer. We are also exploring the manufacturing of lignin-containing CNF as this may have additional advantages regarding biocomposites," explains Chinga

Heartland's Imperium hemp-fibre is available as a filler, masterbatch, or finished compound

Source: Heartland Industries

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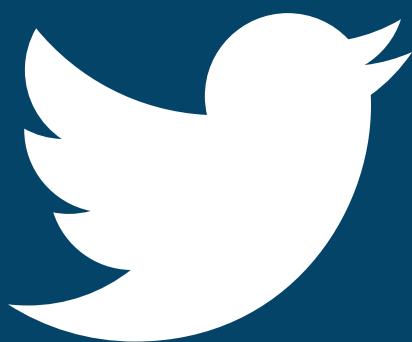
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IMAGE: NORSKE SKOG SAUGBRUGS



**Above:**  
**Norske Skog Saugbrugs' first production line for CEBICO biocomposites is up and running in Norway with a capacity of around 300 tonnes/yr**

Carrasco. Lignin may reduce agglomeration and increase the interphase between the CNF and the thermoplastic matrix, as well as being a cheaper raw material, he adds.

"Recently, we finalised some projects with industrial participation in Norway (Alloc AS and **Norske Skog Saugbrugs**), where we developed TMP-based biocomposite prototypes for new flooring products. These projects demonstrated new potential production technologies from biocomposites, including compounding and injection moulding. Particularly, extrusion of corrugated structures is interesting, and this approach was reported in a [scientific publication](#) that was recently published," he says.

Norske Skog Saugbrugs reports a large and growing interest for using both CNF and TMP fibre in biocomposites. It is ramping up commercial production of its CEBINA cellulose nanofibril CNF products for thermosets and other materials as well as developing new biocomposite recipes for various commercial applications using its CEBICO cellulose thermoplastic biocomposite products containing TMP fibres.

"The first small production line for CEBICO was opened late in 2021 and is now up and running with a capacity of about 300 tonnes/yr with the current set-up," says Dag Molteberg, Senior Development Manager at Norske Skog Saugbrugs. The company now has 12 different products based on virgin LDPE, HDPE, TPU and virgin and recycled PP, and it is currently testing and developing more.

"By adding TMP fibres from spruce wood to [make] CEBICO we achieve levels of tensile strength and

stiffness comparable to glass fibre filled materials," Molteberg says. "All of our products can be recycled (closed loop) several times. Key properties are remarkably lower carbon footprint, increased strength and stiffness. We also manage to maintain a normal flow range for injection moulding. Following our instructions with lower processing temperature and a somewhat higher inlet pressure it should be [able to replace] an ordinary PE or PP, and even achieve reduced cycle times."

## Nano opportunities

Canadian company **Performance Biofilaments** uses a proprietary process to make nanofibrillated cellulose (NFC) – also known as cellulose filaments – with high strength and purity using wood fibres as a starting material. It recently opened its first commercial NFC production plant within a facility owned by Resolute Forest Products, one of its shareholders. Located in Quebec, the plant has the capacity to produce 7,000 tonnes/yr for applications including thermoplastics.

"Performance BioFilaments has the mandate to commercialise nanofibrillated cellulose in polymers and other advanced materials applications and is actively seeking collaborations with the producers and users of biocomposite compounds," says Geoff Fisher, Director of Business Development at Performance Biofilaments. "The capability to provide tonnes per day of high-quality, high-performance nanofibrillated cellulose on a steady basis is an important differentiating factor within the natural fibres domain, and the opening of the commercial plant positions Performance BioFilaments to be a large-volume supplier."

A recently published [study](#) by researchers at Ford and the University of Delaware's Center for Composite Materials looked at the recyclability of glass-fibre composites compared to natural-fibre composites in PP and PA matrices. The compounds were subjected to five mechanical recycling cycles, simulated by injection moulding, regranulation, and exposure to a hygrothermal environment.

The glass fibre composites experienced a drop in properties due to fibre breakage during the recycling and reprocessing steps, but the properties of the glass fibre composites were higher than those of the natural-fibre composites both at the start and after recycling, reports the paper's primary author, Sandeep Tamrakar, Research Engineer at the Ford

**Right:**  
**Parts made from the Norske Skog Saugbrugs CEBICO line of thermoplastic composites using TMP fibre technology**



IMAGE: NORSKE SKOG SAUGBRUGS

Motor Company's Research and Innovation Center in Dearborn, Michigan, US. In contrast, composites containing natural fibres, which are less likely to break, did not exhibit a drop in properties after recycling.

