NOVEMBER 2022

ISSN 2053-7174

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BOOK YOUR PLACE

Norner adds lab compounder

Polymer R&D company Norner has installed and commissioned a new laboratory compounding line at its new Polymer Exploration Centre at Porsgrunn in Norway.

The new Coperion ZSK18 MEGALab compounding line can run in 20, 40 and 60 L/D configurations and is equipped with feeders for pellets, powders, wood and short glass fibres, as well as fluffy nanoparticles and liquids.

Screw configurations can be altered for different compounding tasks and the line can run at temperatures as high as 450°C.

"This new line enables us to work with new base resins and new modifiers like high temperature engineering plastics, higher amount of fillers, liquid components and even nanomaterials," said Asbjørn Noraberg, Manager of Norner's Application Pilot Centre.

› **www.norner.no** › **www.coperion.com**

IMAGE: NORNER

Norner's new lab compounding line is configured for flexibility

PureCycle and SKGC in PP JV

South Korean-based PP producer SK GeoCentric (SKGC) and solvent-based recycling technology company PureCycle have signed an agreement to build and operate a PP recycling plant in Asia.

Each company will have 50% ownership of the joint venture, which is to be located in Ulsan, South Korea, and have a capacity of up to 54,000 tonnes/yr. It is expected to be completed by the second quarter of 2025.

SKGC will bring marketing capabilities related to market development, strategy, and sales to the venture, while PureCycle will provide its patented purification recycling technology/IP and contribute technical capabilities.

› **http://eng.skgeocentric.com/**
› **www.purecycle.com**

FRX to supply Nofia FRs to Polymer Compounders

FRX Innovations said it has entered into a non-binding Memorandum of Understanding (MoU) to supply its Nofia polyphosphonate flame retardant solutions to UK-based Polymer Compounders (PCL).

Under the terms of the agreement, FRX will provide PCL with Nofia materials valued at $170,000 in Q4 of 2022, $1.7m in 2023, and $8.5m in 2024. The two companies will also form a strategic alliance aimed at developing new applications for PCL's Notoxicom family of flame retardant polycarbonate alloys within the UK and European Union.

"This is a watershed moment for both FRX and PCL as we join forces to meet what we anticipate will be an unprecedented change in the global flame-retardant industry," said FRX CEO Marc Lebel.

"This MOU represents the next step in the growing partnership that we have developed with FRX over the last few years and allows us to secure our Nofia supply in advance of the considerable growth expected for Notoxicom over the next 12 to 36 months," said PCL Managing Director, Grahame Houlder.

› **www.frx-innovations.com**
› **www.polymer-compounders.com**

SCG ups capacity at Sirplaste

SCG Chemicals has invested in new technologies and machinery at Sirplaste, the Portuguese plastics recycling specialist it acquired a 70% stake in back in April.

The investment expands production capacity for recycled high-density PE and high-quality PCR by 9,000 tonnes/yr, equivalent to 25% of current total production capacity. It will take Sirplaste's total PCR production capacity to more than 45,000 tonnes/yr.

"SCGC has a clear business strategy for the green polymer that fulfils the market's need for sustainability," said Tanawong Areeratchakul, CEO and President of SCG Chemicals. "The decision to invest in new technologies and machinery at Sirplaste at this time is to strengthen the business and expand the commercial potential to become more competitive in the global market."

› **www.scgchemicals.com**
› **www.sirplaste.pt**

Clariant invests €40m to up FR capacity in China

Clariant is to add a second line for production of its halogen-free Exolit organo-phosphorus (OP) flame retardants at a plant it is currently constructing at Daya Bay in China.

The first line at the Daya Bay plant is scheduled to start production around mid-2023 and represents an investment of CHF60m (€61m). This second line is expected to come on stream in mid-2024 and involves a further spend of CHF40m. According to Jochen Ahrens, head of Clariant's flame retardants business, the investment "demonstrates Clariant's commitment to our flame retardants business".

Ahrens said the decision to go ahead with a second Daya Bay line before the first was completed is based on growing demand for Exolit products from the e-mobility and consumer

IMAGE: CLARIANT

E&E markets in China.

"Brands and equipment manufacturers are increasingly switching to non-halogenated flame retardants to meet rising electrification needs and sustainability claims. And we see this in the rapidly growing demand for our Exolit OP flame retardants in China and other Asian markets," he said.

"Offering local production and the support of technical experts at Daya Bay, alongside the development capabilities at the One Clariant Campus laboratories in Shanghai, will enable us to respond faster to local, regional and global supply needs and also work more closely with our customers to fulfil increasing safety regulations and technical performance requirements in E-mobility, 5G communications, transportation and beyond."

› **www.clariant.com**

IN BRIEF...

Ineos is to invest €30m to convert its HDPE plant at Lillo in Belgium to produce monomodal and bi-modal grades. The move is intended to help the company meet growing demand for polymers for durable high-end applications such as cable ducts and pipes.
www.ineos.com

Celanese has completed its acquisition of most of Dupont's Mobility & Materials business, which was originally announced back in February of this year. The move follows the EU competition regulator's approval of the $11bn deal subject to Celanese committing to sell its global thermoplastic copolyester (TPC) activities to Italian compounder Taro Plast.
www.celanese.com

Repsol has taken a 27% stake in Spanish recycler **Acteco**.
www.repsol.com/en
www.acteco.es

Lanxess wins award for short glass PA carrier

A truck component carrier made from a short glass reinforced PA 6 from Lanxess has won the 2022 GKV/TecPart Innovation Award, presented by Verband Technische Kunststoffprodukte.

The structural component was developed jointly by BBP Kunststoffwerk Marbach Baier, Lanxess and a major German commercial vehicle manufacturer.

The component carrier is used in multiple truck models and takes the form of a trough with a cover. It is fastened to four points at the centre of the truck's ladder frame and performs a number of tasks such as holding two 75kg batteries and three compressed-air tanks weighing 7kg each.

"Our material and comprehensive process and structural simulations have helped to ensure that the carrier does not have to be reinforced with heavy and expensive metal inserts, in contrast to a D-LFT composite design variant based on polypropylene. As a result, the component is around 35% lighter and much cheaper to manufacture," said Dr Matthias Theunissen, an expert in lightweight design in plastics application development at Lanxess.

› **www.lanxess.com**

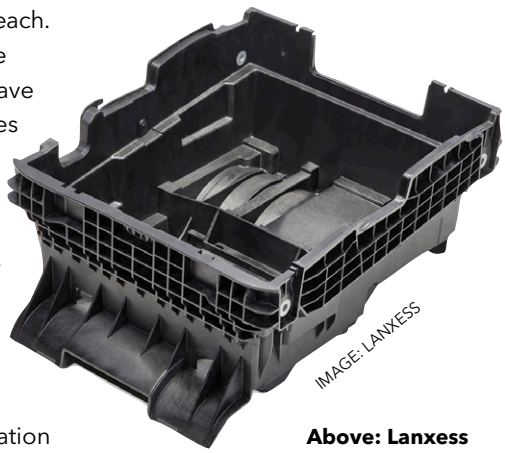

IMAGE: LANXESS

Above: Lanxess developed this truck carrier component in short glass PA6

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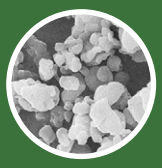

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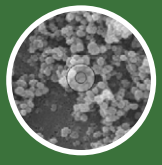

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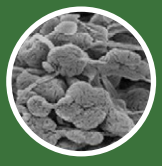

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Kafrit strikes deal with Nemo

Israeli start-up Nemo Nanomaterials, which provides nanomaterial-based industrial additives, and global masterbatch and compound producer Kafrit have signed a wide-ranging agreement that involves investment and collaboration between the two.

