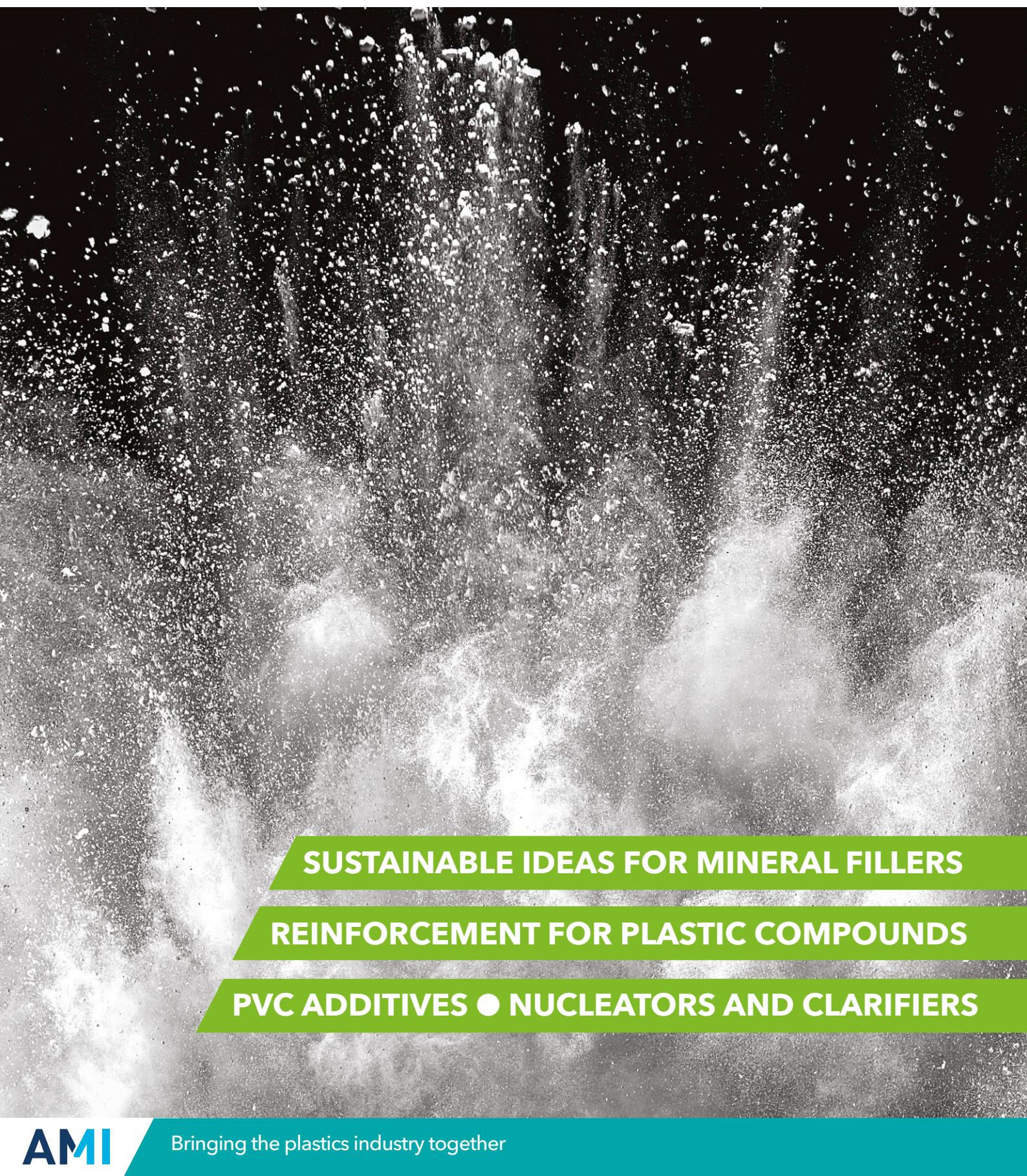


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[extruders.leistritz.com](http://extruders.leistritz.com)



# Compounding WORLD

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[COVER IMAGE: SHUTTERSTOCK]



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## CONTACT US

### AMI

Third Floor, One Brunswick Square,  
Bristol, BS2 8PE, United Kingdom  
Tel: +44 (0)117 924 9442  
Fax: +44 (0)117 311 1534  
[www.amiplastics.com](http://www.amiplastics.com)  
[Twitter: www.twitter.com/plasticsworld](https://www.twitter.com/plasticsworld)  
Registered in England No: 2140318

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#### EDITORIAL

**Editor-in-Chief:** Chris Smith  
[cs@amiplastics.com](mailto:cs@amiplastics.com)

**Technology Editor:** Peter Mapleston  
[editorial@compoundingworld.com](mailto:editorial@compoundingworld.com)

**Contributing Editor (USA):** Jennifer Markarian  
[editorial@compoundingworld.com](mailto:editorial@compoundingworld.com)

**Contributing Editor (UK):** Mark Holmes  
[editorial@compoundingworld.com](mailto:editorial@compoundingworld.com)

**Events and Magazines Director:** Andy Beevers  
[abe@amiplastics.com](mailto:abe@amiplastics.com)

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**Advertisement Manager:** Claire Bishop  
[cb@amiplastics.com](mailto:cb@amiplastics.com) T/ +44 (0)7905 848744

**Sales & Commercial Manager:** Levent Tounjer  
[lt@amiplastics.com](mailto:lt@amiplastics.com) T/ +44 (0)7718 578559

**Exhibition & Advertising Sales Manager:** Jessica Szuts-Naranjo  
[jna@amiplastics.com](mailto:jna@amiplastics.com) T/ +44 (0)117 314 8173

**Advertising Sales (China/Hong Kong):** Maggie Liu  
[maggie.liu@ringiertrade.com](mailto:maggie.liu@ringiertrade.com) T/ +86 13602785446

**Advertising Sales (Taiwan):** Ms Sydney Lai  
[sydney.lai@ringier.com.hk](mailto:sydney.lai@ringier.com.hk) T/ +886-913625628

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# Sirmax posts record Q1 result

Italian compounding group Sirmax posted a record result for the first quarter of 2021 with production volumes up by 15%, driving total sales for Q1 2021 to €100m and EBITDA to €12.5m (70% ahead of 2020).

Strongest performances were seen in its SER business, which produces compounds based on compostable polymers and post consumer waste and saw sales grow by 25%. The company also reported a good result in the US, where production volumes were up by 45% on high demand from the household and appliance industries.

Sirmax – one of the world's largest producers of technical PP compounds for the automotive, appliance, E&E and construction sectors – said the good Q1 performance followed a positive result for 2020, which saw it increase volumes by 5% despite the impact of Covid.



IMAGE: SIRMAX

**Above: Sirmax CEO AND Chairman Massimo Pavin**

"We are very pleased with these figures," said Sirmax CEO and Chairman Massimo Pavin. "They are the result of a well-defined strategy that has made all the difference in these difficult times of pandemic."

Sirmax has continued to invest in its business. In Italy, it has redeveloped and expanded the SER plant at Salzmaggiore Terme, where it produces PCR-based compounds, as well as the Microtec plant at Mellaredo di Pianiga, which produces bio-based film compounds. It is also soon to complete a second plant at Anderson in Indiana in the US, a €20m investment that will focus on its sustainable product lines.

"Current trends and figures show the circular economy is growing at a fast pace," said Pavin. "At present, the production of green materials accounts for 15% of our total business but there is every reason to believe this figure will increase exponentially...In 2020 we generated about €20m in revenues from biopolymers alone; this year we expect to reach €30m."

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

IMAGE: KRAUSSMAFFEI



**Above: The new KM extrusion location at Laatzen near Hanover in Germany**

## KraussMaffei to focus extrusion systems production in Hanover

KraussMaffei is to merge all of its extrusion operations – including compounding – into a single location at Laatzen on the outskirts of Hanover in Germany.

Currently, its extrusion activities are spread across sites in Hanover and Munich. The division will begin relocation to the new site – where it is currently building

a new R&D centre – in Q2 2022. By Q3 2022 around 700 employees will be based at the 67,000m<sup>2</sup> facility.

The move is part of the largest investment programme in KraussMaffei's 180-year history, which includes a new 250,000m<sup>2</sup> facility for its injection moulding, automation and PU systems activities at

Parsdorf near Munich.

The company, which was acquired by ChemChina in 2016, said that bundling its extrusion activities will result in "substantial product benefits for customers, valuable synergy effects for the company and new opportunities and fields of research for the future".

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

## SI invests \$50m in US sites

Additives giant SI Group is to invest \$50m to increase phenolic antioxidant production capacity across three of its production sites in the US.

The company has not disclosed the scale of the expansion but says the move will improve security of supply for its US-based customers while preparing it to meet expected growth in demand resulting from new polyolefin production capacity.

The new antioxidant capacity is expected to come online in the second half of 2022.

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

**IN BRIEF...**

The Biocidal Products Committee of the European Chemicals Agency (**ECHA**) has decided not to support approval of four antimicrobials for product-type 4 (food and feed) area applications: silver zinc zeolite, silver zeolite, silver copper zeolite, and silver sodium hydrogen zirconium phosphate.

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

Prince International is to acquire **Ferro** in an all-share deal that is expected to close in Q1 2022, subject to and regulatory shareholder approval. The deal values the firm at about \$2.1bn and will see it combine with ChromaFlo Technologies.

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

**Farrel Pomini** has invested in WF Recycle-Tech, a UK company with a pyrolysis system for recycling end-of-life tyres. It means WF will able to use its continuous mixing technology "to create a solid platform within the pyrolysis sector". Farrel Pomini's R&D team will optimise compounding applications using recovered carbon black.

[www.wfrecycle-tech.com](http://www.wfrecycle-tech.com)  
[www.farrel-pomini.com](http://www.farrel-pomini.com)

# ECHA withdraws lead pigment restrictions

The European Chemicals Agency (ECHA) last month withdrew its twice-delayed intention to restrict certain lead chromate pigments (CI Pigment Yellow 34 and CI Pigment Red 104) saying it is unable to complete the required REACH Annex XV restriction dossier until the European Commission has determined a decision-making route on proposed restrictions on the use of lead stabilisers in PVC.

The Commission had put forward a proposal – based on a 2016 ECHA Annex XV **restriction report** – that set lead limits in recycled PVC above virgin norms to allow legacy products containing higher levels of lead stabilisers, to be reprocessed at end-of-life. That proposal, however, was voted down in the European Parliament in February of 2020.

ECHA said that while its pigment restriction has a wider scope it is interlinked with the Commission's PVC stabiliser proposal as both consider use of lead in plastics and both identify release at end-of-life as the main potential source of



**Above: Pigment decision impacted by European Parliament rejection of recycled PVC stabiliser limits**

emissions. "Therefore, policy discussions on lead in PVC are expected to have an impact on the underpinning analysis presented in the lead chromates dossier," according to a spokesperson.

ECHA said the pigment restriction proposal could be further affected by a **ruling** in the European Court of Justice in February of this year against a Swedish challenge to the Commission's 2016 decision to authorise use of the same pigments in certain safety-critical applications where alternatives were not deemed to be available.

"The deliberations following this case may also

have an impact on the restriction as it was made under Article 69(2) of REACH and is therefore complementary to the authorisations," the spokesperson said.

The Commission has yet to determine a way to address the Parliament decision on lead stabilisers. An official told *Compounding World* it intends to "find the right balance" between minimising substances that pose potential health and environmental problems in recycled materials while meeting its circular economy and carbon neutrality ambitions.

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

## Arkema acquires compounder Agiplast

Arkema is to acquire Italy-based technical compounding Agiplast. The company, which operates two production plants and generates sales of around €15m, offers an extensive range of high performance polymer compounds, including speciality recycled PA and fluoropolymers grades.

Arkema has worked with Agiplast since 2019, when they jointly launched the Virtucycle programme for collection and regeneration of high performance polymers.

Arkema said the acquisition will enable it to "offer a full service to customers in terms of materials

circularity, addressing growing market expectations in this field". It said it will also make it the first fully integrated high performance polymer manufacturer to offer both bio-based and recycled materials.

➤ [www.arkema.com](http://www.arkema.com)  
 ➤ [www.agiplast-compounding.com](http://www.agiplast-compounding.com)

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# Peak investment for Haartz

US-based Haartz Corporation, a global producer of coated fabrics and specialist interior surfacing materials for the automotive industry, has acquired a minority stake in Peak Performance Compounding.

Established in 2019 at Leominster in Massachusetts, Peak targets the specialty medical and industrial toll and custom compounding markets.

Haartz said its investment is part of an ongoing strategy to diversify into new and growing business areas.

"Haartz has long-looked to diversify our products and markets," said Matthew Williams, Vice President of Global Automotive Exteriors and New Markets. "This partnership with Peak provides us access to the growth-positioned medical plastics marketplace."

Peak currently runs four compounding lines – 22, 35, 52 and 75mm diameters – and has been ISO13485 accredited since 2020. Its current capacity is around 1,800 tonnes on single shift production, with a second production shift expected to start in Q4 of this year, according to Peak President Todd Marchant.

"We are planning to expand our manufacturing

footprint in 2022 by adding a dedicated white room space for our medical production, additional blending and storage space for all products. Although we are in an unusual time, we are very optimistic about the future," he said, adding he expected a further two compounding lines to be installed over the coming two years.

➤ [www.haartz.com](http://www.haartz.com)  
➤ [www.peak-pci.com](http://www.peak-pci.com)

## Maip takes on Eastman's Tritan HM

Italian compounder Gruppo Maip has become an official European distributor for Eastman's Tritan HM glass-filled copolyester and Trēva cellulosic engineering bioplastic.

The move extends the relationship between the two companies, which have been working together to formulate new sustainable polymers for automotive interior applications since last year.

Tritan HM grades include 10%, 20% or 30% glass fibre-reinforced grades. Gruppo Maip President



IMAGE: EASTMAN

Eligio Martini said they "can maintain their modulus values in demanding automotive applications versus reinforced nylons and commodity polymers".

Trēva, meanwhile, is said to have "excellent flow and clarity" to compete with existing material options.

➤ [www.maipsrl.com](http://www.maipsrl.com)  
➤ [www.eastman.com](http://www.eastman.com)

## Perstorp renews DPHP

Sweden's Perstorp has launched Emoltene 100 Pro, a DPHP plasticiser for PVC that is made using renewable biogas in place of natural gas. The company said a 14% renewable grade (based on mass balance) is available now and a 71% grade will be introduced shortly.

According to Perstorp, Emoltene 100 Pro offers the same performance as the existing Emoltene 100 grade, which was launched in 2009, and "is ready to be dropped straight into existing flexible PVC formulations".

Renewable content of Emoltene 100 Pro is certified according to the ISCC Plus mass balance system, which covers both physical and chemical traceability of all components back to the point of origin.

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

## Nexeo acquires Nevicolor

Global plastics distributor Nexeo Plastics (an affiliate of GPD Companies) has expanded its European presence with the acquisition of family-owned Italian distributor and compounder Nevicolor.

Headquartered at Luzzara, Nevicolor offers more than 3,000 grades of

high quality polymers, plus recycled materials, and targets applications in industrial, healthcare, automotive, advanced packaging, agriculture and electrical sectors.