"In comparison to glass fibres, natural fibres exhibit increased resilience and compliance. This attribute results in a reduced likelihood of fracture during various manufacturing processes and mechanical recycling. Moreover, natural fibres possess a unique ability to effectively navigate through sharp corners and thin sections during moulding, while incurring relatively lower damage," he says.

Tamrakar suggests that using natural fibres in composite materials as a partial substitute for glass fibres can provide benefits such as weight reduction, cost efficiency, and the ability to resist mechanical property degradation during recycling.

Other work at Ford has looked at converting natural fibres into biochar to address challenges such as variability, susceptibility to moisture absorption, and incompatibility with polymers. "Biochar exhibits reduced variability, better resistance to moisture, and an expanded process-



IMAGE: GARY CHINGA CARRASCO, RISE PFI

ing window. Consequently, this technique presents a viable solution for the successful incorporation of natural fibres in automotive parts," Tamrakar says.

Delaware, US-based **New Polymer Systems** (NPS) is introducing a next-generation version of its NeroPlast bio-renewable lignocellulosic filler, which is intended for use in thermoplastics as well as other materials, including thermosets, rubber, and asphalt. The filler is made from "deeply pyrolysed biochar, with selected wood as the feedstock for the char," according to Joe Roesler, cofounder of

**Above: 3Dprint production is one area of application for natural fibres currently being evaluated by RISE PFI**

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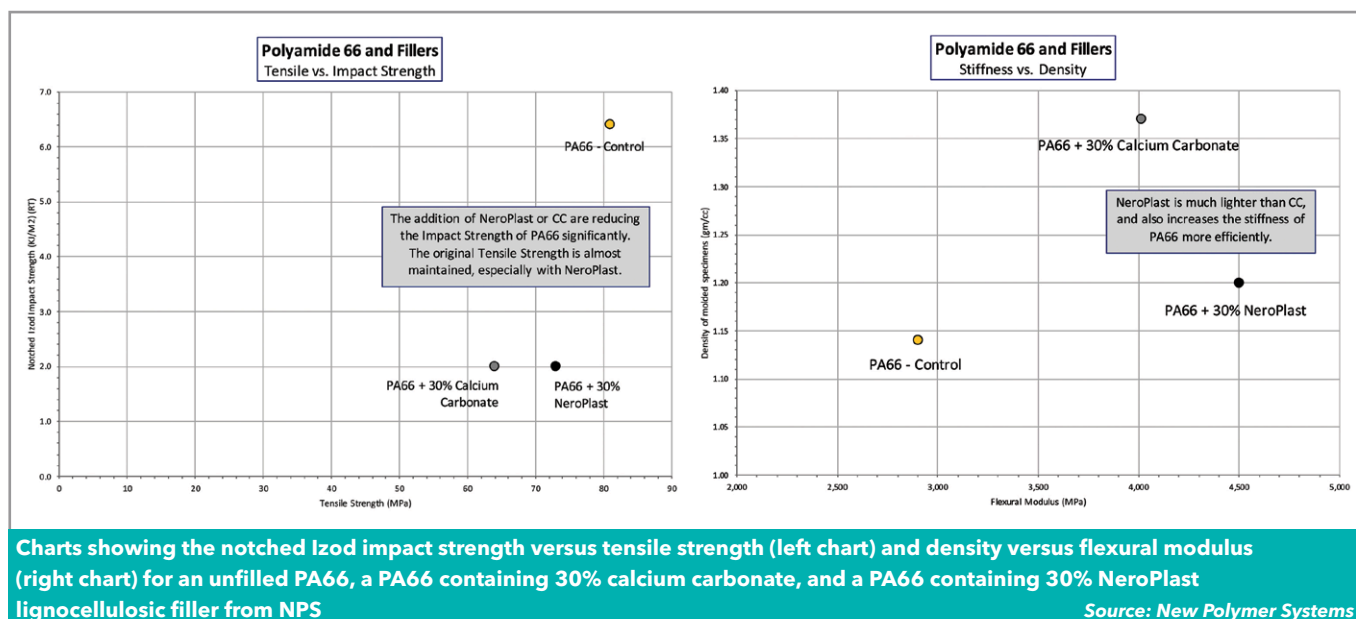


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NPS. He says the novel advantage of the filler is that pyrolysis makes it hydrophobic, and so more compatible with polymers and longer-lasting than most natural fillers, which are hydrophilic and absorb water.

Roesler and NPS cofounder Hans Korte first proved this concept and launched NeroPlast masterbatches in 2011 but were limited by supply and cost issues.