The partnership will allow Nemo access to the markets Kafrit is already active in, as well as providing opportunities to develop new products.

Nemo's technology allows even dispersion and distribution of carbon nanomaterials such as single-walled carbon nanotubes (SWCNT) in a variety of matrix materials. These proprietary NemoBlend additives are said to enable new properties in thermoplastics.

"Kafrit is continuously looking for breakthrough technologies which create value for our customers," said Nadav Goldstein, VP Business Development and Innovation at Kafrit Group. "We found a unique technology both in the process and in the additives produced by the company, and we are delighted to invest in Nemo. Together we will work for the future of the plastics industry."

Nemo products can be applied in automotive, electronics, textile, construction, energy, aviation and aerospace sectors.

› **https://kafrit.com/**
› **www.nemonano.com**

Borealis LFT-PP gives VW's Multivan a lighter tailgate

Borealis' Fibremod long fibre thermoplastic (LFT) is being used to produce what is claimed to be largest-ever all-thermoplastic tailgate for the new VW Multivan.

Borealis worked with leading Tier One supplier Magna to develop the lightweight tailgate, which consists of several components. The outer frame and the inner part are made in Fibremod GB416LF and are glued together; painted exterior parts are glued to the tailgate structure as well.

The Fibremod GB416LF grade used is specifically modified for use in tailgate carriers and visible structural parts. It is a high-flow, 40% fibre-reinforced material that meets emission and mechanical performance requirements while offering excellent surface aesthetics.

› **www.borealisgroup.com**

All change at Wells Plastics

UK-based Wells Plastics has announced a secondary management buyout (MBO) led by two of its executive Directors, Carl Birch and Stuart Law.

The MBO, which bought out the two previous long-term investors following an initial MBO in 2011, sees Technical Manager Dr Gary Ogden becoming a shareholder and the formation of a new Executive Management Team from within the company.

The move follows a series of investments within the company, including the recent creation of an Innovation Centre to support ongoing development of bespoke masterbatches and compounds. This has lifted capacity for its specialist additive masterbatch products to 10,000 tonnes/yr.

"We have all worked extremely hard in recent years [and], despite the challenges of Brexit, global pandemics and input cost price increases, turnover has more than doubled to over £20m," said Stuart Law, Finance and Operations Director. "This MBO now presents an opportunity for management to share in the success and future growth of the business."

› **www.wellsplastics.com**

Aurora grows on merger

US-based polymer compounder Aurora Plastics has merged with engineering compounds maker Enviroplas, also based in the US, as part of its plan to broaden its product platform.

Under the deal, Enviroplas founder and CEO Jim Stratman will remain a substantial shareholder and continue as president of Enviroplas, which will become the engineered polymers segment of Aurora Plastics.

"We completed extensive research of the market and growth opportunities prior to initiating this merger. Jim and his leadership team have dramatically accelerated the company's growth by leveraging their deep industry knowledge, operating rigour, and results focus," said Aurora CEO Darrell Hughes.

› **www.auroraplastics.com**
› **www.enviroplas.com**

IMAGE: PEAK PERFORMANCE COMPOUNDING

Peak targets medical with white room

US-based Peak Performance Compounding has commissioned a dedicated white room for medical compound production at its plant at Leominster.

The 90m^2 white room is climate controlled and equipped with a 32mm Steer co-rotating twin-screw compounding extruder fitted with multiple feeders. It can process commodity resins (including PE, PP, PS, and ABS), engineering polymers (including PEBA, PA 11/12, and PC) and high-temperature materials (including PEEK, PAEK, PEKK, PSU, and PEI).

Compounding capabilities include custom-coloured polymers and radiopacificed materials (using barium sulphate, bismuth subcarbonate, bismuth oxychloride and tungsten) for Class I and Class II medical device applications, including minimally invasive devices.

› **www.peak-pci.com**

LyondellBasell partners with Shakti in India

LyondellBasell and Shakti Plastic Industries, one of India's largest plastic recyclers, have signed a Memorandum of Understanding (MoU) to establish a joint venture to build and operate an automated mechanical recycling plant in India.

The plant is intended to process rigid packaging post-consumer waste and will have a capacity of 50,000 tonnes/yr of recycled PE and PP. The new facility is expected to be the largest mechanical recycling plant in the country and aims start production at the end of 2024.

› **www.lyondellbasell.com**

› **www.shaktiplasticinds.com**

GCR to build 200ktpa PO recycling plant

Spanish compounder GCR has announced plans to open a dedicated recycling plant in Castellet i La Gornal, close to Barcelona in Spain, to meet increased demand for its Ciclic range of recycled polyolefins.

Ciclic polyolefins are based on up-cycling of fully-traceable waste to deliver similar material properties as virgin plastic. It claims a carbon footprint reduction of 60-80% lower compared to virgin alternatives.

The company says that when fully operational in 2025 the 200,000 tonne plant will be one of the largest of its kind. The facility will lift its capacity for Ciclic and Granic mineral-filled masterbatch and compounds to 500,000 tonnes combined.

› **www.gcrplasticsolutions.com**

IMAGE: GCR

GCR plans to build a 200,000 tonne/yr recycling plant in Spain

Evonik to sell TAA assets to stabiliser firm SABO

Evonik is to sell its TAA derivatives business, part of its Specialty Additives Division with production sites at Marl in Germany and Liaoyang in China, to Italy's SABO.

TAA derivatives are precursors to produce light stabilisers, which are a key part of SABO's product portfolio. No financial details of the deal have been disclosed but it is expected to close in early 2023.

"The acquisition of the TAA business from Evonik propels SABO into a new phase of growth," said SABO CEO Germano Peverelli. "The addition of new cutting-edge technologies, proprietary processes, and integration of production assets in Germany, China and Italy will consolidate our manufacturing position, to the benefit of our ccustomers and our employees."

Christian Kullmann, Chairman of the Executive Board of Evonik, said the sale of the business, which no longer fits its strategic focus, will support its planned growth in specialty chemicals.