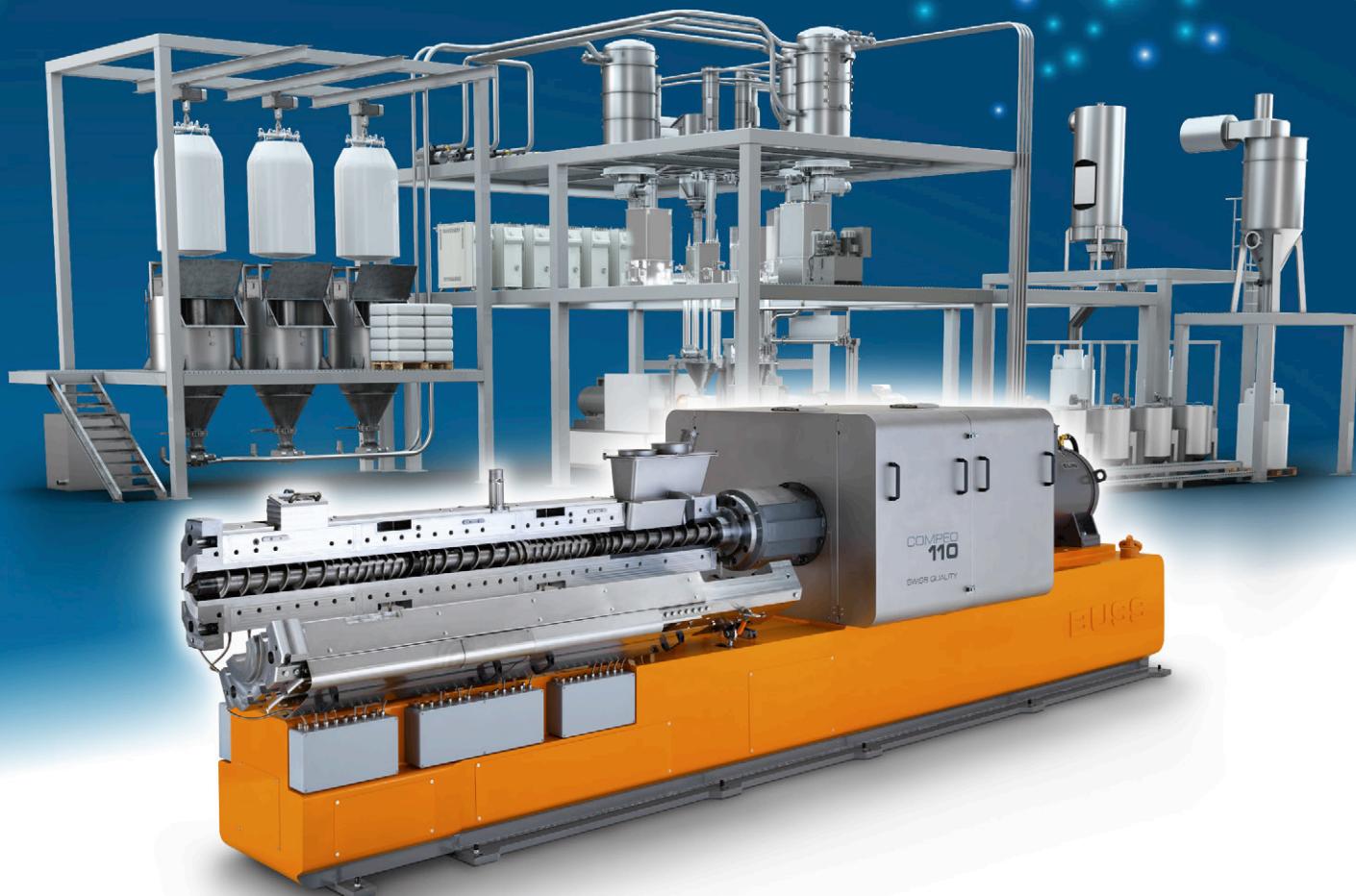
"This strategic acquisition increases GPD's scale and affords Nexeo Plastics access to Nevicolor's highly

technical and analytical specialisation," said Paul Tayler, Chief Executive Officer of GPD. "Nevicolor has built a reliable network of international suppliers, and we look forward to continuing to serve its customers."

➤ [www.nexeoplastics.com](http://www.nexeoplastics.com)  
➤ [www.nevicolor.it](http://www.nevicolor.it)

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## Alphagary takes over Shakun

US speciality compounding Alphagary, a division of Orbia's Polymer Solutions business group, has acquired a majority share in India's Shakun Polymers, a family-owned producer of compounds for the wire and cable markets.

According to Alphagary, the move will enable it to expand its regional footprint. Shakun supplies to the Indian sub-continent, the Middle East, Southeast Asia and Africa. The company operates four plants with a capacity of around 40,000 tonnes.

The acquisition will also expand Alphagary's product range. Shakun's halogen-free, flame-retardant and PVC-based compounds complement its offering while its semi-conductive and cross-linkable compounds further extend its portfolio, the company said.

Alphagary said the existing management team will remain in place.

➤ [www.alphagary.com](http://www.alphagary.com)  
➤ [www.shakunpolymers.com](http://www.shakunpolymers.com)

# Canadian plastics firms to fight 'toxic' listing

A coalition of Canadian plastics companies is to challenge its government's decision in May to add 'all plastics manufactured items' to the toxic substances (Schedule 1) list in the Canadian Environmental Protection Act (CEPA), the country's main piece of legislation covering human health and environmental protection.

The newly-formed Responsible Plastic Use Coalition (RPUC) has filed a notice of application in the Federal Court of Canada challenging the decision. It argues it is scientifically unjustifiable and points out that plastics comply with

federal regulations in place to ensure safe use.

Substances can be added to the CEPA Schedule 1 list if they are considered to be harmful to environment and biodiversity and/or human



IMAGE: SHUTTERSTOCK

health. Legal experts say that inclusion of 'all plastics manufactured items' on the list may simplify the process of implementing bans on single-use products such as plastic drinking straws and

can collection rings.

However, 'all plastics manufactured items' is the only non-specific class of substances to be added to the Schedule 1 list. The RPUC described the inclusion as "a significant over-reach by the federal government" and said the move presents an obstacle to creation of a circular economy.

"The challenge we face is not that plastic is toxic, but rather the challenge of post-consumer plastic in the environment resulting from human behaviour and systemic waste management and recycling shortfalls," the coalition says.

➤ <https://rpuc.ca/>

## Huber buys all of Magnifin

As part of its planned growth in speciality chemicals, JM Huber has agreed to buy the 50% of Magnifin Magnesiaproducte that it did not already own from partner RHI Magnesita. The deal should close in the second half of this year,

subject to regulatory approvals.

Originally part of the Martinswerk operation of Albemarle that Huber part-acquired in 2016, Magnifin makes coated and uncoated magnesium hydroxide products at a site

in Breitenau, Austria. These are used as flame retardants in many polymers.

It says the move "demonstrates our clear strategy to grow our halogen-free fire retardant business globally."

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

## Azoty moves to develop in bioplastics

Poland's Grupa Azoty has launched a 300 tonnes/yr pilot line for production of thermoplastic starch at its R&D centre at Tarnów. It is the company's first biodegradable product and the move is said to be a response to the impending EU ban on non-biodegradable plastics for single use applications.

"Production of biodegradable plastics, which can be decomposed in a com-

pletely natural and environmentally neutral process, is part of the European Green Deal and in line with our objectives," said Tomasz Hinc, President of Grupa Azoty. "The lack of manufacturers of thermoplastic starch on the Polish market and in Central and Eastern Europe makes us a pioneer of TPS production. It is a niche that needs to be filled."

Grupa Azoty said it began working on

its TPS production technology in 2019 and filed a European patent application this year. The process is said to be easily scalable. "We can transfer the manufacture of thermoplastic starch granulates to Grupa Azoty Compounding, where the production volume can be increased eight-fold," said Grzegorz Kądzielawski, Grupa Azoty Vice President.

➤ [https://grupazoty.com/en/](http://grupazoty.com/en/)

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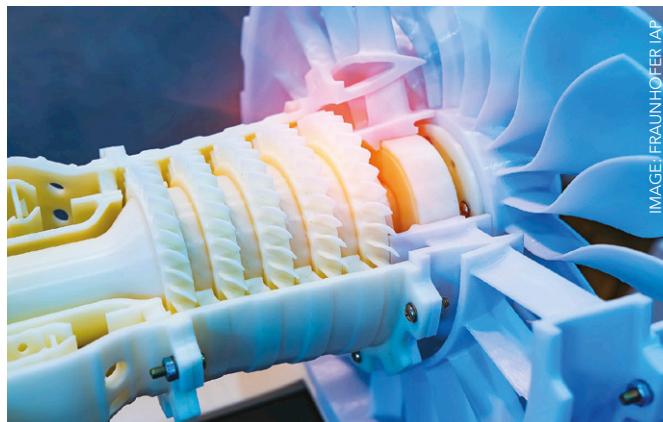
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# Fraunhofer/SKZ move ahead with anti-friction research

Following a successful first phase, the Fraunhofer Institute for Applied Polymer Research (IAP) and the Plastics Centre (SKZ), both based in Germany, are to continue their joint project on self-lubricating plastics using micro-encapsulated liquid lubricants for a further two years.

Materials have been developed using the micro-encapsulation technology in conventional twin screw compounding systems that achieve up to 85% less wear on plastic-steel pairings in friction and



wear tests, the institutes said.

"The challenging task was to mix the microcapsules with thermoplastics under high temperatures without damaging the

capsules. Only when friction occurs in the final component the capsules should break and release the lubricant. This allows the component to lubricate

**Left: Encapsulated lubricant technology has cut polymer wear by up to 85%**

itself automatically", said Moritz Grünewald, Researcher in the Materials Development Group at the SKZ Plastics Centre.

The aim for the next phase of the research, which is funded by the German government, is to optimise the technology for potential applications, with the key focus on improving mechanical and thermal properties.

➤ [www.iap.fraunhofer.de](http://www.iap.fraunhofer.de)  
➤ [www.skz.de](http://www.skz.de)

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# Injection moulding expo to debut in Detroit in 2022

AMI, publisher of *Compounding World*, and the Crain Global Polymer Group are launching a major American exhibition focused on the design and production of injection-moulded plastic parts and products. The first Injection Molding & Design Expo will take place on 16-17 March 2022 at the TCF Center (formerly the Cobo Center) in Detroit, Michigan, US. It is backed by Crain's *Plastics News* and AMI's *Injection World* magazines.

The exhibition and its three focused conference theatres will be free to attend, ensuring they will attract a large audience of relevant specifiers and buyers from throughout the supply chain. Exhibitors that have already booked booths at the event include Wittmann Battenfeld, Conair, Ampacet, Polykemi, Tederic, Mastip, Frigel, Moldex3D, Beaumont Technologies, Chroma Color, iD Additives and many more.

"We believe that America's large and diverse injection moulding market will really benefit from a focused expo that provides a cost-effective and time-efficient way to exchange information and build new business", said Brennan Lafferty, VP and Group Publisher for the Crain Global Polymer Group. "The Injection Molding & Design



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Expo will fulfill an important need in this market, similar to what the Fakuma show achieves so well in Europe."

Andy Beevers, AMI's Events and Magazines Director, added: "We are delighted to be partnering with Crain to launch this exciting new exhibition, which is a logical extension of AMI's successful expos focused on compounding, extrusion and recycling that take place in Cleveland, Ohio. The initial reaction to the new event has been extremely positive and working with Crain and *Plastics News* will enable us to deliver an exhibition that exceeds the expectations of exhibitors and visitors alike".

Headquartered in Detroit, Crain Communications is one of the largest privately held business media publishers in the world. Its

Global Polymer Group publishes *Plastics News*, which is the plastics industry's only weekly magazine and has 45,457 print subscribers. In addition, Crain publishes *Automotive News* and local business titles in Detroit, Cleveland, Chicago and New York.

AMI is a leading provider of market intelligence and events to the plastics industry. It publishes global digital magazines, including *Injection World* and *Compounding World*, and organises a group of expos focused on plastics compounding, recycling and extrusion that take place in Cleveland, Ohio. These attracted 261 exhibitors and 4,375 visitors from 42 countries when they last took place in 2019.

Visitors to the Injection Molding & Design Expo will

include injection moulders, OEMs, Tier Ones, brand owners, design consultancies and mould makers, all operating within a wide range of end-use markets. These include the automotive, packaging, electrical and electronic, medical, industrial and consumer sectors. They will have access to three free conference theatres - one focused on Molding The Future, one on Designing The Future, and a third featuring a series of practical training seminars.

Rita Andrews, AMI's Head of Exhibitions, explained the reasons for selecting the Detroit venue: "It's the ideal location for the Injection Molding & Design Expo because of the very high concentration of moulders in Michigan and neighbouring states, along with the importance of Detroit as a centre for automotive design and production, plus the proximity of the mould making cluster across the river in Windsor, Ontario".

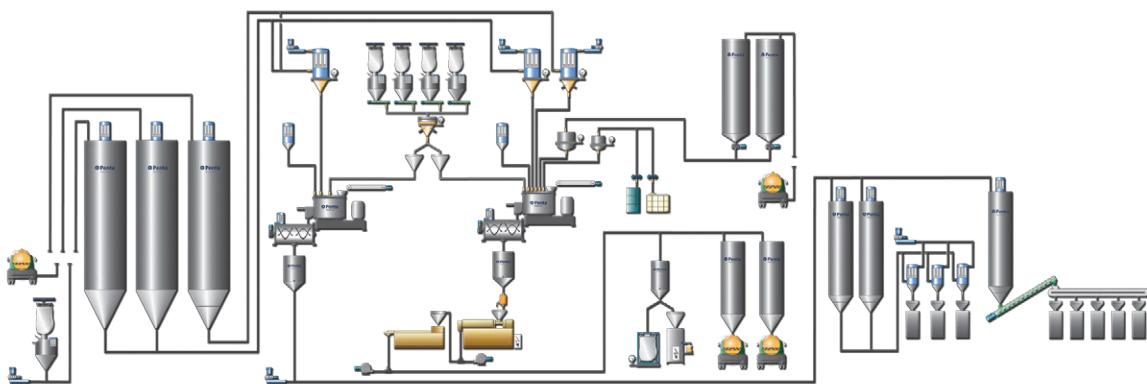
Exhibitors at the event will include suppliers of: injection moulding machinery; auxiliary equipment; automation systems; moulds; hot runners; plastic resin and compounds; additives, masterbatch and liquid colours; design and analysis software; and a wide range of industry services.

**For more information about exhibiting at the Injection Molding and Design Expo 2022, or to register your interest in a free ticket, please visit: [www.injectionmoldingexpo.com](http://www.injectionmoldingexpo.com)**

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**Sustainability and renewability are not, perhaps, terms immediately associated with mineral fillers but they both feature among the claims for some of the latest introductions. Peter Mapleston learns more**

# Mineral fillers adopt a new green image

Producers of mineral fillers are developing some innovative additives that plastics compounders can exploit to improve the performance, cost-effectiveness, and – possibly surprisingly – sustainability of their products. Several suppliers even use the word “renewable” when describing their offerings. This article delves into some of these new ‘green’ developments, as well as looking at the latest innovations in established mineral fillers.

Greenland-based **Hudson Greenland** has developed a new multi-functional additive from anorthosite, which has only recently begun to be mined. Branded as Greenspar, this white mineral is a calcium aluminium silicate from a high-purity deposit in White Mountain, Greenland. Anorthosite can be found in other locations in Europe and North America, but the Greenland product is said to have the highest quality and commercial potential. Hudson Greenland is targeting anti-block applications in PE film and is optimistic in finding

uses in other areas as well, predominantly in non-polar polymers. It says it has several customers currently sampling material.

In PE film applications, Greenspar matches the refractive index of the polymer so it provides very good clarity as well as highly efficient anti-blocking performance. “Greenspar has differentiated properties as a low surface-area silicate mineral. Our products can be ground finely and silane treated for functionality in different systems including engineering thermoplastics. Greenspar provides outstanding dimensional stability and reduces shrinkage and warp,” says Hudson Greenland CEO Brian Hanrahan.