"It seems our very first efforts with NeroPlast were a little bit ahead of their time," says Roesler. "I believe that we may be witnessing the start of a new era now, although actual changes will rather be gradual, of course. I see an increased willingness to look at solutions [that] would reduce the consumption of limited resources, reduce the dependence on petrochemicals, and to move us further towards a cyclical, sustainable economy."

The new generation of NeroPlast masterbatches have been optimised for use in thermoplastics, including polyolefins and polyamides. NPS plans to produce commercial quantities of masterbatch at its production facility in Florida in the second half of this year. Roesler suggests that the US will be capable of supplying a few million pounds per year (several thousand tonnes). "When the demand is there, we will be able to expand capacity extremely quickly," he says.

The NeroPlast filler, which is black in colour, will also be available as a precision-manufactured powder for use in thermosets and non-polymer applications such as cement and coatings. A sister company in Germany, **PHK Polymertechnik**, markets the products in Europe as Nerolit, and will be offering the powder version from April.

Compared to mineral fillers used for resin-re-

placement, such as talc or calcium carbonate, or to glass fibres, NeroPlast is much lower in density. In addition, compared to other bio-fibres and bio-fillers that decompose at temperatures above 200°C, NeroPlast can be processed up to 290°C. "Furthermore, minimally processed bio-fillers (like dried wood flour) still possess most of their original organic volatiles, which can interact with the specific chemistry of the matrix resins. NeroPlast does no such thing as it is essentially purified carbon and [is] naturally very inert," says Roesler.

"In general, like every filler made of solid particles, NeroPlast will make any polymer matrix stiffer but also more brittle. If needed, the increased brittleness can, of course, be countered with impact modifiers and other additives," Roesler says. He suggests that in polyamides, for example, NeroPlast could be combined with reinforcing glass or carbon fibres.

Compounds that contain at least 25% of NeroPlast can be certified to qualify for the USDA BioPreferred Program, which means the products (depending on the end-use) would be preferred for purchasing by US federal agencies. In September 2022, the US launched a National Biotechnology and Biomanufacturing Initiative that, among other actions, is designed to increase bio-based purchasing through the BioPreferred Program. An example could be using the filler in lightweight shipping pallets, suggests Roesler.

The Maxxam BIO bio-based polyolefin product line from **Avient** includes grades with up to 40% natural filler sourced from cellulose fibre or powder produced from recycled coffee grounds. These compounds are manufactured in Europe but commercially available globally.

IMAGE: AVIENT/GETTY IMAGES



"We're generally seeing growing demand in the thermoplastics market for sustainable content. Besides the sustainability advantages, bio-fillers often have a density advantage over minerals. By using bio-fillers, we're helping our customers achieve certain particular visual aspects that can create a unique and differentiated end product," says Hermann Fuechter, Senior Marketing & Product Manager EMEA at Avient.

"The coffee grounds can add a unique visual aspect to the material and, depending on the

dosage, an appealing scent," he adds. The wood-based cellulose fibre used in the Maxxam BIO grades is derived from sustainable sources and controlled through FSC certification (FSC C015022). The cellulose fibre offers mechanical reinforcement performance, although not at the same level as a glass fibre," Fuechter explains.

A Maxxam BIO grade launched at K2022 contained olive seed powder. "The olive seed powder improves dimensional stability in a polyolefin matrix, just as a conventional talcum filler would do. Through the lower density, the customer can have lightweight benefits as well as a certain percentage of bio-renewable material in their products," he says.

**Left: Avient's latest Maxxam Bio PO compound introductions include grades containing recycled coffee grounds**

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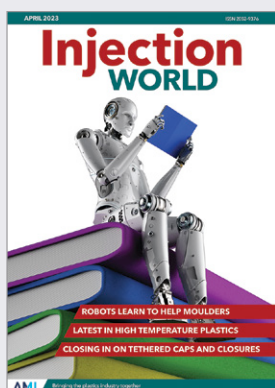
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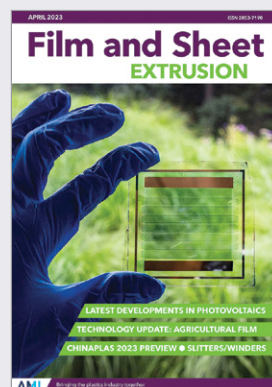
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<b>5-8 September</b>	Plast 2023, Milan, Italy	<a href="http://www.plastonline.org/en">www.plastonline.org/en</a>
<b>20-21 September</b>	Injection Molding & Design Expo, Novi, MI, USA	<a href="http://www.injectionmoldingexpo.com">www.injectionmoldingexpo.com</a>
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