› **https://corporate.evonik.com/en**
› **https://sabo.com/**

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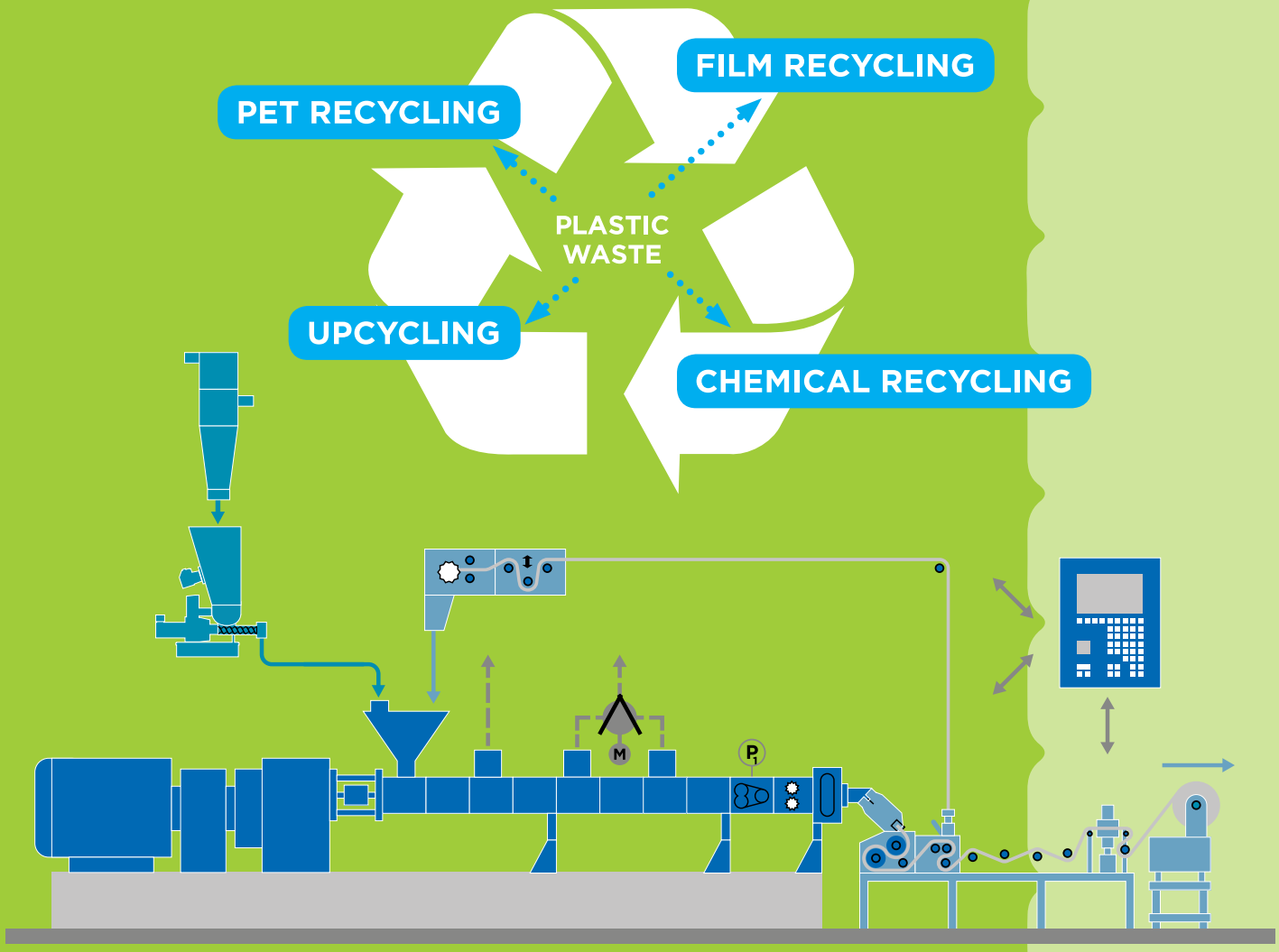

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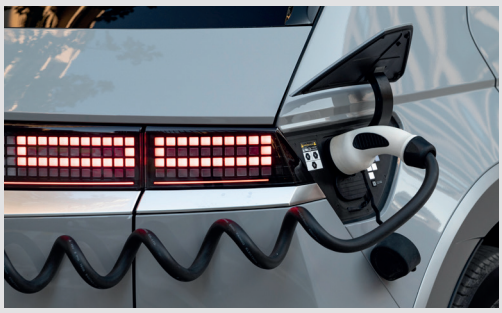

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Plastics industry returns to K fair; numbers exceed expectations

The doors closed on K2022 on 28 October and it was without doubt a successful event. "K in Düsseldorf has once again fulfilled highest expectations. It continues to be the most international, complete and innovative trade fair of the global plastics and rubber industry," said Erhard Wienkamp, Managing Director at K organiser Messe Düsseldorf.

The verdict from Ulrich Reifenhäuser, Chairman of the Exhibitor Advisory Board at K 2022, was equally positive: "After hardly any trade fairs could take place worldwide, K 2022 was all the more eagerly anticipated as the world's number one trade fair of the plastics and rubber industry and succeeded in providing fresh impetus in all sectors of our industry."

IMAGE: MESSE DUSSELDORF

Above: Visitors wait to enter the K2022 fair in Dusseldorf last month

K2022 marked the 70th anniversary of the fair, which in its last pre-pandemic edition in 2019 drew in around 224,000 visitors. The 2022 edition, which took place in a global environment where the shadow of Covid continues to impact on international travel, attracted 22% fewer at 176,000.

The organisers had not publicly given an indication of their expected attendance but the *Compounding World* team understands the result to be at the highest end of private expectations – certainly on some days the centre seemed to be as busy as previous K shows.

More than 70% of visitors to the show came from outside of Germany, with the Netherlands, Italy, France, Belgium, Poland and Spain the most represented European visitor nations. According to Messe Dusseldorf, 42% of visitors came from beyond Europe. It said Covid quarantine regulations had depressed attendance from south-east Asia but the US, Brazil and India were well represented.

Over the following three pages we present some of the newest business initiatives and announcements made at the show; in next month's edition we will cover the many new product introductions.

› **www.k-online.com**

KM adds to BluePower extruder line-up

KraussMaffei extended its ZE BluePower range of twin-screw extruders with the introduction of a large 186mm screw diameter model.

The new ZE 186 BluePower extruder is designed for maximum productivity in high throughput applications, says the company. "The modular design enables optimum adaptation to different processes. Typical areas of application include reaction, degassing and compounding as well as recycling processes," a company spokesperson said.

At the other end of the size range, the company demonstrated a ZE 28 BluePower extruder in a circular economy production cell demonstration. This started with a PX 200-1400 injection moulding machine producing pen caps from virgin PP. The caps were subsequently shredded to regrind, which was transferred into the ZE 28 BluePower to produce a compound with glass fibre reinforcement and additives. In the final process step, the recompounded material was used to injection mould automotive door handles.

The ZE28 on show was equipped with the company's UltraGlide feature, which allows the screws to be removed automatically from the processing section for cleaning or product changeover.

› **www.kraussmaffei.com**

Clariant eyes chemical recycling

Clariant announced a move into the chemical recycling area at K2022 with the launch of a portfolio of new products developed to improve the quality of products from pyrolysis-based chemical recycling ventures.

Projects for chemical recycling of plastics waste are proliferating, with a large proportion based on pyrolysis technology. However, the pyrolysis oil produced in these facilities is likely to require further processing to remove contaminants before it can be used as a feedstock for new polymer production.

Contaminants are highly variable and can include by-products of nitrogen, oxygen, sulphur in differing amounts. Clariant's new HDMax catalysts and Clarit adsorbents are tailored to remove a wide range of contaminants that are continuously changing in the feed, which it says enables the flexibility pyrolysis oil producers need regardless of process configuration.