Hanrahan has plenty of experience in minerals for the plastics industry. He joined Hudson Greenland in April of this year but his career includes a 15 year spell at Imerys, where he rose to General Manager of the company’s US Performance Additives operation before leaving to set up

**Main image:**  
**Oolitic  
ragonite is one  
of a number of  
new mineral  
sources that  
promise fillers  
that deliver  
improved  
compound  
performance  
while address-  
ing sustainabil-  
ity concerns**

**Right: Greenspar products, sourced from Greenland, are available as a dust-free 95% filled masterbatch in various resin systems**

Celestial Materials, which toll-produces various types of masterbatches containing up to 95% filler loadings using a proprietary low-shear technology.

"Another unique aspect of Greenspar is its availability as both a powder and as a 95% filled masterbatch in polyolefins, polyamides, PVC, and other polymers," he says. "The masterbatch [intended for use by compounding companies] will allow for handling and feeding of ultra-fine powders in a format that looks and feels like resin. They are designed for high throughput and high dispersion. They solve a critical need in the market to ensure a dust-free environment while maximising throughput and properties without the need for any powder handling systems."

Hanrahan views Greenspar as an alternative to other silicate minerals, most notably kaolin, but also as a replacement for wollastonite and mica, even though aspect ratios are sometimes different. He highlights its ability to reduce warpage in products, although points out it has little reinforcement effect. "I see glass/Greenspar hybrids as a great opportunity," he says.

Hanrahan says Greenspar requires less processing than alternatives (no calcination is required for example) and believes the company will be able to supply to compounders around the world – and certainly to those in the Northern Hemisphere – at competitive cost. "Our location is right on a deep-water fjord allowing for efficient transportation to North America, Europe, and – especially when the Northwest Passage is open - Asia," he says. The mineral will be shipped out of Greenland to milling and surface treatment operations in strategic locations. The company is currently in advanced planning for operations in the US and in Europe, with possible capacities of around 30,000 tonnes/yr. It already has a warehouse in the US.

The company also claims that its Greenspar products are very environmentally friendly. "Our deposit is high-purity, fully exposed at the surface,

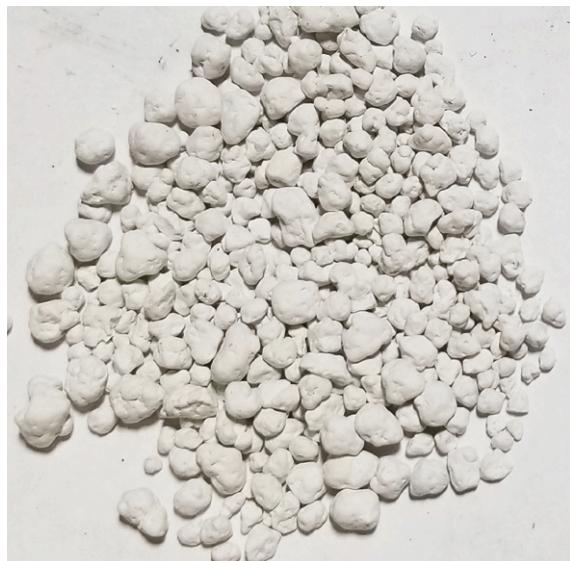


IMAGE: HUDSON GREENLAND

and contains no entrained water. This means our products are made without extensive stripping or thermal processing and require no wet processing to purify."

### Marine opportunity

In contrast, calcium carbonate could be considered to be at the other end of the supply spectrum; it has been used in plastics for decades and is mined all around the world. Even so, new sources are becoming available, some of them with interesting USPs. **Calcean Minerals & Materials**, which is headquartered in Gadsden, Alabama, claims to offer a renewable calcium carbonate. CEO Anthony Myers says the company has developed unique processes to create high-performance products that can be applied in plastics as both a 'green' economic filler and a product enhancer. It has branded the materials as BioCal and OceanCal.

Calcean is taking advantage of the vast underwater deposits of aragonite sand – oolitic aragonite – found on the Great Bahamas Bank, which is located around 80 km from the US mainland. First investigated in the 1950s, oolitic aragonite was found to have unique physical and chemical properties that proved attractive as a raw material in many industries, from agriculture to construction materials (oolitic means egg-shaped).

Oolitic aragonite is a biogenic product, which means it is produced by living micro-organisms, and deposits are being constantly replenished. It forms naturally during seasonal bi-annual events called 'whitings.' During these, blooms of phytoplankton move over the shallow banks of The Bahamas, pulling carbon dioxide from the atmosphere and binding it to calcium in the water to ultimately precipitate out oolitic aragonite.

Reserves on the Bahamas banks are estimated

**Table 1: Key comparative data for calcite/limestone and oolitic aragonite mineral fillers**

Test	Calcite/Limestone	Oolitic Aragonite
Specific Gravity	2.6 - 2.8	2.8 - 3.0
Mohs Hardness	3	3.5 - 4.0
Crystal Structure	Trigonal	Orthorhombic
Surface Area	0.55 m <sup>2</sup> /g	1.82 m <sup>2</sup> /g
Zeta Potential	-1.01mV to 11.55mV	-33.85mV to -6.65mV
Crystallinity	Low	High
Microporosity	Low	Very High

**Source: Calcean Minerals & Materials**



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**Right and below:**  
**Harvesting of oolitic aragonite takes place in shallow waters in the Great Bahamas Bank**



to amount to between 50bn and 100bn tonnes, and the estimated annual renewal rate is 14m to 120m tonnes each year. Carbon dating indicates that much of the mineral found in the area is recently formed, with the newest having been created in the past three to five years.

Calcean obtains oolitic aragonite from an affiliate, Sandy Cay Development, which owns a long term lease on an area of almost 1,300km<sup>2</sup>. The company 'harvests' the aragonite sand from shallow waters around 4m deep, where very little marine life is said to exist. The process involves mechanically scooping up the top 60cm of the sand from the sea floor. It then mills the mineral, producing grades in several sizes and with several coatings selected for the final application.

Calcean says it will sell this refined oolitic aragonite to compounders and others for their own formulations and utilisation. "It took us six years to figure out how to properly handle and mill a mineral that is hydrophilic, highly electron charged, harder than calcite and has a crystalline morphology, yet is calcium carbonate," says Myers.

Alyson Myers, Calcean's R&D Director, points out a number of important aspects in the crystallinity of

IMAGES: CALCEAN MINERALS & MATERIALS



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# Improved co-operation is the key to unlocking potential of fillers

Many smaller producers of minerals would be happy to work with plastics compounders on new uses for their materials - if they could only find the right door to knock on. That is the view of Ted Dickson, who runs the TAK Industrial Mineral Consultancy, and who spoke at the AMI Functional Fillers Virtual Summit.

He listed no fewer than 26 minerals mined commercially around the world, but said that, for some, use in polymers is limited. "The supplier has to get it right on the grades, but they don't always know what compounders want," he says. "It's not always just

about fine grinding. The solution may involve a mix of coarse and fine particles, or possibly blends of different minerals: kaolin and CaCO<sub>3</sub> mixes may work, for example."

What many mineral producers lack is insight into the compounders' specific requirements. "Smaller mineral companies would be happy for plastics companies to come to them to discuss new applications, especially if they reckon they can get a premium product without having to invest heavily in equipment and other resources to get there. Adding a bit of extra processing is not necessarily

that difficult. Small tweaks may be all that is needed."

Dickson sees considerable untapped potential in engineering minerals due to lack of communication. "There are so many smaller compounders and masterbatchers, and minerals companies often don't have large sales and marketing forces," he says. A good place to start for any compounder looking to connect could be a trade association web site like the Industrial Mineral Associations in Europe and North America.

➤ [www.ima-europe.eu](http://www.ima-europe.eu)

➤ [www.ima-na.org](http://www.ima-na.org)

oolitic aragonite. She says that while most calcium carbonates from overground mines look like building blocks (with a rhombohedral crystalline morphology) under a microscope, oolitic aragonite looks more like interlaced needles (orthorhombic). An advantage of this is that it has a higher surface area combined with a high electron charge (see Table 1). "These important differences translate to a number of benefits for a variety of industries, including plastics," she says.

Oolitic aragonite is claimed to enhance physical properties such as stiffness, impact, and heat distortion temperatures. Studies are also being carried out to explore its effectiveness as a nucleating agent. Pat Lahmann, who heads up **Nant Bioplastics**, a compounding and moulding company affiliated with Calcean, says it is possible to fill compounds with higher loadings of oolitic aragonite than regular calcium carbonate. Some compounds being beta tested contain more than 60% filler.

Nant Bioplastics, which was founded in 2019, produces compounds containing oolitic aragonite for third parties and also for its own moulding operation (this concentrates on products for the single-service food industry - straws, cutlery, thermo-formed plates and the like - based on bioplastics such as PLA). At present it has a compounding capacity of around 2,700 tonnes/yr. Lahmann says it is currently getting ready to build new facilities on the east coast and possibly also the west coast of the US. "We are looking to expand milling and bioplastics activities significantly," he says.

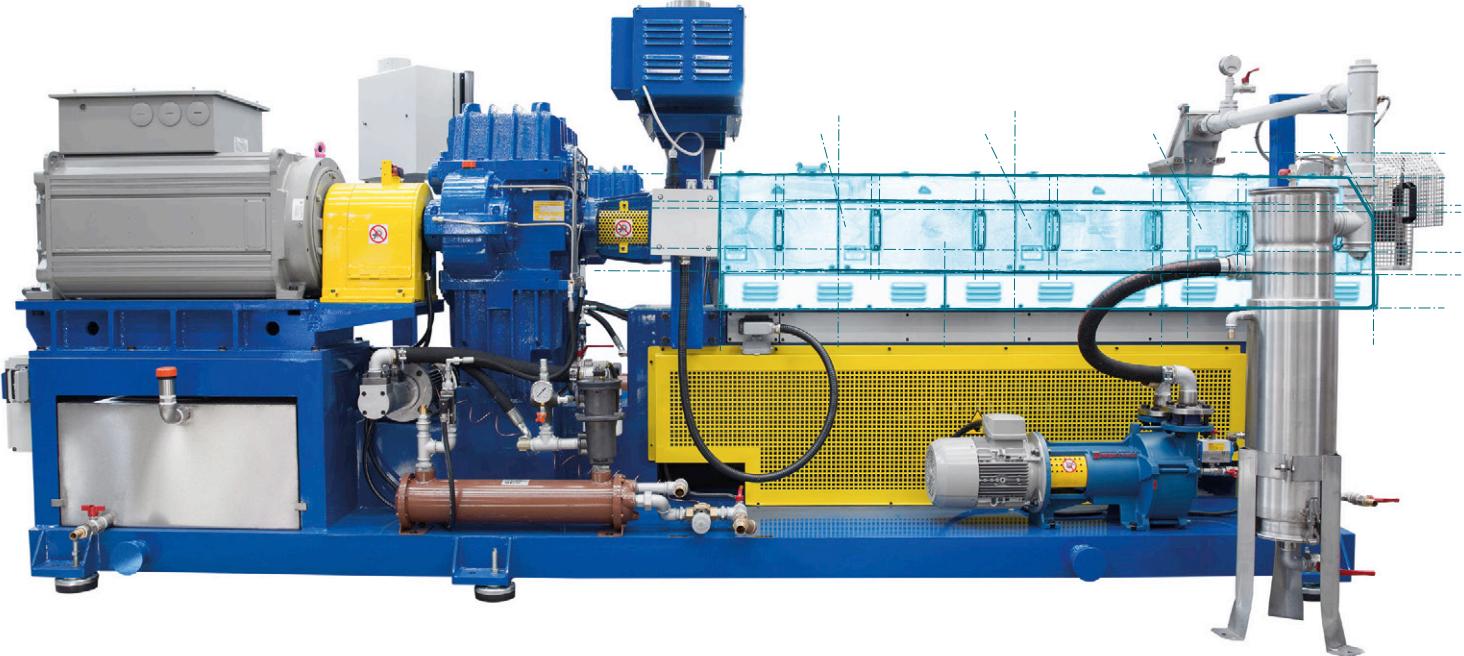
## Diversified move

Other companies understood to be involved in either mining or milling oolitic aragonite include mineral suppliers Asbury Carbons and Kish Company (through its affiliate Arctic Minerals).

**Asbury Carbons** calls its product CarboRay, which it offers with particle sizes from 750 microns and finer. The company is probably best known to compounders as a world leading producer of graphite nanoplatelets. Explaining the move into oolitic aragonite, Jeffrey Julian, Director of Marketing and Product Management, says: "There is value in diversification, so we strive to grow and diversify our engineered product offerings...Asbury's CarboRay products offer a crush strength that is twelve times that of conventional calcium carbonate, so its use would be for two purposes: for strength and as a filling agent. Additionally, many eco-conscious customers will find our CarboRay products quite appealing as a biogenic alternative to standard calcium carbonate fillers."

Julian says CarboRay products are expected to find a good fit in some of the company's top markets globally. "This product line is new to us, so we're still in the process of growing it both within the US and internationally."

Asbury obtains its raw material from Pisa Carolina, which was founded in 2018 in Fairfield, North Carolina, US. It supplies oolitic sand acquired through a licensed Bahamian supplier, Tycoon Management Ltd (TML), which has access to several deposits. Pisa Carolina COO Jayson Meyers



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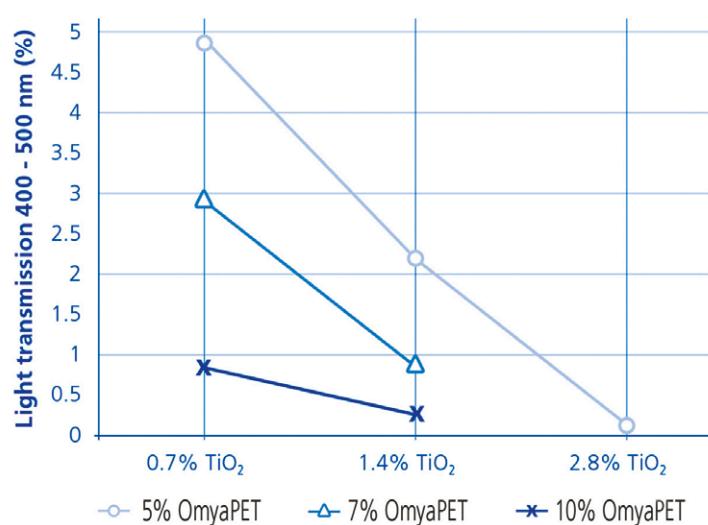
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**Figure 1: Light transmission rate in range 400 - 500 nm for a 1 litre UHT milk bottle with side wall thickness of 380-420 microns with various OmyaPET addition levels**

Source: Omya

has a long history in the oolitic aragonite sector. "Pisa Carolina is the largest distributor of aragonite and other Bahamian calcification sands," he says.

Asbury took a 47% share in Pisa Carolina in 2019. "Our interest in aragonite pre-dates the establishment of the joint venture," says Julian. "We carefully vetted potential partners before selecting Pisa Carolina as the right partner."

Independent consultant Chris DeArmitt, who works with **Arctic Minerals**, says its product is called AquaFlex and that samples are available on request. "Because it's calcium carbonate, people are comfortable with it," he says. "There's been a lot of interest."

Oolitic aragonite was first covered in *Compounding World* back in 2014. Then the material was being supplied by a company called US Aragonite Enterprises, under the name Oshenite. That company is no longer active.

### Renewable claims

One of the attractive claims for oolitic aragonite is that it is derived from a renewable source. Coincidence or not, the Calcium Carbonate Association - Europe (CCA Europe), a sub group of the **Industrial Minerals Association Europe**, issued a **statement** last November headlined "Calcium Carbonate is a renewable material". It claimed that CaCO<sub>3</sub> "is continuously replenished by means of natural cycles in rivers, lakes and oceans or formed as minerals in the form of shells, skeletons, stalactites and stalagmites."

The association went on to say that "while a substantial increase of the use of calcium carbon-

ate has been observed over the last decades, there is no scarcity of calcium carbonate deposits and there are proven reserves/resources for many centuries...the annual replenishment rate (according to the ISO 14021 definition) exceeds the consumption rate...In addition, the footprint of extracting and processing calcium carbonate (Ground Calcium Carbonate and Precipitated Calcium Carbonate) is low as shown by life cycle inventory data compiled by CCA-Europe."