Speaking to *Compounding World* at the show, Clariant's Global Business Development Manager Séval Schictel said that in small volume pilot plants contaminants are diluted to low levels, but the need for pyrolysis oil purification is becoming important as chemical recyclers aim to start up production scale facilities from 2025 onwards.

Schictel said the Clarit adsorbents are designed for use in the first step, where they target a range of different contaminants to adjust for the variability of the input materials. The second step involves catalytic hydrogenation using the new HDMax catalysts.

Clariant also introduced a number of additions to its existing product ranges, including two new grades of Exolit OP flame retardants (1466 and 1480) for use in unattended home appliances. AddWorks AGC 970 is its latest light stabiliser, which is intended to extend the service life of PE agricultural films by increasing UV resistance and resistance to high levels of agrochemicals.

Licowax AS 100 TP is an anti-scratch additive based on renewable materials for PP and TPO formulations which enables injection moulded products – such as car dashboards and door panels, household appliance casings, lightweight luggage –to maintain their original look and feel for longer. "Expanding the lifespan of products is a key element in the move from a linear to a circular economy," said Martin John, Head of Advanced Surface Solutions at Clariant.

The company also launched a new product carbon footprint (PCF) tool. It says the CliMate automated carbon footprint calculator allows it to offer consistent cradle-to-gate greenhouse gas (GHG) emission data for all of its products.

› **www.clariant.com**

Delta Tecnic extends masterbatch range

Delta Tecnic, the Spanish-headquartered masterbatch maker focused on PVC and cable applications, introduced a range of new products aimed at specific markets including PVC recycling, EMI shielding and profile extrusion.

The company is offering new colour masterbatches for recycled PVC in black, white and brown. Marketing Manager Eva Gotor said that they all have high concentrations of pigments and are formulated to deliver good dispersion. She added that the white masterbatch has a high titanium dioxide content and includes ingredients to help restore the appearance of recycled white PVC that has yellowed during its lifetime.

Delta Tecnic's new conductive formulation for cable applications combines carbon black with graphene to give enhanced EMI shielding performance. It is currently in a trial phase. The company already has a range of commercial conductive products based on carbon black and carbon nanotubes.

For window profile applications, the company has introduced a new range of colour PVC masterbatches, which are designed to provide fast dilution, high colour consistency and weather resistance. The range includes popular colour options for window profiles such as various browns, creams and greys.

The company offers PVC masterbatches in a range of shapes and sizes including its very fine Criopellets – with particle sizes less than 1,000 microns – small micro pellets, micro pellets and standard pellets. Area Manager Filipa Martins said that using masterbatch rather than powder pigments is a cleaner solution for profile extruders producing their own compounds. It also shortens cleaning times.

› **www.deltatecnic.com**

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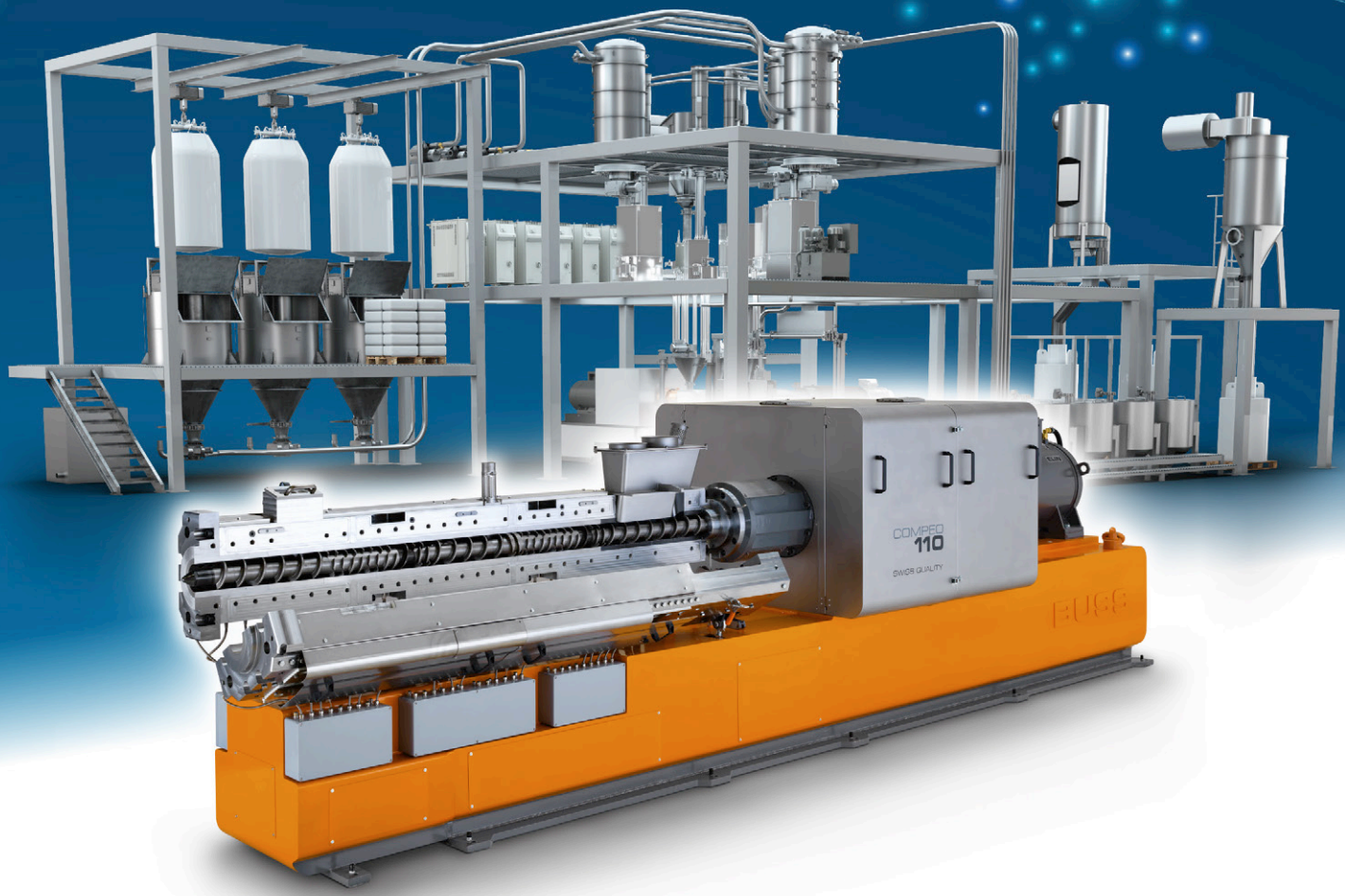

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Solvay pushes sustainability

Solvay was underlining the progress of its materials sustainability strategy with the launch of several high-performance products with a reduced carbon footprint for high-end applications. These are based on mechanical and chemical recycled resins and recycled reinforcements.

As the first milestone in the project, the company recently gained ISCC-Plus certification – a well-recognised standard for bio-based, recycled and mass balance materials – for its Augusta site in Georgia in the US.

Using the mass balance method, Solvay said it will track and trace the flow of certified circular and/or renewable materials through the value chain. This will enable the development of the new ReCycle MB (Mass Balance) Specialty Polymers Portfolio.

The site is already manufacturing an ISCC-Plus compliant sulphone monomer, which will subsequently be used for the production of Udel PSU ReCycle MB and Radel PPSU ReCycle MB sulfone polymers.

The ISCC-Plus certification will cover a growing portfolio of products spanning different chemistries. Additional certified high-performance materials will become available globally soon, starting with Ryton PPS ReCycle MB and Amodel PPA ReCycle MB.

Solvay said it also continues to invest to improve the sustainability of its operations and supply chain. It said 100% of the electricity that Solvay sources in the US for PPA, PPS, HPPA and PEEK base polymer production is renewable.

Georges Houtappel, Global Head of Transportation Business at Solvay Specialty Polymers, said many Solvay customers are now demanding recycled content. "How do you integrate this into high performance materials and still maintain high performance? We can't reduce performance by using recycled plastics coming from waste streams where the content is not exactly known. That's never going to work," he said.

"So we can offer our products with certified renewable content certified using the mass balance approach. You can't see the difference from virgin materials. We now have four different product lines making use of chemical recycling and we will expand that solution," he said. "We are also looking at recycled fillers. We now offer solutions to offer for example recycled glass fibre, mostly post-industrial but also very limited amounts of post-consumer."

› **www.solvay.com**

SI Group enters into recycling

SI Group launched a new range of additives for recycling under the brand name EverCycle, which is said to have been created with a view to building industry collaborations with plastics recyclers, machinery companies and polymer producers.

The move underlines a significant transformation in the SI Group business over the past three years, according to Robert Kaiser, VP Polymer Solutions and MD for the EMEA region. This has included investments in expanding antioxidant production at various global sites, in particular production of its Weston 705 phosphite antioxidants, but is also forward-looking.

"Innovation should not be limited to what we already have but also connected with the future and sustainability," he said at the show.

The first products in the EverCycle family include two additives for PET recycling and converting, which are claimed to enhance process stability and colour control and reduce acetaldehyde levels. The EverCycle PET-102D and PET-103D grades are intended for use with PET bottles, trays, and fibres; PET-102D is available as a pellet and PET-103D as a liquid.

Two additives for polyolefin recycling offer process stabilisation and performance enhancement while enabling increased recycled content. EverCycle PP-101S has been developed for stabilisation in HDPE and PP rigid packaging; LD-101S is intended for stabilisation in LDPE flexible packaging. EverCycle LD-104P targets mechanical performance issues such as gel formation in films that creates weak spots and affects clarity.

› **https://siigroup.com**

Coperion inks Dubai contract

Coperion signed a deal on its stand to supply a complete system for chemical recycling of PMMA to Dubai-based Renov8.

The system will be installed at the Kezad Polymers Park in Abu Dhabi and will thermally convert PMMA to liquid rMMA in a continuous process. It includes material handling, two ARW discharge agitators with discharge screws, and two Smart Weigh Belt (SWB) feeders, as well as a ZSK 92 Mc^{18} twin screw extruder with 92 mm screw diameter.

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Leistritz adds 60mm iMAXX

Leistritz showed a new larger iMAXX twin screw compounding extruder. The new machine is engineered for fast product changeover and pitched at compounding and high throughput masterbatch production. It shares many of the features of smaller iMAXX models, including specific torque of 15.0 Nm/cm³ and a high free volume of 1.66.

› **https://extruders.leistritz.com**

BASF extends PCF data

BASF announced availability of Product Carbon Footprint (PCF) data for a number of new products at the show. Produced using its own digital PCF application, the cradle-to-gate calculations are based on GHG emissions from its own plants combined with either average data for purchased raw materials and purchased energy or supplier specific data as it becomes available.

First PCF data has been made available for several antioxidants and light

stabilisers in its Irganox, Tinuvin and Chimassorb additive ranges. Speaking at the show, BASF Plastic Additives Sustainability Specialist Marina Leed highlighted the company's Valeras platform, which brings together additives and services that have sustainability benefits, and its new IrgaCycle range of additives to improve the properties of mechanically recycled plastics.

The company also launched Ultraform LowPCF, a new addition to its POM range that offers a PCF at least 30% lower than one of its conventional Ultraform grades by using green electricity and energy-efficient production technology.

› **www.basf.com**

Milliken and Purecycle cut carbon footprint

Additives producer **Milliken** and recycling technology company **PureCycle** updated on progress with their collaborative work in PP recycling and carbon footprint reduction.

PureCycle is commercialising a patented solvent-based PP purification process, which was developed and licensed by Procter & Gamble. It is claimed to separate colorants, odour and other contaminants from PP waste feedstock to convert it into a virgin-like resin.

Milliken announced a new PP concentrate based on PureCycle's recycled PP that it says offers a carbon footprint (GHG) approximately 35% lower than that of virgin PP. The new concentrate is formulated using Milliken's Millad NX 8000 ECO clarifier; the company said an added benefit is that the certified energy savings realised by using resin produced with this clarifier allows brand owners to display the UL Environmental Claim Validation label on injection moulded parts.

PureCycle has opened its first plant, in Ironton, Ohio, and plans to install two lines at a new plant it is building in Augusta, Georgia. It also has a joint venture with Mitsui in Japan and with SK Geo Centric in South Korea.

Dustin Olson, CEO of PureCycle, said at the show that the company is making progress in work with the US FDA to gain food-contact approval for its rPP products but that feedstock and product testing will take some time. "A good base has been laid with the FDA," he said.

› **www.milliken.com**
› **www.purecycle.com**

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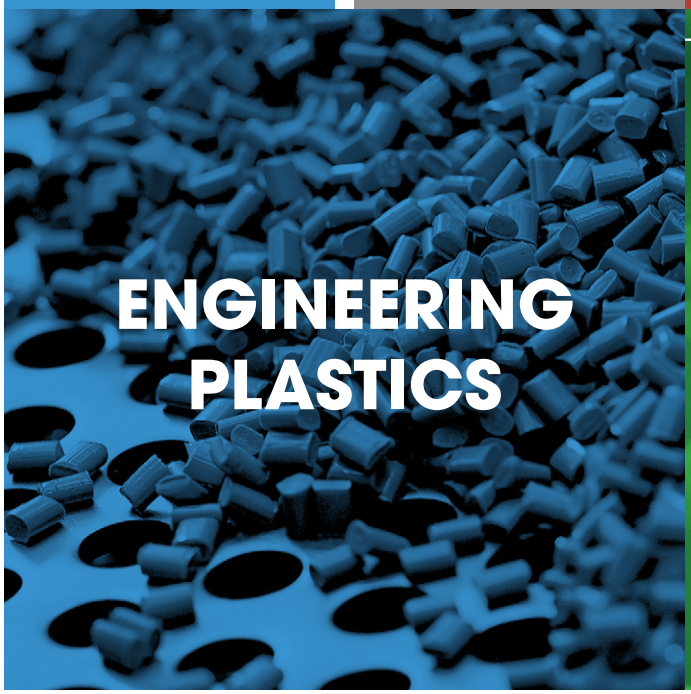