Omya International was the initiating company behind the CCA-Europe renewability statement. "In the Bahamas, the [renewal] process can be seen at a local scale. Our approach is that the relevant way to assess renewability is the global scale, on both natural generation and industrial consumption," says Ernest Barcelo, the company's Vice President Sustainability based in Oftringen, Switzerland. "When special cases are identified, they must receive the positive credit, like oolitic aragonite on the Bahamas [but it will] not be the solution to a global problem."

Barcelo points out that truck transport can often cause more CO<sub>2</sub> emissions than mining does so locality can be important. "One key advantage of industrial minerals, CaCO<sub>3</sub> included, is that they are very abundant in different places on our planet," he says.

### Substituting TiO<sub>2</sub>

In May, **Omya** launched OmyaPET, a family of functionalised calcium carbonates intended for use as a cost-effective opacifier for use in white opaque PET bottles or white opaque BOPET film. "It ensures a lower environmental footprint in, for example, UHT milk bottles," the company says. "OmyaPET improves the production costs for bottles without compromising on mechanical and optical properties."

According to Karsten Schulz, Business Development Director Polymers, OmyaPET is made from Bureau Veritas-verified 100% recycled feedstock that would otherwise have been disposed of. "It is not a post-consumer recycled material and therefore meets the requirements for food contact use. To achieve OmyaPET functionality, the product surface is modified to meet the high requirements of PET," he adds.

The additive functions in two ways, he explains. "Standard calcium carbonate causes too much PET degradation in extrusion, with the result that the PET changes colour and the properties deteriorate. With OmyaPET, PET remains much more stable. In applications such as BOPET and stretch blow moulding, where the PET is stretched, OmyaPET

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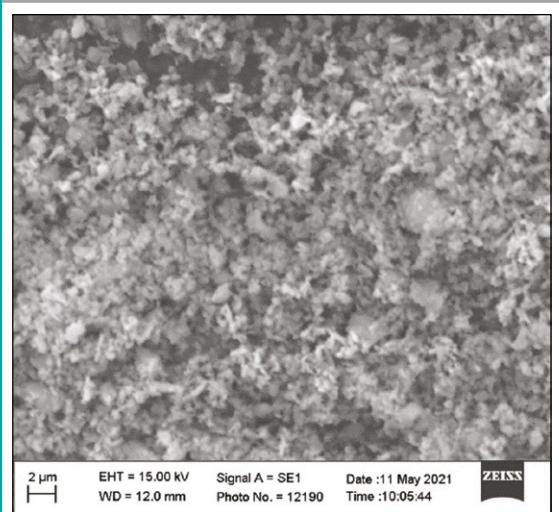


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**Calcinated kaolin provides enhanced opacifying performance and can partly replace TiO<sub>2</sub>**

**Image:** Kärntner Montanindustrie



creates a laminar structure that causes high opacity."

Schulz says while high opacity can be achieved with OmyaPET (Figure 1), when a 100% light barrier is required, such as in UHT milk bottles, some TiO<sub>2</sub> is needed. "In single-layer PET milk bottles, the use of 10% TiO<sub>2</sub> is common and Omya has shown that 70% of the TiO<sub>2</sub> can be replaced by OmyaPET."

The OmyaPET additive also reduces the amount of energy needed to heat PET bottle preforms prior to blowing into bottles. This is because preforms are heated with IR heaters and TiO<sub>2</sub> reflects a lot of the radiation. This is not the case with OmyaPET.

Omya says the OmyaPET products are being introduced first in Europe with other regions to follow later.

### Optimised for white

Spanish CaCO<sub>3</sub> supplier **Reverté** is also offering a product to complement TiO<sub>2</sub> with the introduction of a new grade for production of white masterbatch. "The first thing that comes to mind when we want to maximise productivity and filler levels in producing [granules] is to adjust the process parameters (rpm of the spindle / rotor, temperature profile, spindle configuration, etc.)," says the

company. "However, the contribution of calcium carbonate in terms of productivity and [granule] filler level should not be underestimated, as it is a unique opportunity to delay the need for major investment in both new machinery and modifications of production processes."

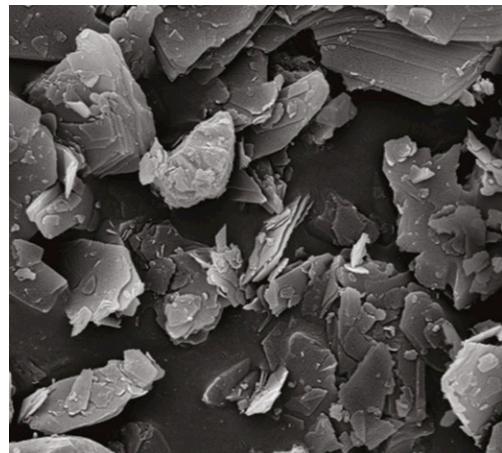
Calcipore 80T AL was developed for this reason. The company says it is specifically designed to offer maximum productivity and the highest level of filler in the masterbatch granule. One key benefit is the ability to greatly reduce levels of TiO<sub>2</sub> in white masterbatch.

The company says it has demonstrated improved productivity using twin-screw extruders and continuous mixers compared with other calcium carbonates of the same average particle size (D50 = 1.1 micron). "In continuous mixers – for example, Farrell CP 2500 – it has been found to eliminate undissolved particles, as shown by the low pressure values in the filter test," the company says.

Austria's **Kärntner Montanindustrie** (KMI) specialises in delaminating and micronising minerals with special particle shapes. "Sophisticated grinding technology maintains the platelets and the needles even at finest particle sizes and provides products with high aspect ratio (HAR)," says Veronika Mayer, Application Management & Quality Management.

The latest developments at the company are mainly connected with trends such as the circular economy and sustainability, she says. One example she highlights is the potential for its Miopac calcined kaolin to be used as an extender for TiO<sub>2</sub>, which she says has certain health and safety issues associated with it. Calcination of kaolin develops opacifying properties by removing hydroxy groups and building up aggregates of calcinated particles. "Complete substitution [of TiO<sub>2</sub>] still seems to be the Holy Grail, but at least partial replacement is possible," she says. "Miopac provides excellent opacity and high whiteness."

**Right:** This SEM image of aluminium silicate shows its high aspect ratio structure



Trinity Performance Materials is marketing its Altibright as a talc alternative

IMAGES: TRINITY PERFORMANCE MATERIALS

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The company also offers a way of improving barrier in monolayer food packaging. "Latest tests in polyolefins and biopolymers show that with KMI's ultra-fine mica types it is possible to reduce water damp and oxygen permeability significantly, even by low filler addition," she says. "Again, the trick is the combination of suitable mineral raw material with a special grinding technology to achieve finest products which are still flaky. The platelets provide the barrier, and the fineness supports the dispersion in the compound."

### Talc alternatives

Not all minerals are as geographically widespread as  $\text{CaCO}_3$  and kaolin. Calcined Neuburg siliceous earth, for example, is only found near Neuburg in Germany and **Hoffmann Mineral** is the only company mining it. But its properties make it interesting to plastics companies working in several diverse areas. During the Mineral Fillers Virtual Summit held in March by *Compounding World* publisher AMI, Félix Vicente Mondéjar, Area Sales Manager with the company, discussed applications for the mineral, which include use as an alternative to premium talc in PP (where it can provide better

impact strength and scratch resistance); as an impact modifier and warpage reducer in PA; as an anti-block agent in PET film; and as an IR absorber in LDPE greenhouse films.

Use of mineral fillers to improve various properties in bioplastics also came up in a presentation from **Imerys** at the same AMI summit. In this case, the mineral in question was talc. Imerys offers talcs branded Steamic and HAR. Anaïs Berjeaud, Technical Support Manager Polymers EMEA, says they provide significant improvements in flexural modulus of PLA, for example, and increase melt strength. Steamic talc used as a nucleating agent can significantly reduce crystallisation times too. On top of this, because of its high aspect ratio, HAR talc can double barrier to oxygen and moisture in PLA film at a 20% loading level.

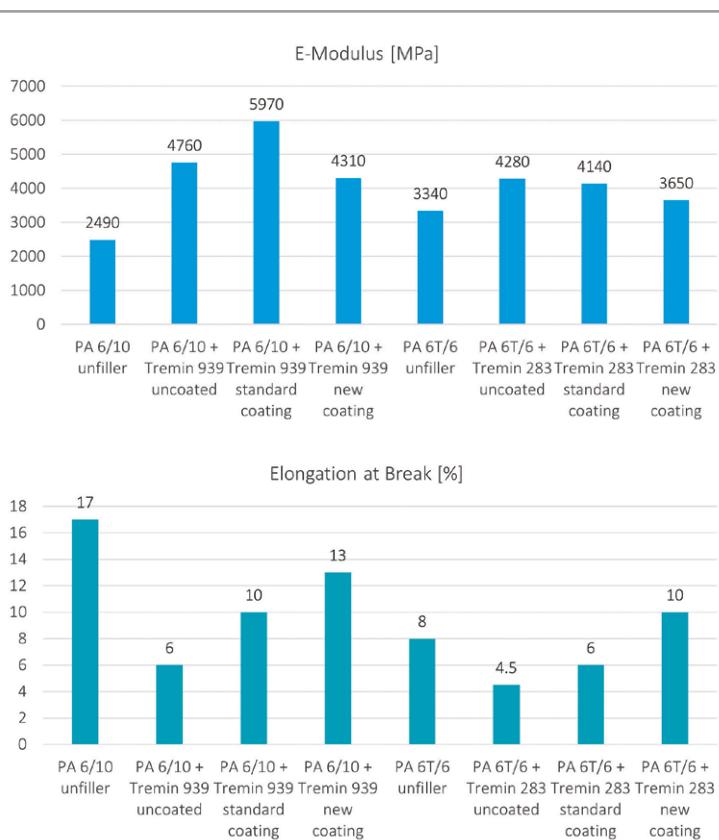
Canada's **Trinity Resources**, which is in the process of rebranding to Trinity Performance Minerals, is introducing its Altilbright aluminium silicate-based high performance reinforcement additives as a talc replacement for polyolefin compounds. It is mined and produced in Newfoundland, and is currently available for market applications in North America and Europe. Company president John Hurley says it provides extremely high brightness and high aspect ratio properties.

Key properties cited by Hurley include high wet brightness, zero asbestos-form mineralogy, extremely low iron oxide content (less than 0.15%), and undetectable levels of carbonate. "Performance results at 20% and 38% reinforcement levels either matched or exceeded several incumbent talcs when comparing colour, impact, tensile and flexural test results," he says. Grades are available in 2, 4 and 6 median micron sizes.

Trinity has reserves in excess of 35m tonnes and Hurley says the company has developed a "zero waste" mining process that provides sustainable supply and price stability. "Combined with the implementation of a robust Environmental Social Governance Platform, Trinity Performance is guiding its operations to a net zero Carbon footprint by 2023," he says.

### Surface modification

At Quarzwerke Group subsidiary **HPF The Mineral Engineers**, Péter Sebő, Head of Marketing & Market Development, highlights the potential for development of functional filler systems for polyamides. "Some interesting new developments showed the possibilities of the replacement of high performance plastics (for example PPS) with some HT-PA grades," he says. "For this reason, we have made recently a quite extensive investigation in



**Figure 2: Data showing the effect of various filler treatments on E-modulus and elongation at break in a number of different high performance PA compounds**

Source: HPF The Mineral Engineers

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**Right: Evonik's Tegopren 6875 coating effectively that high-density TiO<sub>2</sub> will float on water**

terms of different high performance fillers for high temperature polyamide grades, such as PA610, PA6T/6 and PA9T, with the goal to modify the properties."

A key element in the project is the application of appropriate surface treatments. "Polymers usually have low surface tensions and low polarity. Water and minerals have high surface tensions and high polarity. If they are mixed together, the interfacial energy is high, and the phases tend to separate. Modifications of minerals by, for example, silanes or other organic molecules have the task of lowering this interfacial tension and making the phases compatible," he explains.

Emphasising the company's extensive experience in surface treatments on minerals, Sebö says it has tested various fillers, including kaolin, mica, and wollastonite, with different newly-developed temperature-resistant surface treatments suitable for the higher processing and working temperatures of HT-PAs. "The development showed us very interesting and promising results, for example, in the mechanical properties, especially in terms of elongation at break," he says.

Very good results in terms of elongation at break have been obtained with HPF's Tremin 939 (long needle Wollastonite) in PA 610 and with Tremin 283 (short needle Wollastonite) in PA6T/6 the E-modulus is slightly reduced compared to the specimen with the standard coating.

"The technology can be transferred to other thermoplastic materials, but at processing temperatures over 330°C, which was the case for PA9T, there is no longer any effect visible from the surface coating," says Sebö. Tests are still ongoing with other thermoplastic materials with much lower processing temperatures such as PA6 and PP, with the goal of improving processing and impact strength.

### Improved dispersion

Dispersion is another challenge in compounding of mineral fillers and this can lead to agglomerates in the polymer matrix, which can result in high stiffness and low toughness of the final products. For some time, **Evonik** has been developing additives to improve the dispersion of fillers (organic as well as inorganic) in polymeric matrices. These additives, branded Tegomer and Tegopren, are based on organo-modified siloxane (OMS) chemistry.

Evonik says the OMS chemistry allows higher filler loadings in combination with better melt flow and reduced abrasion in highly filled inorganic compounds. Tegopren 6875 was one of the first



IMAGE: EVONIK

surface treatment additives based on the OMS non-coupling technology. More recently, Evonik has launched Tegopren 6879, a bifunctional modified OMS containing a minor amount of silyl functionalities.

Similar to silane chemistry, the ethoxy groups can react with the filler but they are claimed to generate almost no VOCs. "This surface treatment creates super-hydrophobic filler surfaces," says an Evonik spokesperson. "It is not only suitable for oxides but interacts with carbonates and sulphates as well. On top of that, its functionality allows interaction with nitrogen/phosphorous-based flame retardants and organic pigments."

Evonik surface treatments have FDA and EC food contact regulation compliance and are suitable for use by filler manufacturers as well compounders. Compounders can apply them during the compounding process or using an external mixer, which will typically require lower concentrations. Filler manufacturers can use Evonik's OMS emulsions, Tegopren 6875-45 and Tegopren 6879-50, as part of a water-based inline surface treatment.

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**While glass fibre has traditionally been the reinforcement of choice for thermoplastic compounders, a number of alternative material and format options are emerging.**

**Mark Holmes learns more**

# Reinforcing options for polymer compounds

Fibre-based reinforcing materials are widely used in plastics compounds, providing an effective and affordable means of modifying performance properties such as strength and stiffness. Glass continues to be the most important and widely used fibre for polymer reinforcement but other fibres are also used, with carbon fibre increasingly being employed in lightweight thermoplastic compounds as costs fall and availability of recycled grades improves. While most compounds use short or long fibre reinforcements, non-fibre options – such as solid or hollow glass spheres – are also emerging.

Transportation continues to dominate the long fibre reinforced thermoplastics (LFT) market, according to **Avient Corporation**, which purchased long fibre reinforcement technology specialist Plasticomp in 2018. "Historically, automotive has relied heavily on long glass fibre reinforced polypropylene in its quest to lighten vehicles and improve fuel economy, in addition to lowering emissions to meet regulatory requirements," says Eric Wollan, General Manager, Long Fiber Technologies.

"Widespread use of these materials will continue

and increase as build numbers grow. Most automotive parts that can benefit from metal-to-composite conversion using long glass fibre polypropylene have already been converted. Remaining metal parts that will benefit from conversion require higher performing materials, which bodes well for long glass fibre reinforced engineering resins, as well as the adoption of carbon fibre reinforced materials when they can economically be justified," he says.

"Electrification is not going to end automotive's mass reduction quest as lighter weight vehicles have greater range. The migration to electric vehicles is actually increasing performance requirements," Wollan adds.

"Metal replacement has always been the bread-and-butter application segment for long fibre compounds and that will continue to be the case in transportation and other markets where the increasing desire for applications to be more portable is driving material change away from metals. All major OEMs around the globe also have sustainability initiatives in place and these have designers and engineers increasingly inquiring

**Main image:**  
**Long fibre reinforced thermoplastics (LFT) compounds provide good metal replacement opportunities in sectors such as automotive, whatever powertrain technologies are used**

IMAGE: SHUTTERSTOCK



**Above:  
Automotive  
lightweighting  
has been a  
major applica-  
tion area for  
LFTs and that  
remains the  
case with new  
EV powertrains**

about materials that either contain recycled or renewable content."

There are several key considerations when selecting a reinforced thermoplastic system for any application, according to Wollan, and with long fibre materials it is all about the structural requirements. Engineers really need to have a good understanding of what loads will be experienced and what the typical usage environments will be to avoid spending a lot of money on an over specified material. However, combining known specifications in tandem with the current line-up of software performance analysis tools means truly structural parts can be designed using long fibre reinforced thermoplastics, he says.

### Sustainability aims

In terms of development, finding cost-effective materials that will meet the growing demand for sustainability are at the top of the list, according to Wollan. "The pultrusion process used to manufacture long fibre composites has a narrow processing window so locating streams of post-consumer recycled polymers with a consistent melt flow and free of particulate contaminates is imperative. The expectation is always that sustainable materials have to perform the same and be just as, or more, cost effective to implement. Most markets show little willingness to accept an upcharge to obtain sustainability," he says.

"Most of the development in long fibre is around incremental improvements to meet the specific performance requirements of individual applications rather than revolutionary innovation. Unless someone invents a new type of fibre or a new polymer system, everyone is working with the same raw material feed stocks," Wollan says.

Although LFTs are most established in automotive, they are also applied in other industrial applications. Avient recently worked with US-based Bettcher Industries, a leading manufacturer of food processing equipment, to convert the support yoke of its Quantum motor from aluminium to Complēt LFT. The companies re-engineered the yoke, which

supports an 11.3kg (23lb) motor that powers a variety of meat trimming tools. The aim was to deliver a lightweight polymeric replacement that would lower part cost yet retain reliable performance in the demanding end-use environment.

Avient's Complēt long glass fibre reinforced PA compound resulted in a part 40% lighter than the cast aluminium predecessor while bringing the added benefit of injection moulding for faster, single-step production. Avient carried out virtual prototyping on the re-designed yoke while Bettcher conducted testing on a physical prototype to simulate half a million use cycles. Backed by these results, a pre-coloured LFT was formulated that matched Bettcher's existing product palette, eliminating secondary painting and finishing to provide further cost savings.

### Market disruptions

Wollan says market disruptions also play a part in stimulating innovation. "The two recent major disruptions in the nylon supply chain have many looking for alternatives that are less volatile but provide similar performance at a comparable price point. Successful industries count on stability."

Avient has introduced two new material lines intended to provide a solution to these supply constraints. Both are based on polyketone (PK) and are formulated to deliver comparable performance and lower production-related carbon dioxide levels than PA66 and PA6 and acetal (POM). The Edgetek PKE and LubriOne PKE series formulations combine good chemical and hydrolysis resistance to meet challenges of applications in chemical, fuel contact, or high-moisture environments. The new materials also offer sustainability benefits over the product lifecycle as the company claims the production of the PK base resin emits up to 61%



IMAGE: AVIENT

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IMAGE: JOHNS MANVILLE

**Above: Johns Manville has added a glass fibre recycling unit at its plant at Trnava in Slovakia**

less carbon dioxide than PA and POM.

The Edgetek PKE series includes short glass-reinforced formulations with 10-40% short glass fibre. These materials provide good chemical resistance, low moisture uptake, good dimensional stability, and high impact and wear resistance. They are targeted at applications such as pipes and tubing, electrical battery components, and under-the-hood fuel or chemical contact components. The LubriOne PKE series are internally-lubricated grades that combine chemical resistance with improved wear and low coefficient of friction. Target applications include conveyor belts, gears, switches, pumps, and spigots.

### Glass developments

Chinese company **Jushi** recently developed an ultra-high modulus glass fibre, providing a modulus of 100GPa against the 70-75Gpa for typical E-glass. The company says the E9 glass fibre is produced using an advanced production technology that has significantly improved the cost-performance ratio. It says it expects E9 glass fibre to provide new solutions for high-end applications in areas such as wind power, infrastructure, transportation, aviation and aerospace, as well as fibre optic cable reinforcement, temperature resistant materials and sports equipment.

Meanwhile, global glass fibre maker **Johns Manville** has set up a thermal recycling unit for waste glass fibres at its Engineered Products plant in Trnava, Slovakia. "The primary goal of this investment is to achieve a tangible positive environmental impact by drastically reducing the landfilling of glass fibre waste," says Elena Hrivikova, Manager for Environment, Health and Safety - Europe/Asia at the company. "This project is part of our response to the European Commission's zero waste programme and our overall target for sustainable management of the planet's natural resources."

The Trnava unit has a projected hourly recycling

capacity of more than three tonnes and comprises a warehousing area, feeding and transportation equipment, shredder, burning chamber and milling. After processing, the recycled glass powder is said to be free of organic particles and is reintroduced as a raw material into the glass production process on-site. The company estimates the project will keep more than ten thousand tonnes of waste out of landfill each year.

"We have invested nearly €10m into state-of-the-art technology and made sure the recycling capacity will allow further glass fibre production capacity growth in Trnava," says Martin Nywlt, Director of Global Operations for JM's Engineered Products business.

### Hollow spheres

#### China's Sinosteel Maanshan New Material

**Technology** has developed a line of hollow glass microspheres for use as low-density additives for compounds that require higher mechanical performance for application in marine, aerospace and automotive structural components.

The company's T40 grade borosilicate hollow glass microspheres, for example, are described as lightweight and low thermal conductivity reinforcing additives with a high compressive strength. They are said to improve tensile strength, impact strength and hardness in PA6 compounds and to improve dimensional stability and heat resistance in rigid PVC. Used in ABS compounds they can improve dimensional stability and reduce shrinkage. Applications include bearings, camera components, pipes, TV cabinets, and automotive parts.

Hollow glass microspheres have to be used with some care. The company says they can be damaged – crushed – by the high-shear forces and pressures generated in processes such as compounding and injection moulding. Crush strength is linked to bulk density: glass spheres with a bulk density of 0.125 g/ml have a crush strength of 250 psi (1.8 MPa); spheres with a density of 0.60 g/ml around 18,000 psi (124 MPa). Sinosteel says its hollow glass microspheres range in diameter from 11-18 microns and provide crush strengths of 8,000-10,000 psi (55-69 MPa) depending on the grade.

According to the company, its hollow microspheres can be successfully compounded on twin screw or kneader extruders. It recommends downstream feeding so the microspheres are introduced into the molten polymer and says screws should be designed to minimise shear – kneading blocks are not recommended. Chopped fibre feeders are generally suitable for microsphere addition, it says, with auger types providing the

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most consistent results. Other recommendations include the use of vacuum venting and underwater pelletising equipment.

### Alternative fibres

Last year **Mafic** commenced operation at what it claims is the world's largest basalt fibre production facility at Shelby in North Carolina in the US. The facility, the first in North America, represents a \$20m investment and is able to produce 6,000 tonnes of basalt fibre annually – equivalent to near 30% of current global basalt fibre output.

Basalt fibre is a drawn continuous mineral fibre. It is produced from mined basalt rock that is first washed and then placed into a furnace at a temperature of approximately 1,500°C to create a melt that is extruded through a metal bushing to form individual filaments. On leaving the bushing, the fibre filament hardens and a sizing is applied to improve its properties before winding with other finished fibres to form a strand.



IMAGE: MAFIC

According to Mafic, basalt fibre is well suited for use as a reinforcing additive in polymer composites for applications such as automotive due to its lightweighting potential and low cost. It is available

as a chopped fibre in lengths from 3 to 96mm and can be supplied with sizings suitable for use with PE, PP and PA. The company also offers a pre-compounded PP-LFT compound.

Aramid fibres offer a low density/high tensile strength ratio that makes them suitable for a variety of polymer reinforcement applications. **Teijin**

**Aramid** has been working with a number of partners for some time in a sustainability-focused pilot programme to develop its high-performance Twaron aramid fibres from renewable, bio-based materials. The pilot has shown it is possible to reduce the environmental impact of the production process without altering

**Left: Mafic has started production of basalt fibre at a new production unit in the US**

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the material properties of the resulting Twaron aramid yarn (the company produces its Twaron ultra-high-strength para-aramid fibres at a facility in the Netherlands).

### Carbon developments

The latest development from **Toray Industries** is a high tensile modulus carbon fibre that it plans to commercialise over the next few years as a fibre and as a thermoplastic pellet for injection moulding.

Toray's product line currently includes the Torayca T series of high-strength carbon fibres for pressure vessel, aerospace, automotive and other industrial applications and Torayca T1100G carbon fibre, which offers a tensile strength of 7.0GPa and a tensile modulus of elasticity of 320GPa. In 2018 it commercialised Torayca M40X to expand the potential of carbon fibre for high-end sports equipment and aerospace structural. This is said to use nano-level fibre structure control to balance a tensile strength of 5.7GPa with a tensile modulus of 377GPa. However, the fibre diameter of 5.0 microns constrained productivity, which makes cost an issue.

Toray has addressed this in the new development by optimising the Torayca MX series control technology to create 7.0 micron fibres with uniform internal structures. This results in a fibre with a tensile modulus of elasticity of 390GPa, around 70% higher than the standard level of Torayca offerings for industrial applications and delivering much better cost-performance.

The company says that thermoplastic pellets incorporating the newly developed carbon fibres maintain longer fibre lengths than conventional high tensile modulus offerings after moulding. As a result, the pellets can produce parts with a tensile modulus of up to 41GPa and a specific gravity of 1.4 (comparable to the 45GPa and specific gravity of 1.8 for magnesium alloys). It claims that using the pellets to make complex injection moulded parts could enhance productivity and contribute significantly to lightweighting.

Reporting growing demand for carbon-reinforced compounds for electronics and medical applications in Europe, Germany-based **Teijin Carbon Europe** has increased production capacity for its chopped carbon fibre Tenax-E HT C604 6mm grade by 40%. The company says that demand for the C604 grade, which it says enables production of high-grade compounds with good mechanical properties and electrical conductivity, has increased significantly in recent years. That European demand has been met until recently by delivering the same grade from Teijin's Mishima plant in Japan; the



**Above:** Koller Kunststofftechnik is producing hybrid composite windshield frames for BASF using carbon fibre reinforced thermoplastic profiles from SGL

increased German capacity will mean it can now react more flexibly to local customers. Other Tenax short fibre products – chopped, pelletised or milled – are produced at facilities in Japan and the US. They are supplied in a variety of sizings.

Last year, **Zoltek** released details of a production-ready engine cover developed for Ford using its Zoltek PX35 carbon fibre in a PA66 compound. It resulted in a 24% weight saving over its aluminium predecessor and incorporated load limiters at all through bolt interfaces, threaded inserts at attachment points and an RTV seal. PX35 chopped fibre is frequently compounded with engineering thermoplastics such as PC, PA and high-temperature thermoplastic resins such as PEEK and PEI. The chopped fibres are said to offer a high bulk density value, which makes for more consistent feeding, and to distribute easily during compounding.

### Hybrid moulding

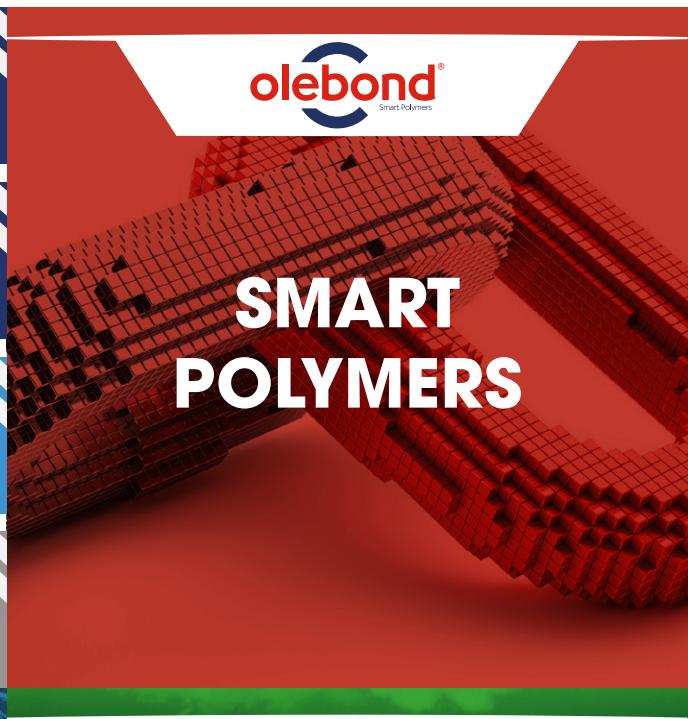
Germany's Koller Kunststofftechnik started production of skeletal injection moulded windshield frames at the end of last year for an undisclosed BMW car model using thermoplastic impregnated carbon fibre reinforced profiles supplied by **SGL**

**Carbon.** The profiles will be produced by SGL using its 50k carbon fibre at its site at Innkreis, Austria, and subsequently processed into the windshield component by Koller using a hybrid injection moulding technique.

The thermoplastic composite component is a structural part that will replace the traditional steel element, which acts as a connecting element between the roof frames and provides a stabilising function. The carbon fibre profiles add the required

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**Procotex**

stiffness and crash safety to the part, at the same time helping to reduce the weight of the roof. In the BMW Group model, this component will cut weight by 40% compared to steel designs.

The latest additions to the Ultramid Advanced polyphthalamide (PPA) portfolio from **BASF** include carbon-fibre reinforced grades with 20, 30 and 40% reinforcement. The company says the new materials will allow production of lightweight parts that can safely replace aluminium and magnesium without loss in stiffness and strength. They are also electrically conductive. The compounds are based on BASF's Ultramid Advanced N (PA9T), which provides high dimensional stability due its low water uptake together with good chemical and hydrolysis resistance, high strength and modulus.

According to BASF, the Ultramid Advanced N3HC8 grade with 40% carbon fibre reinforcement shows better strength and modulus at 80°C (conditioned) than either magnesium or aluminium. It also retains nearly 100% of its tensile modulus after heat ageing at 120°C for 5,000 hours or at 150°C for 3,000 hours.

"Our new PPA compounds with carbon fibres are the ideal metal replacement," says Michael Pilarski from PPA business management at BASF. "And this not only from a material property point of view. Producing parts out of magnesium or aluminium also requires additional post-processing and tooling which increases system costs. Given the opportunities for 25-30% weight reduction with our new PPA grades, we can offer a safe, cost efficient and high-performance alternative for parts traditionally manufactured from metal."