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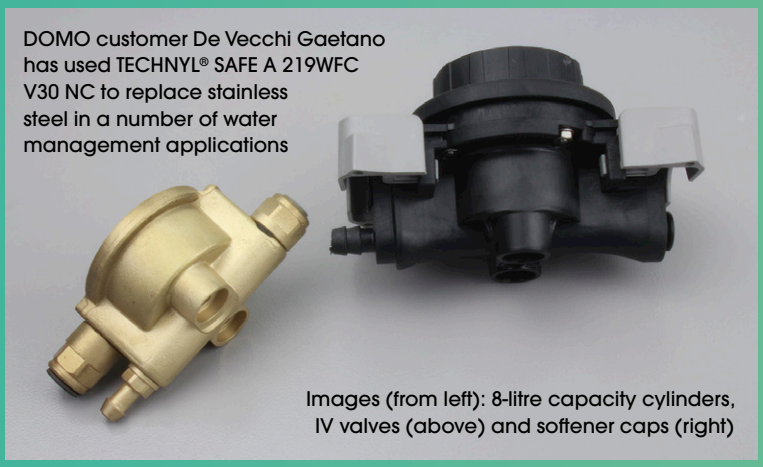


DOMO customer De Vecchi Gaetano has used TECHNYL® SAFE A 219WFC V30 NC to replace stainless steel in a number of water management applications

Images (from left): 8-litre capacity cylinders, IV valves (above) and softener caps (right)

The TECHNYL® SAFE material portfolio includes a comprehensive range of US and European drinking water-certified solutions dedicated to the water management industry, as well as food contact compliant grades to meet specific regional regulations in the EU, US and China. These polyamide materials include PA6, PA66, and PA6.10-based alternatives and are produced in accordance with good manufacturing practice (GMP).

Reference applications for this product line comprise components traditionally made of brass, stainless steel or other metals. These include heating and water meter systems, such as pipes, pumps, valves, fittings, faucets, cartridges, boiler components like hydro-block manifolds, along with balancing and other small home appliance parts.

The TECHNYL® SAFE portfolio of drinking water-certified metal replacement materials eliminates the risk of galvanic corrosion and scale build-up. It also helps reduce costs and ensures compliance with tighter regulations on permissible levels of lead in drinking water. And, thanks to its bio-based content, it can offer more sustainable water management solutions.

Water distribution

Water distribution systems include water filtering, water softeners and metering systems, as well as submersible pumps or shut-off valves. These systems require long-term dimensional stability, good mechanical properties, and resistance to chlorine at ambient temperatures. The type of disinfectants (free chlorine, chloroamine) and concentration levels can significantly influence the long-term resistance to oxidative degradation of engineering plastics.

Using DOMO's TECHNYL® SAFE range ensures water systems are lead-free and compliant with water regulations. It also means significant system savings compared to the high cost of processing and machining new brass alloys and the high environmental impact of end-products manufactured in foundries.

The long chain PA6.10 TECHNYL® SAFE D grade is a particularly suitable engineering material for water meter and water distribution applications. PA6.10-based TECHNYL® SAFE D can also replace high transition temperature PPA with the same glass fiber content in cold water meter body and top plate applications with the following benefits:

- Better dimensional stability after water uptake;
- Improved roughness and surface finish;
- Easier processing – a wider processing window and lower temperature setting on the barrel means no need for an oil heated mold and reduced energy consumption;
- Lower density material means easier handling and transport of final products (reducing CO_2 emissions);
- Better material environmental footprint (GWP);
- Superior performance on cyclic pressure (fatigue) tests.

Sanitary systems

Sanitary systems cover all water systems that are in contact with water in kitchens and bathrooms, both in domestic and commercial buildings. Typical applications include water tap mixer cartridges, shower water distributors, and kitchen water taps. These systems demand long-term dimensional stability and mechanical properties, resistance to chlorine at high temperatures and, sometimes, wear resistance and resistance to cleaning detergent.

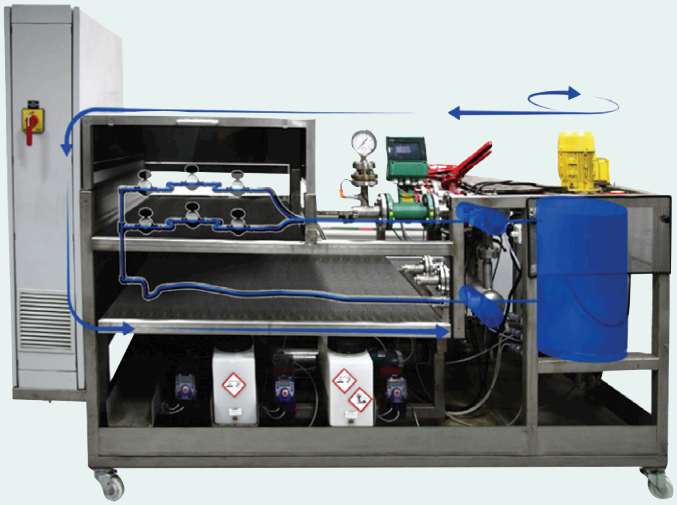
In all these applications, TECHNYL® SAFE delivers:

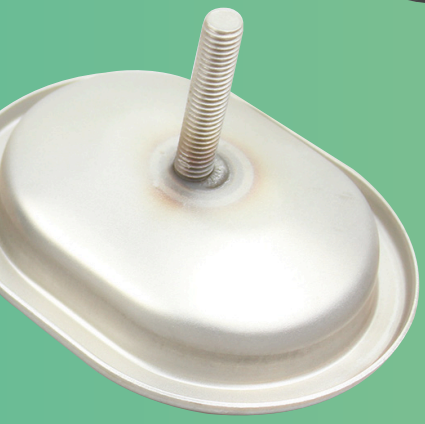
- Drinking water regulation compliance;
- No scale build-up or corrosion;
- System cost savings.
- A lead-free solution

Heating systems

Heating systems comprise all systems that provide heat to a building, including heat pumps, furnaces, and boilers. While furnaces or heat pumps carry heat in warm air, boiler systems distribute the heat in hot water, which gives up heat as it passes through radiators or other devices throughout the house. The cooler water then returns to the boiler to be re-heated.

Right: A chlorine test bench for water management systems in DOMO's APT lab





Right: Wilo's Para MSL/6-43/SC heating system circulation pump is produced in TECHNYL® A218 V30 BLACK 34NG, which is a 30% GF, heat stabilized and glycol resistant PA66

Typical heating system applications currently using TECHNYL® SAFE materials include heating manifold, circulation pumps, valves, floor heating fittings, heat exchanger parts, as well as solar heating system components. These systems demand long-term dimensional stability, mechanical properties, and resistance to chlorine at high temperatures.

The combination of fresh water with disinfectants like chlorine and oxygen at high temperature creates a particularly aggressive environment for plastics due to oxidative degradation.

The growing use of engineering plastics in these systems enables designs that integrate parts that were previously in metal, resulting in significant savings. A typical example of the benefits in utilizing TECHNYL® SAFE materials is the hydro-block manifold, which achieves significant system cost efficiency through design integration of several previously assembled brass parts.

Home appliances

Applications in the home appliance segment include power module housings for refrigerators or dishwashers requiring material robustness and flame retardant properties; oven ventilation ducts requiring high thermal and chemical resistance; washing machine door levers requiring high fatigue resistance as well as excellent surface finish; and electro valves for large and small appliances requiring excellent water resistance as well as water potability compliance.

TECHNYL® SAFE provides solutions for the home appliance market that are safe for human use, reliable, cost effective, suitable for high-productivity end products, and more sustainable.

DOMO SERVICE HUB

DOMO's solutions have long proven to be an excellent solution in both brass and PPA replacement, thanks in part to the DOMO SERVICE HUB. This includes advanced simulation, prototyping and part testing.

Multi-scale modeling, mechanical calculation and injection molding (MMI) simulation ensures manufacturers understand the real behavior of materials before moving forward with physical production phases. Helping avoid costly re-engineering and development iterations, this platform simulates fiber-reinforced parts made with TECHNYL® materials for unprecedented structural analysis accuracy.

The Prototype/Application Part Testing (APT) lab can anticipate and reveal possible weaknesses or failure of the parts by simulating the strains of water circulation during real-life utilization. The lab is currently equipped with 15 test benches to support customers in achieving final part validation. These include mechanical, electro-dynamic shaker, glycol, oil, chlorinated water circulation, hot air pulsation, and burst tests.

A greener future

The TECHNYL® SAFE portfolio comprises a combination of formulations and expertise to ensure metal replacement technology in a full range of US and European drinking water certified solutions. By providing effective polyamide replacements for metal and high-end polymers for the water management industry, the polymers help ensure lower system and maintenance costs, easier handling, better longevity, and enhanced sustainability for a greener future.

Learn more about the TECHNYL® SAFE product line HERE

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SECURE YOUR DISCOUNTED PLACE TODAY

The latest black and white colorant options aim to meet today's demanding environmental, regulatory, and performance demands, writes ***Jennifer Markarian***

IMAGE: SHUTTERSTOCK

Pigment options in black and white

We live in a colourful world but black and white pigments remain mainstay products in plastics product formulations. According to Cherie Stancik, Product Development Manager Plastics Segment at titanium dioxide (TiO_2) white pigment producer **Chemours Titanium Technologies**, aside from colour and opacity, plastics industry customers are looking for efficiency in processing and energy management, including thermal management and light protection. She says the company has several grades of TiO_2 that meet these demands in different applications, including a grade for film and sheet that is certified by DIN Certco for use in compostable resins.

Circularity is also a concern, Stancik says. "To address this, Chemours has partnered with diverse organisations across academia and the plastics value chain in an initiative called Remove2Reclaim to develop an efficient, cost-effective, and sustainable process for recovering TiO_2, other additives, and polymers from plastic products at their end of life, such as post-consumer plastic waste. The goal is to create a completely new recycling strategy that could enable reclaimed TiO_2 and polymers to be returned to high-value applications, contributing to the circular economy while yielding significant benefits to society and the planet."

Chemours also announced in August this year the commissioning of a new mineral sand mine in Florida that will expand its supply in the US of the minerals it uses to make its Ti-Pure brand of TiO_2 by the chloride manufacturing process.

Turning to black pigments, one of the more significant uses is opaque packaging, which is

Main image: Black and white pigments are a mainstay of plastics production, offering both functional and aesthetic benefits

IMAGE: LANXESS

Above: Lanxess developed its Bayferrox 303T manganese ferrite black pigment for NIR sorting applications

particularly important in growing applications such as packaging for food transported over long distances, says Stefano Bartolucci, Head of Global Market Segment Plastics, Paper and Specialties, Inorganic Pigments, at **Lanxess**.

"Black opaque packaging material protects perishable goods from UV radiation. This is important because light can change the properties of food; [UV light can] destroy vitamins, cause oxidation or lead to fading," he says. Black pigments can be more than just practical, however. "Black gives consumers the impression that the product is serious, elegant, classy or respectable. It is often used in the packaging industry to create a high-quality impression."

Carbon black has long been the "workhorse" colorant for black plastics, including packaging. With the increasing push for mechanical recycling, however, carbon black can pose a problem in material recovery facilities (MRFs) that use near infrared (NIR) sensors to detect material type. Carbon black absorbs IR wavelengths and cannot be detected with NIR sensors, which prevents plastics from being sorted. In the past several years, pigment suppliers have introduced a range of "NIR visible" black pigments that reflect rather than absorb NIR, making them sortable in such recycling systems.

Bartolucci explains that two types of black pigments—complex inorganic coloured pigments (CICPs) and manganese ferrites—reflect IR light and can be detected by MRFs using NIR sortation. Lanxess launched Bayferrox 303T, a manganese ferrite black pigment, in September 2021, to satisfy this need.

Bartolucci reports that Bayferrox 303T has a very low magnetic value, which is important for plastics packaging. "Magnetisable pigments can trigger false alarms during quality control processes in the food industry, [because] metal detectors cannot distinguish between pigments and pieces of metal in an edible item. This is why metal contaminants must be avoided in both the masterbatch and the packaging," he says. Bayferrox 303T offers colour strength that is 20% higher than comparable pigments, says Bartolucci, who adds that manganese ferrites are generally more cost-effective than CICPs. The company's Bayferrox 645T is another NIR-reflective pigment that can achieve black and brown shades.

Magnetic attraction

Formed in April 2022 when Prince International Corporation completed its acquisition of Ferro Corporation and combined the two companies with Chromaflo Technologies, **Vibrantz Technologies** also offers manganese ferrite pigments. "We have recently improved our Nubifer NB-803K FCP Manganese Ferrite (Pigment Black 33), mainly used

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IMAGE: SHEPHERD COLOR

Right: Shepherd Color's CICP IR-sortable black pigment line now includes FDA FCN grades for food applications

as an NIR sortable Black," says Daniel Llado, Market Segment Manager for Plastics at Vibrantz. He explains that the pigment now has a specification for low magnetism to prevent any problems with pigment particles in highly loaded masterbatches being caught by magnets used in plastics processing to filter metal contaminants.

Philippe Lazerme, Head of Marketing, Plastics at **Heubach**, says that a limitation in the use of these alternative blacks is that the cost is generally higher than traditional carbon black. As a consequence, their use is typically limited to packaging from high-end brands. "Cost in use, consistency, jetness, and food-contact approval are only some aspects that need to be considered," he says. Heubach currently offers two grades: Graphtol Black CLN for polyolefins and Solvaperm Black PCR for PET and styrenics.

Despite those limitations, the use of NIR-visible blacks is expected to grow. "We expect to see these black pigments used more broadly as they gain acceptance, which is why it's crucial that the industry uses pigments that have extended conditions of use," says Marc Dumont, Head Global Segment Management Plastics, Colour Materials at **Sun Chemical**. He cites the company's Sicopal Black K 0098 FK, which was extended from two-percent use level for FDA food contact conditions of use A-H to additionally include condition J, which allows use in microwaveable and oven ready food packaging. "PET trays remain a large opportunity for recycling black plastics applications, especially in food contact applications," he says.

Dumont adds that while the current product is a low-dusting powder form, Sun Chemical will soon introduce Microlen Black K 0098 MP, an NIR-visible black pigment in a fully dispersed pigment preparation form. "It has high colouring efficiency and is easy to mix with [polyolefin] resins as virgin or recyclate." The company says the pigment preparations are fully dispersed, free-flowing and easy to meter.