The company also highlights the benefits the new carbon-fibre reinforced PPA compounds show in weight and tensile modulus compared to glass-fibre

**Below: BASF describes its Ultramid Advance carbon fibre reinforced PPA compounds as the "ideal metal replacement"**

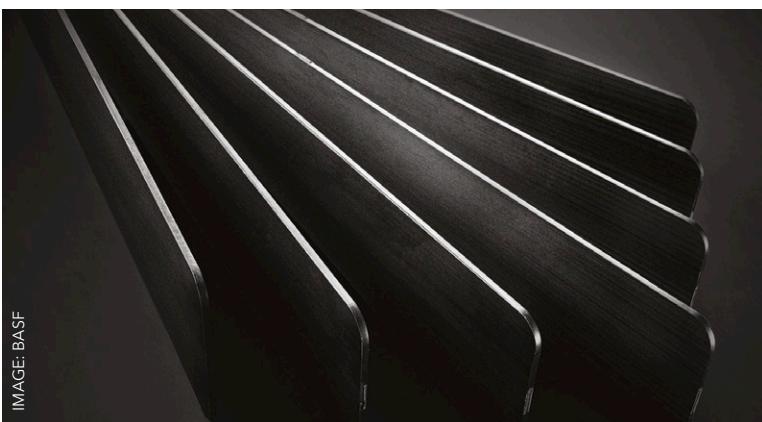
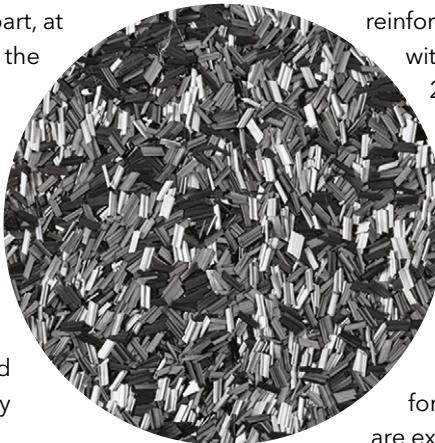


IMAGE: BASF



reinforced PA. PPA grades reinforced with 20wt% carbon fibre are about 20% lighter than PA6 or PA66 filled with 50% glass fibres; the tensile strength of a 20% carbon fibre reinforced Ultramid Advanced compound is either better or equivalent to a 50% glass fibre reinforced polyamide and processing is easier.

The new carbon-fibre reinforced Ultramid Advanced grades are expected to find application in automotive structural parts for body, chassis and powertrain, for pumps, fans, gears and compressors in industrial applications, as well as ultra-lightweight components in consumer electronics.

### Recycling moves

Last month, Belgium's **Procotex Corporation** acquired the recycled short carbon fibre business of ELG Carbon Fibre, which is based in the UK but is part of the German Haniel Group. Procotex will continue to supply ELG customers and says there will be no interruption to business. It says the acquisition complements the existing carbon fibre business of its Apply Carbon subsidiary in France. ELG will continue its recycled long carbon fibre activities.

Germany-based **Romira** is the latest addition to the list of compounders working with recycled carbon fibre, introducing a line of high strength and lightweight polyamide compounds. The company says its re-processed carbon fibre (rp-CF) is produced from residual cuttings/offcuts supplied by leading carbon fibre manufacturers. As the fibres are virgin quality they provide homogenous properties so there is no property fluctuation due to mixed fibre types, it claims. The use of rp-CF also results in a 90% reduction in carbon dioxide footprint compared to prime carbon fibre.

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# Bouncing back in PVC

**As we edge towards pandemic recovery, producers of PVC additives are dealing with supply chain issues while pushing ahead with product developments, writes Peter Mapleston**

The Covid-19 pandemic has hit the world on many levels, from the personal through to business, and it is still some way from being over. After dealing with the challenges of restrictions on movement and factory operation and huge shifts in product demand, manufacturers across various sectors are now having to cope with supply chain disruptions. When it comes to various types of additives for PVC, for example, producers and users alike have had to work out ways to handle sourcing issues as well as pushing forward with other product and application developments.

Swiss company **Sanitized** supplies material protection and hygiene additives. "Like major parts of the industry, this sector was – depending on the region and country – more or less heavily affected by lockdowns and other restrictions resulting from the pandemic. Now that these difficulties have rather disappeared in the last quarter of the past year, a major part of the PVC industry is now struggling with significant problems in procuring the necessary raw materials," says Michael Lüthi, Head of the Polymer Additives BU at the company.

"We know of major development divisions that deal almost exclusively with reformulations of

products with substitute raw materials. This shortage of raw materials is also problematic because in many cases, it is difficult to pass on the resulting hefty price increases in this industry to customers," he says.

However, Lüthi says that many of the company's customers have been fortunate enough to have weathered these turbulent times relatively well financially. "Safety equipment and high demand for items for craftsmen and handymen have provided great business opportunities that we seized in many areas," he says.

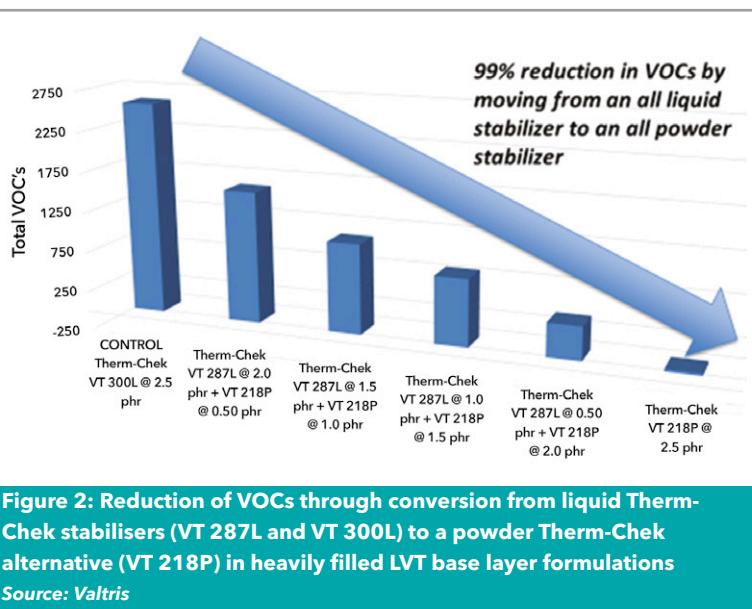
The post-Covid period has seen the biocide additive component in PVC formulations undergo a major shift in importance. "Whereas [the] biocide's main task used to be material protection – protecting end products from microbe infestations and all the undesired consequences – integrated hygiene function in PVC is also in very high demand today," he says.

"By specifically choosing and using a suitable biocide additive, it is possible to enhance the final product with an integrated hygiene function such as anti-bacterial or anti-viral surface protection," Lüthi explains. "This additional function is very important for buyers and end-users, namely for floor cover-

**Main image:  
The impact of  
the Covid-19  
pandemic on  
global supply  
chains is one of  
the challenges  
facing the PVC  
additives  
sector**

**Figure 1:** Brabender chips for a Therm-Chek Ca/Zn organic based stabiliser developed as a tin offset for substrate formulations. The Ca/Zn powder system (right) shows the early colour that tin stabilisers are known for along with improved mid-term colour and no loss of processability. Left column shows time in minutes

Source: Valtris



ings or artificial leather applications in public transportation, car sharing, public spaces, hotels, hospitals, etc. As such, the customer also requested the biocide additive in soft PVC as a product characteristic to stand out from the competition."

### Tackling shortages

Brenda Hollo, Business Director, Stabilizers, at **Valtris Specialty Chemicals**, also highlights the difficult conditions brought on by the pandemic. "2021 has also been an unprecedented year for raw material shortages, which has affected almost every industry, including PVC," she says. As one example, she says that a shortage of the preferred tin stabilisers in North America has led to an increased interest in calcium/zinc (Ca/Zn) technology. "Valtris has worked with its customers to develop creative solutions to keep production lines up and running. Ca/Zn based stabilisers are an offset to tin stabilisers in both pipe and substrate formulations." Performance of one example system is shown in Figure 1.

Valtris offers a complete line of non-toxic and heavy-metal-free stabilisers for PVC, with a strong focus on stabilisers for the flooring industry, including luxury vinyl tiles (LVTs). Hollo says they are designed to meet ever-changing regulatory needs, helping customers to satisfy indoor air quality certifications and produce products that are SVHC-free while meeting performance targets. Grades include Ca/Zn powders and liquids free of barium, which can be formulated to be ultra-low and phenol-free.

Recent developments from the company for LVT flooring applications include Therm-Chek VT 328L and VT 329P, which are liquid and powder stabilisers respectively. They are said to provide outstanding heat stability while at the same time maintaining the very good clarity required for clear wear-layer applications.

Therm-Chek powder stabiliser products have been designed for heavily-filled base layers in LVT

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where they can provide optimum processing while reducing VOC emissions, which is critical for meeting requirements of indoor air quality certification. One existing grade, Therm-Chek VT 218P, has proven performance in a heavily-filled base layer to replace liquid stabilisers, Hollo claims. "By moving to an all powder stabiliser, there is a 99% reduction in VOCs, with no sacrifice in performance in terms of heat stability," she says (Figure 2).

### Tin alternatives

Japan's **Adeka** says that many PVC materials – such as flooring, film, wire & cable, and profiles – are required to meet increasingly challenging sustainability demands, which it has been addressing in its development of its ADK Stab RX and RUP Series Ca-Zn stabilisers.

The company says its ADK Stab RX-400 Series grades are intended as alternatives to tin stabilisers for rigid applications. They are said to provide transparency, colour stability and heat stability comparable to tin-based systems. Meanwhile, its ADK Stab RUP series products, which are intended for wire & cable compounds, "provide excellent heat stability, colour stability, heat aging characteristics and offer superior mechanical properties compared to lead-based stabiliser systems."

Adeka has also developed a stabiliser system offering the high weatherability required for flexible PVC used outdoors, such as high-end artificial leather. The new stabiliser system combines its Ca-Zn stabilisers with ADK Stab LA-81, a hindered amine light stabiliser (HALS), and a UVA absorber. The improvement in stability can be seen from the exposed samples (Figure 3).

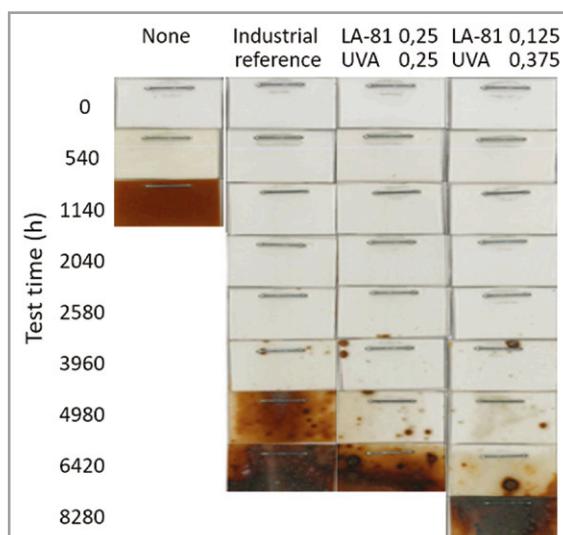
### Liquid options

Demand is growing for stabilisers that comply with FDA regulations and contain no substances of very high concern (SVHC) such as tris(nonylphenyl) phosphite, TNPP, according to **Songwon**. It has

**Right:** Songwon offers a variety of tin and Ca/Zn stabilizer systems for PVC pipe fitting production



IMAGE: SONGWON/IISTOCK



**Figure 3: Weatherability of transparent PVC with ADK-Stab LA-81 HALS, ADK-Stab 135A Ca/Zn stabilizer (0.5phr), and UVA (benzophenone-type)**  
Source: Adeka

introduced several new additions to its Songstab product line formulated for different applications.

Songstab CZ-LF420 is a liquid calcium-zinc (Ca-Zn) stabiliser for PVC food-wrap applications that is said to impart high heat stability and transparency along with good processability. For PVC flexible films offering very high transparency, Songwon recommends Songstab BZ-L155, a powerful liquid barium-zinc (Ba-Zn) stabiliser that also offers good heat stability and lubricity.

Songwon already supplies a wide range of additives for PVC fittings. It says that liquid tin stabilisers are a robust solution where liquid products are suitable, but they may influence softening point. It describes its Songstab CZ-SF400 series as a "well-balanced" range of solid one-pack tin stabilisers that improve Vicat softening point. Solid one-pack Ca-Zn grades from the Songstab CZ-SF300 series are said to provide good processability and impart lubricity and high heat stability. The Songstab CZ-SF600 series of solid Ca-Zn stabilisers incorporate tin boosters and are designed for pipe fittings, especially large-diameter systems. Good processability, a high Vicat softening point and easy dosing are among cited advantages.

### Performance waxes

The latest developments from **Clariant** include wax products designed to lift production performance in high-output scenarios. "Successful processing of PVC is a balance of internal and external lubrication, wetting out and dispersion of high amounts of fillers and additives, and maintenance of colour standards and physical integrity of the finished product, while achieving maximum output with the least amount of



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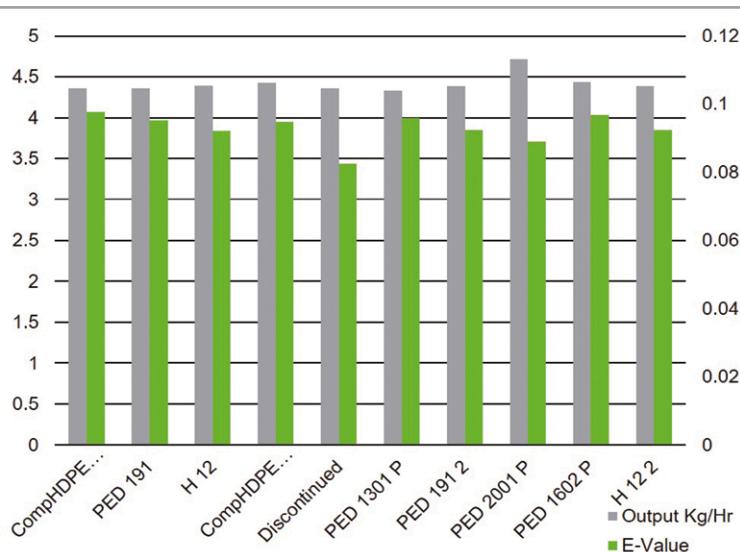
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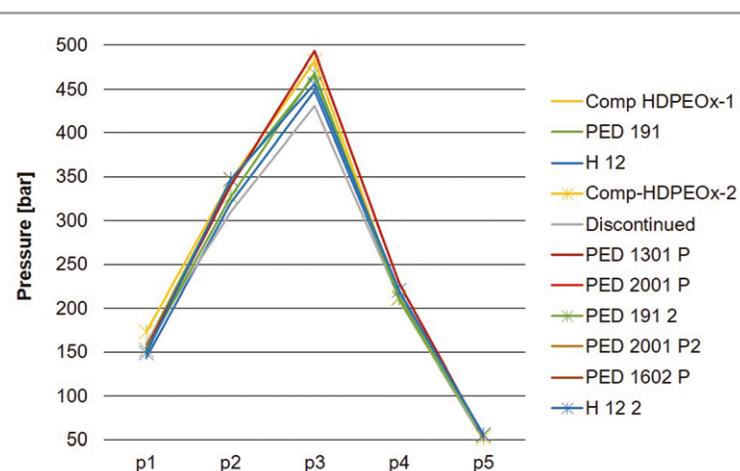
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**Figure 4: Comparison of output (left axis) against energy consumption when processing a PVC compound containing the new Licolub PED 1301 and PED 2001 grades compared to a typical competitive offering and other Clariant PEOx waxes (compounded on a Collin E30M laboratory compounder with an additive level 0.5%)**

Source: Clariant



**Figure 5: Pressure levels at five zones in an extruder processing PVC compounds containing Licolub PED 1301 and PED 2001 waxes compared to a typical competitive offering and other Clariant PEOx waxes. The results indicate few or no process changes required**

Source: Clariant

energy consumption and machine wear possible," says Frank W Neuber III, Regional Segment Technical Manager - Americas in the company's Additives BU, BL-Advanced Surface Solutions.

Among the new products are two oxidised HDPE waxes (HDPEOx) with improved performance. These may be incorporated into PVC compounds as internal lubricants in place of existing HDPEOx waxes to enable higher outputs, or used as a secondary wax source. The Licolub PED 1301 and Licolub PED 2001 products are designed with drop points and viscosities that keep extruder pressure, gelation and fusion consistent with current typical offerings while increasing the amount of output with less energy consumption, the company says.

The new PED waxes are available in powder form, which Neuber says makes them easier to incorporate and distribute into powdered compounds than granulated versions. They are also priced economically, he adds.

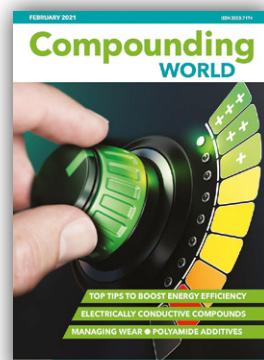
Clariant has provided various PE and PP copolymer waxes for PVC compounds for many years. However, according to Neuber, "recent requests for improved performance and viable alternatives to the diminished wax supply currently available to customers has prompted experimentation into the benefits of other Clariant wax products – Licocene PE 4201 and Licocene PP 6102 – and their subsequent adoption by PVC compounders." Barrel pressure and output-per-kWh energy comparisons of external lubricants in PVC, where only the external lubricant was changed at a dosage of 0.2 phr, have shown the two products to be able to reduce surface drag and improve wetting of fillers.

Clariant's Licolub CE-2, which is a highly modified polar copolymer wax designed for easy emulsification, has recently found use in liquid carriers for PVC colorant and additive systems used in both rigid and flexible PVC formulations.

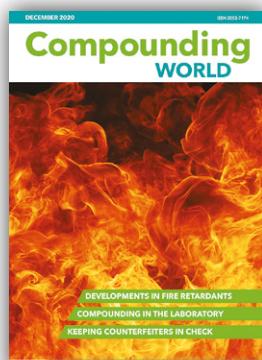
"Customers have reported that it goes into solution and suspensions easily, with excellent final perfor-

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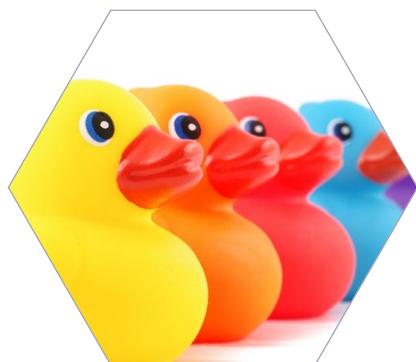
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# IKA is planning for stabiliser growth

German stabiliser producer IKA Group was acquired by a consortium in October last year and the buy-in management of CEO Alexander Hofer and CTO Timo Seibel say they are working with existing managers Swetlana Fischer and Thomas Hillen on what they describe as an ambitious international growth strategy.

IKA produces EuroStab calcium-based and GreenStab heavy metal-free stabilisers for window profiles, foamed profiles, technical profiles, sheets, pipes and fittings in rigid PVC, as well as for cable insulation and other applications in flexible PVC. The stabilisers can be supplied in product forms from powder to low dusting compacted granules, as well as the company's non-dusting "S" granules, which can be delivered in bulk and stored in silo. Its portfolio is completed by distributed products such as



**IKA is expanding capacity for its "S" granule stabiliser format**

impact modifiers and processing aids.

"The ongoing trend in the stabiliser industry goes clearly towards innovative solutions and implementation of customer requirements through comprehensive technical service, all that surrounded by quality and reliability of supply" says Hofer. Seibel, meanwhile, emphasises the importance of innovative and solution-oriented stabiliser systems that provide

users with a wider processing window.

"Especially IKA's well proven granulation process of non-dusting "S" granules, with its patented production technology via extrusion and under-water granulation is a success story" says Managing Director Hillen, who adds that a large capacity increase at IKA's production site in Wolfen is almost complete.

➤ [www.ika-wolfen.de](http://www.ika-wolfen.de)

mance as a dispersant of organic pigments and as an external lubricant when extruding films and tubes," says Neuber. "This means more efficient extrusion processes are achieved at a lower cost, due to the now reduced amount of expensive organic pigments, increased output and reduced scrap generation."

## Castor alternatives

Another commonly used lubricant for PVC is 12-hydroxystearic acid (12-HSA) and the only large-scale source for that is castor oil. "Security of supply can be quite a challenge since approximately 90% of the world's castor seed is sourced

from just one country: India," claims **Emery Oleochemicals**. "Having adequate alternatives to 12-HSA is necessary due to the ongoing scarcity of cargo space combined with dramatically increased shipping costs. Uncertain delivery times caused by the recent issue at the Suez Canal further exacerbate the situation."

To become more independent of castor-based PVC lubricants, Emery's Green Polymer Additives (GPA) business unit has developed another bio-based product – Loxiol G 19 – which it claims offers near identical processing characteristics in PVC.

Loxiol G 19 is a combination lubricant suitable for various rigid PVC applications. Highly compatible with PVC, it reduces stickiness and provides good anti-pilate-out properties. The lubricant has already been extensively tested to ensure that it meets user requirements, with customer trials indicating no change in Vicat softening point, mechanical properties, or colour of the end product.

**Right: Most PVC additives supplied by the GPA business unit of Emery Oleochemicals are produced from bio-based materials**



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**Nucleating and clarifying agents speed crystallisation and can enhance processing, appearance, and performance across a range of polymers and applications. Jennifer Markarian reports**

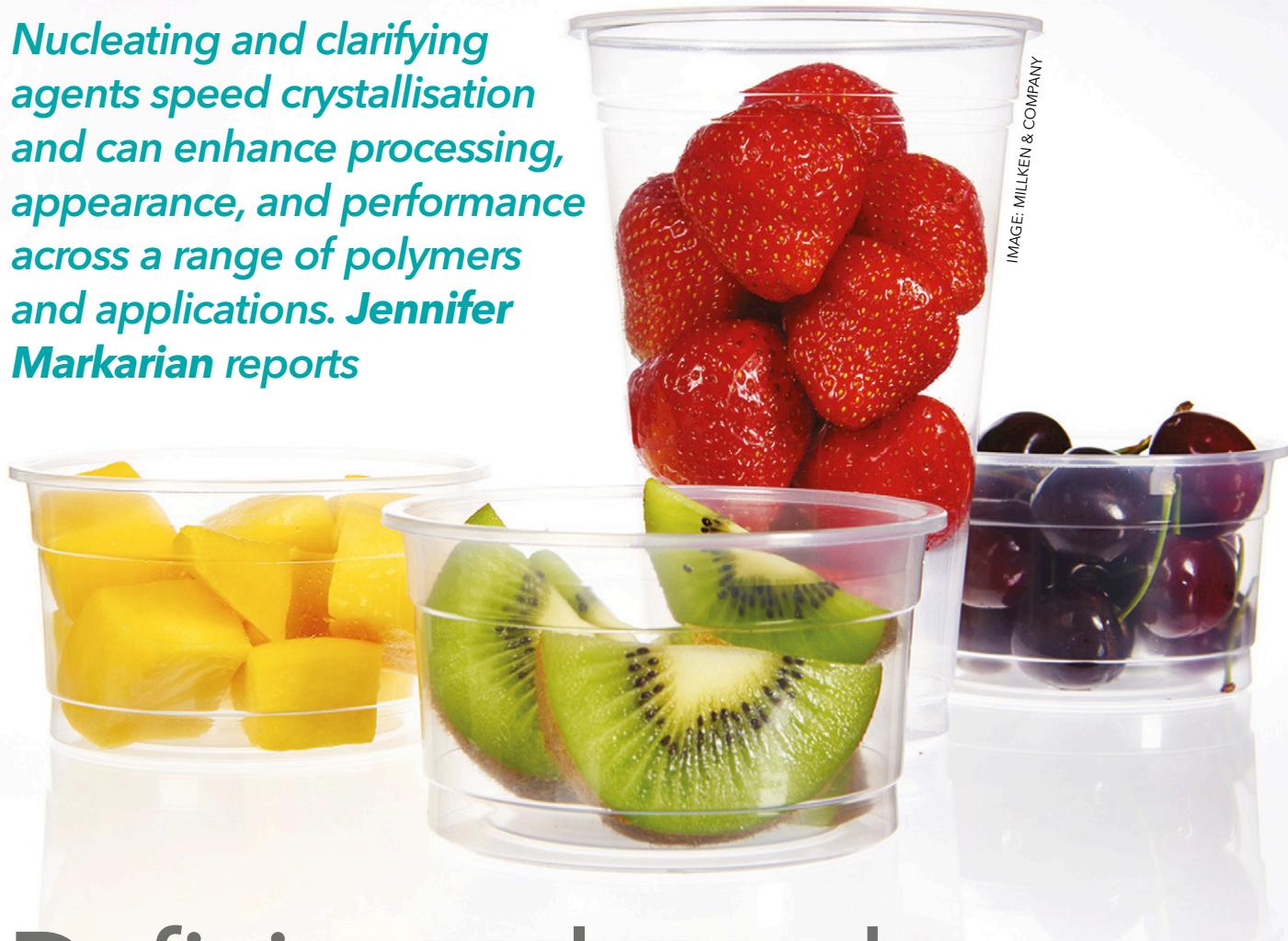


IMAGE: MILLIKEN &amp; COMPANY

## Defining a clear advantage

As the plastics industry seeks to improve sustainability, material formulators are looking for ways to reduce material consumption and to make greater use of recycled resins. Clarifiers and nucleating agents are among the available tools, allowing physical properties to be enhanced to support downgauging, lift performance of recycled resins, and (in the case of clarifiers) to improve clarity.

Clarifiers and nucleating additives can deliver productivity benefits, too. By speeding crystallisation of the polymer, it may be possible to lower processing temperatures and reduce cycle times to save energy and reduce production costs. A broad range of nucleating chemistries are available, extending from talcs, metal oxides, sodium benzoate and organophosphates to soluble nonitol and sorbitols, including DMBDS (dimethylidibenzylidene sorbitol).

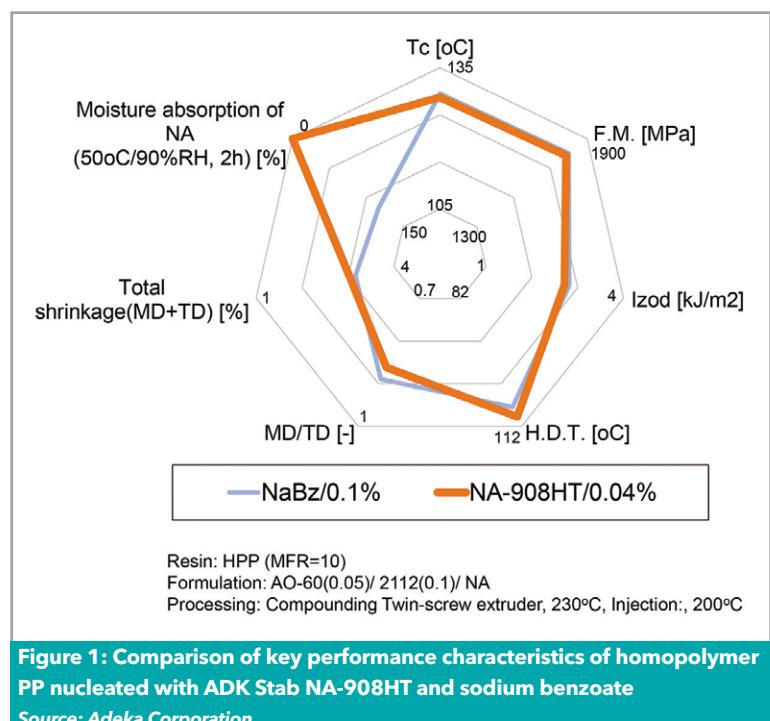
Nucleators and clarifiers are used widely in PP, where their ability to modify the polymer can frequently allow the polymer to be used to substitute other, more expensive or potentially less recyclable, resins. The continued growth of PP in areas such as

packaging is driving increased use of nucleators.

"In the packaging space, PP is being enhanced with nucleators to boost physical properties, enabling replacement of polystyrene (PS) and high-impact PS (HIPS), especially in thin-wall injection moulded applications," says Bhavesh Gandhi, Global Product Line Manager, Plastic Additives at **Milliken & Company**. "Milliken's Hyperform HPN performance additives for PE and PP help improve shrinkage behaviour to avoid warpage, and also help optimise the balance between stiffness and impact."

Milliken's latest Hyperform grades for nucleating thermoformed PP are HPN 909ei and HPN 500ei. Both products improve optics, including reducing haze and yellowing, to give a "cleaner, newer appearance," says Gandhi. The Hyperform HPN 500ei nucleator improves stiffness while maintaining impact performance and helps improve the material's heat deflection temperature. The Hyperform HPN 909ei nucleator is designed to address migration concerns, especially in food contact applications. "It eliminates one 'Specific

**Main image:**  
**Nucleators**  
such as  
**Milliken's new**  
**Hyperform**  
**HPN 909ei for**  
**thermoformed**  
**PP improve**  
**performance**  
**and appear-**  
**ance while**  
**simplifying**  
**migration**  
**testing**



**Figure 1: Comparison of key performance characteristics of homopolymer PP nucleated with ADK Stab NA-908HT and sodium benzoate**

Source: Adeka Corporation

Migration Limit' substance that must be monitored and tested for, reducing the compliance burden on customers," says Gandhi.

In addition to packaging applications, Gandhi says nucleators for PP – and also for PE – are seeing strong growth in automotive applications.

### Driven by weight

Light-weighting is the key goal for automotive customers. "There is a mandate for lightweighting, but parts must also pass emissions and collision testing. Nucleating agents improve stiffness and heat resistance, as well as speeding moulding cycles," according to Amit Gupta, Product Line Manager for nucleating and clarifying agents at **Amfine Chemical Corporation** in the US (a joint venture between Adeka Corporation and Mitsubishi Corporation). Adeka's ADK Stab NA-27 nucleating agent, for example, works in talc-filled formulas but can also be used to replace talc, to increase flexural modulus without increasing density.

Among the latest introductions from Amfine and Adeka is ADK Stab NA-908HT. It is described as a cost-effective formulation using organophosphate technology to improve stiffness as an alternative to sodium benzoates, which have potential to cause skin irritation and poor flow in humid conditions.

"With NA-908HT, the formulation cost and shrinkage properties are matched to that of sodium benzoate, so users do not have to change tooling. In addition, users do not have to add a separate acid scavenger," says Gupta. "NA-908T can be used at less than half the levels of sodium benzoate, or

you could add more to tailor the properties and improve stiffness-impact balance." Key performance characteristics compared to sodium benzoate are shown in Figure 1.

### Clarifying options

Clarifiers, which are a subset of nucleating agents, are frequently used to make PP clear enough to replace polymers such as PET and PS in packaging applications. Clarified PP can even replace glass in some uses. The work-from-home trend resulting from the pandemic has boosted use of food packaging, as consumers have been doing more grocery shopping, as well as driven an increase in take-out packaging. Packaging integrity (most notably stiffness), sustainability, aesthetics (including clarity) and affordability are all important in these applications, says Gupta.

Amfine is currently expanding production capacity at its manufacturing plant in Kentucky for its ADK STAB NA-71 clarifier, with the new capacity expected to be online by the end of 2021. Gupta says that the additive has been well accepted in the market and is proving especially effective in retort packaging, which requires improved thermal stability so the package does not warp under the high retort temperatures. He says that NA-71, which is an organophosphate chemistry, offers similar clarity and much lower extractable levels than competitive clarifiers. Low extractability and clarity are important in food packaging and are particularly key for some medical applications, such as syringes and drip bags.

E-commerce and consumer concerns about sustainable packaging are two megatrends that are "opening new opportunities for clear, lightweight packaging materials," says Zach Adams, Global Product Line Manager, Plastic Additives at **Milliken & Company**. Milliken offers both the Millad NX 8000 clarifier and NX UltraClear masterbatches containing the clarifier. "The two largest opportunities are replacing polystyrene packaging with a more sustainable solution to meet brands' environmental goals, and replacing glass packaging that is problematic for the growing e-commerce market due to weight and breakage," he says.

The clarifier has been certified to help processors save energy. Brand owners using PP clarified with Milliken's Millad NX 8000 ECO clarifier can display a UL Environmental Claim Validation label on their injection moulded parts, explains Adams. Milliken has similarly certified some Hyperform nucleator grades, which by lifting the resin crystallisation temperature allow moulders to cut cycle times and reduce energy use.

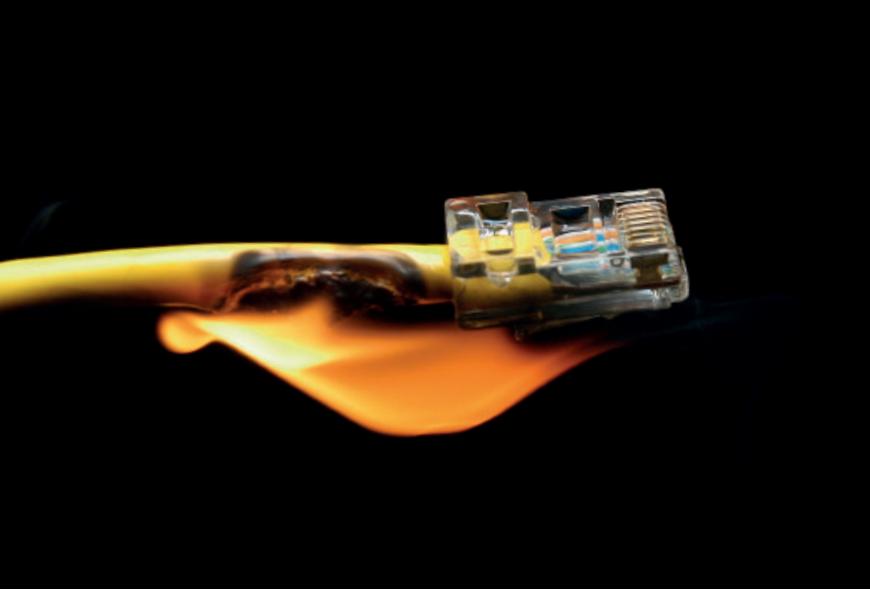
Milliken is building a new manufacturing facility



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**Above:** Brand owners using Milliken's Millad NX 8000 ECO clarifier can promote its environmental benefits with UL-validated labels

at Blacksburg in North Carolina in the US that will expand its capacity for Millad NX 8000 clarifier by 50%. It is expected to start up this year.

### Improving recycling

Improving the recycling stream for PP – collection and reuse – is important to meet sustainability targets. In the US, PET post-consumer recycling is well-established but PP has limitations. The country's Polypropylene Recycling Coalition (of which Milliken is a member) is working to raise \$35m to install sorting equipment for recovering PP packaging from the post-consumer recycling stream.

"Currently, many [US] material recovery facilities (MRFs) only have sorting stations for #1 PET and #2 HDPE bottles. This is one reason why only about 1% of the 170 billion pounds [77 tonnes] of PP consumed last year was recycled, according to the American Chemistry Council. Our goal is to ensure more recyclers can effectively sort waste PP in their facilities," Adams says.

Also aiming to improve recycling, Adeka last year introduced its ADK CycloAid brand, which includes one-pack additives for use with recycled resins. ADK CycloAid UPR-011 is a combination of stabiliser and nucleating agent and is intended for use with recycled polyolefins, including recycled PP. The nucleating agent is designed to improve mechanical properties, which can allow increased levels of recycled resin to be used (Figure 2). "At 70% recycled content, you can get to virgin-like quality with 4,000ppm of UPR-011," says Gupta. "In recycled resins that we evaluated, the secondary antioxidant was consumed and there were more metal impurities. The one-pack can 'top up' the formula to make up for this."

### Beta nucleation

Beta nucleating agents function differently from other nucleating additives, changing the crystal structure and inducing crystallisation of the beta crystal phase in a film or sheet, which when stretched (such as in a thermoforming or BOPP

production process) transform into alpha crystals. This solid-state transformation creates voids, which scatter light and make the part appear white, explains Dr Philip Jacoby, independent consultant and President of **Jacoby Polymer Consulting**.

Jacoby helped commercialise beta nucleating agents and, while working for **Mayzo**, developed a beta nucleating masterbatch. This masterbatch can be used in thermoformed PP to reduce or eliminate titanium dioxide, as the additive creates a white part without pigment (recycled resin without pigment has a higher value).

An even more significant sustainability driver than replacing titanium dioxide, however, is the ability to improve light-weighting, according to Jacoby. "In thermoforming, rigidity depends on the process conditions and how the material draws into the mould. The beta crystals create a more uniform material distribution throughout a part, such as a drinking cup, which makes the part more rigid overall," he says. With this increased stiffness, the part can be downgauged without sacrificing functionality and a quality feel. "Reducing the amount of resin used is both an environmental benefit and a cost savings."

### Blown film PP

**Constab Polyolefin Additives**, a member of the Kafrit Group, worked with BASF to develop a clarifying and nucleating additive technology that allows production of blown PP film on standard PE lines. PP blown film production would normally require extrusion lines designed and dedicated for the polymer, according to Michael Weber, Technical Service and R&D manager at Constab.

"Although for decades work has been done [by resin producers] in the PP industry to optimise crystallisation of PP in film and injection moulding, we decided to investigate the potential to make



IMAGE: MAYZO/JACOBY CONSULTING



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additional use of that know-how in designing a masterbatch for final applications," he says.

The Constab NC 00607 PP masterbatch with BASF's Irgaclear can be used at low levels in PP blown films to reduce haze, remove flowlines and visual defects, and improve stiffness and mechanical performance in both the machine and transverse direction. Weber cautions that it is not a 'drop-in' solution, but it does increase flowability, enable stable processing, and improve the processing window. He sees interest from the industry, as this technology could give more processors the ability to use PP.

### Nucleating polyamides

US-based distributor **CAI Performance Additives** recently introduced a nucleating agent for polyamides to the North American market. ST NA22D is sold as a granulated powder for compounding into PAs including PA6, PA66, PA11, and PA12. It is an additive blend of PA22 with a specially treated highly functional mineral that allows use at low dosages, says Richard Marshall, CEO of the company. It is said to be useful in unreinforced and reinforced polymers, forming a fine and uniform crystal structure in glass-filled PA resin. During moulding, the nucleating agent shortens cycles and improves dimensional stability, mechanical properties and stress cracking resistance.

"While not every large volume PA will need this sort of performance additive, there are many applications continuing to push the boundaries of performance," says Marshall. "One application we are hearing about more and more is vehicle electrification. People are pushing thinner and more difficult to mould components. For non-structural uses, they are looking for lighter, tougher parts," says Marshall.



Haze = 62%: Reference	Haze = 31%	Haze = 7%
- 40 µm thickness	- 40 µm thickness	- 40 µm thickness
- Same polymer in the 3 layers	- 10% copolymer in the middle layer	- 5% copolymer in the middle layer
- No additive	- No additive	- +3.1% CONSTAB NC 00607 PP

**Film samples showing the haze improvement achievable in 3-layer blown PP film using Constab's NC 00607 PP performance enhancer with Irgaclear**

Source: Constab Polyolefin Additives

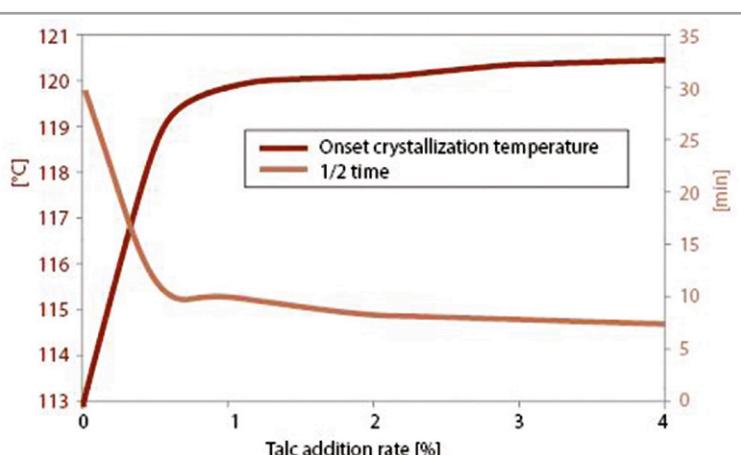
### Mineral option

Talc is widely used as a nucleating agent in semi-crystalline polymers – particularly in PP but also other polyolefins, polyamides, polyesters and polyacetals. "Usually, fine (10 micron top size) and ultrafine (3 micron top size) talc grades are used for nucleation of semicrystalline polymers because such grades contain a higher number of fine particles, which all act as crystal seeds," says Michael Schmidt, Technical Service Manager at **Imerys**.

The company's Crys-Talc grade is said to be optimised for nucleation. This talc range features a micro-lamellar morphology and contains more ultrafine particles than conventional talc of similar fineness, according to Schmidt. "95% of the Crys-Talc particles are smaller than one micron. More than 50% of the particles are under 0.5 micron, whereas conventional talc with the same fineness does not contain these fine particles at all. That unique property makes Crys-Talc a high performing nucleating additive," he says.

As shown in Figure 3, nucleation of polypropylene with talc at addition rates as low as 0.5wt% results in an increase of recrystallisation temperature and the reduction of the crystallisation half time. This allows faster processing, resulting in increased extrusion and injection moulding productivity.

Nucleation using talc also improves many polymer properties, including modulus and strength as well as impact resistance. "Additionally, the dimensional stability of plastic mouldings can be greatly improved, resulting in low warping, especially in combination with fibrous reinforcement such as in glass fibre/mineral hybrids," says Schmidt. At addition rates higher than 0.5wt%



**Figure 3: Onset crystallisation temperature and crystallisation half time of a copolymer PP nucleated with Crys-Talc**

Source: Imerys

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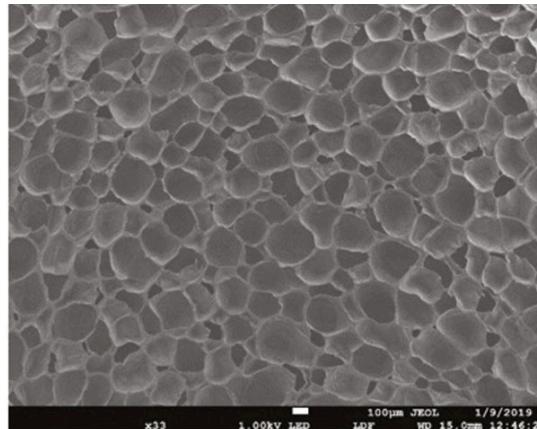
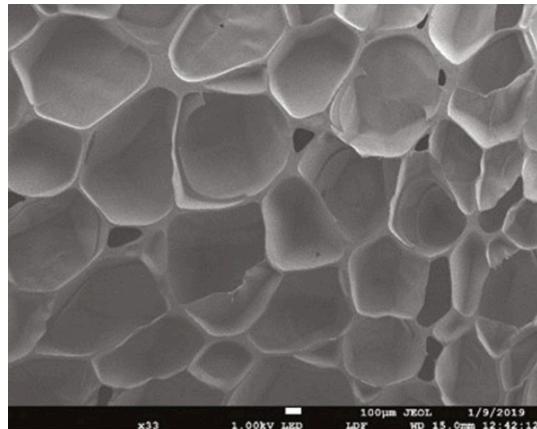
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Electron micrographs show foam cell size distribution using LNP ColorComp WQ117945 PET compound (right) compared to a traditional nucleation system (left)

Source: SABIC



Crys-Talc will act as a reinforcing additive, increasing stiffness almost linearly with talc content.

The Imerys nucleation portfolio also includes Steagreen talc, which is targeted at recycled polymers. It acts as a nucleating and reinforcement agent for the PP fraction in post-consumer recycled resin. And the company's HAR talc is also frequently used for nucleation of biopolymers such as PLA, PBS and PHA. "Talc is used mainly to enhance crystallisation speed, which is usually quite low for some of those bio-based polyesters," says Schmidt.

### Improving foams

For nucleation of polymer foams, Imerys recommends its Mistrocell talc grades. "In this application the talc particles act as a seed for growing foam bubbles, in addition to acting as a powerful polymer crystallisation promotor," Schmidt says.

A key role of nucleating agents in plastics foams is to help create a uniform cell structure. "Good foam nucleation allows a cellular structure in the finished good that is a closed structure that is as small and evenly dispersed as possible. The improved use of the gas via foam nucleation helps to attain greater density reduction while retaining key properties like stiffness and strength. Talc, calcium carbonate and chemical nucleation agents are all candidates. Particle size of the nucleator and its ability to disperse will influence nucleation as well," says Peter Schroock, President of **Reedy**

**Chemical Foam.** "Foam bubble nucleation must consider the nucleation (non-foam nucleation) package of the PP itself. We have designed products that consider the effect of foaming agents in PP formulas."

Cristina Arroyo, Manager of New Products and R&D at **Cellmat Technologies** in Spain, agrees that polymer, blowing agent, and foaming technology must all be considered when designing a foam nucleating system. She says that while traditional

foaming solutions are functional, there is scope for significant improvement to develop nucleating systems based on a deeper understanding of nucleation phenomena, as well as considering dispersion. "We have developed several nucleating systems based on nanoparticles and on organic phases that are extremely efficient in reducing the cell size several times in XPS, PU, PE and PP based foams," she claims.

Meanwhile, the newly-launched LNP ColorComp WQ117945 compound from **SABIC** is designed to improve control over nucleation and cell growth in PET foams used as core materials in sandwich structures. The resulting decreased cell size and uniform, narrower cell size distribution can reduce the foam's weight by minimising resin uptake in sandwich structures and can potentially improve shear strength/strain properties for better fatigue performance, the company says. It claims that, compared to conventional talc nucleating agents, the WQ117945 can reduce foam cell size as much as three-fold and decrease cell size disparity by a factor of up to five. PET foams can be used, for example, as cores in wind turbine blades, where lightweighting and strength are key. The company says that the nanotechnology nucleating agent can be used in other polymers as well.

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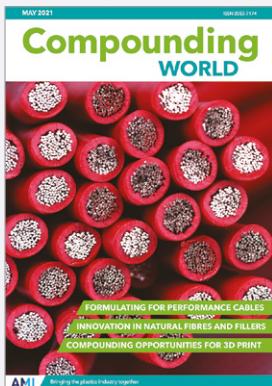
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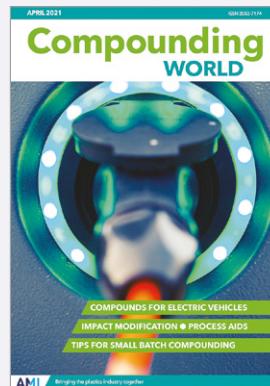
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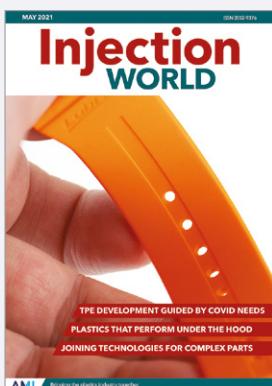
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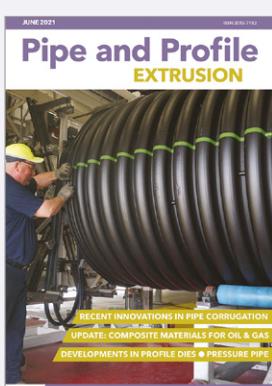
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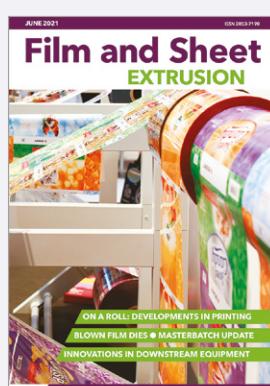
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