"They are the more efficient way to colour when compared to their powder counterparts. With advantages such as shorter change-over times, easier cleaning for production lines and significant reduction in reworking production batches, they are gaining a lot of momentum as we engineer new colour solutions," says Dumont.

US-headquartered **Shepherd Color** recently added FDA food contact notification approval to its CICP IR-sortable black pigments. Black 10F925 has a deep, neutral masstone colour for plastics supplied by resin manufacturers, while Black 10F951 has higher opacity and greater tint strength for colouring PCR material, according to Mark Ryan, Marketing Manager at the company. ›

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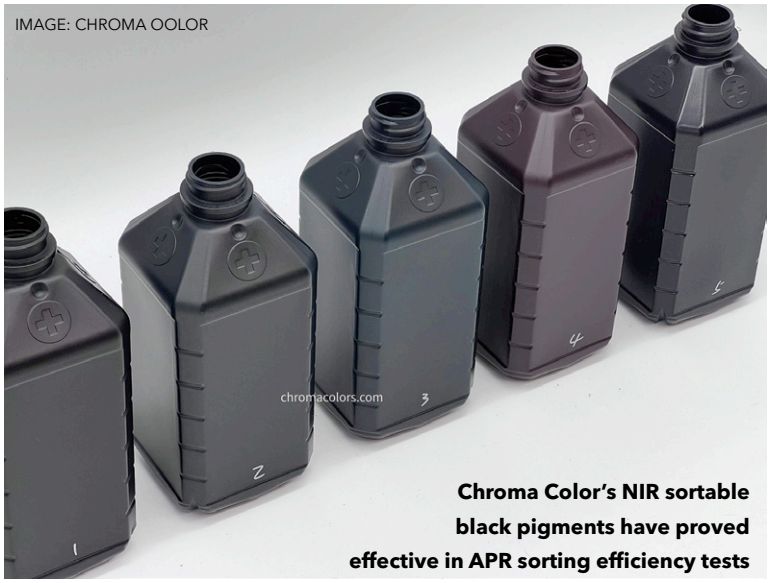

Chroma Color's NIR sortable black pigments have proved effective in APR sorting efficiency tests

Expert formulations

Compound and masterbatch producers are adding their own formulation expertise to these new black options. US-based **Techmer PM**, for example, launched its NIR Black in 2021, and the company has since developed a next-generation version with better opacity, which improves coverage of PCR with less colour concentrate, says Steve Smith, Techmer PM's rigid packaging market manager.

The colorant is offered in both compound and masterbatch forms for HDPE, PP, and PET and is suitable for food-contact applications. It can be used in consumer packaging as well as fibres. "We formulate with multiple components to improve upon the offerings from the raw material suppliers, resulting in a blacker black," says Kimberly Williamson, Colour Innovation and Technology Manager at the company.

Ampacet recently added to its range of NIR-detectable masterbatches with a black designed for flexible applications. REC-NIR-Black PE 512 is said to provide a high level of opacity in flexible PE packaging. Another product, REC-NIR-Black High Alcohol, is designed for monolayer PET containers for high alcohol applications, including hand sanitisers and cleaners.

The US Association of Plastic Recyclers (APR) publishes guidelines for testing how well a package can be sorted by typical MRFs. **Chroma Color** reports that its NIR Sortable Black concentrates were tested by an independent lab using these guidelines. The alternative black formulations were made into extrusion blow-moulded bottles produced in three formulations in HDPE and one in PP; all passed the test with 100% of bottles able to be sorted.

Chroma Color says its NIR Sortable Blacks are made from a proprietary combination of specialty dyes and organic pigments that allows near-black and other dark colours. The colourants are FDA-compliant and available in commonly used packaging resins, including PP, PE, PS, ABS, and PET.

Tony Gaukroger, Director of **Colour Tone Masterbatch** in the UK, says the company has been working with NIR-detectable black masterbatches for many years, originally in conjunction with the UK's Waste and Resources Action Programme (WRAP). A next-generation product was then developed to provide lower-cost grades that could better compete with carbon black. He says these "sit approximately halfway between the initial development and traditional blacks."

The company's UK and EU patents cover various blends of materials and colorants that meet food contact criteria, give a good black colour and excellent opacity, and are reasonably cost effective, says Gaukroger. Both the initial product and the newer lower cost products are being used commercially. "Over 10,000 tonnes of black plastic [diverted from landfill] can be directly attributed to colorant we have supplied," he claims.

Gaukroger cautions that, even using colourants that do not contain carbon black, users should evaluate the formulated colour to be sure that it

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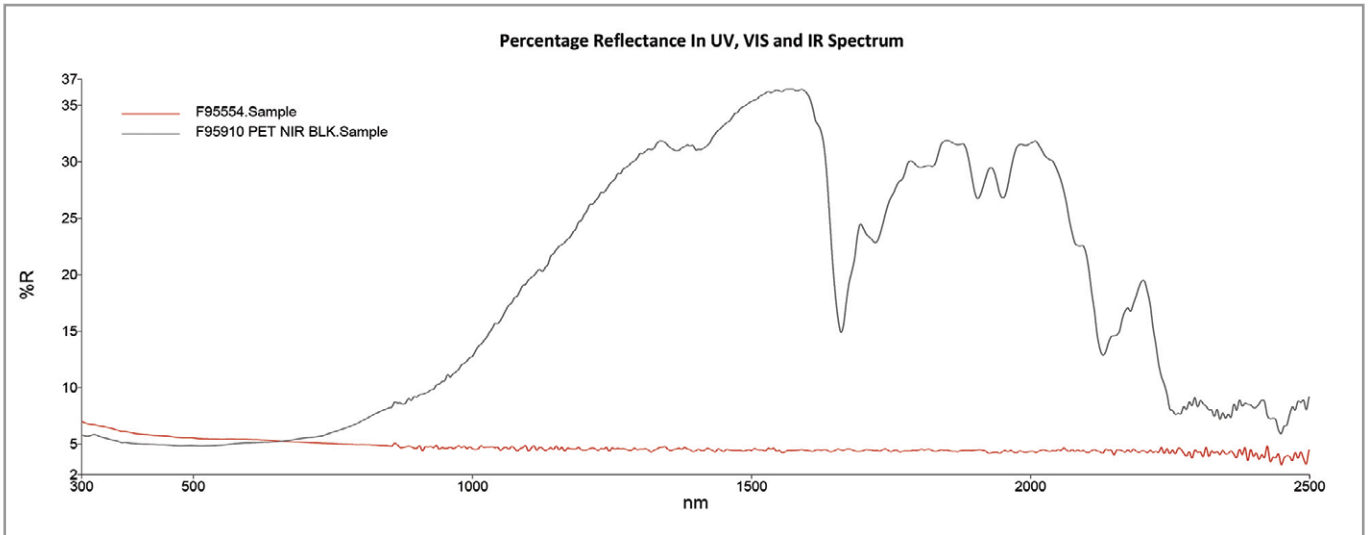

Figure 1: This graph from UK-based Colour Tone Masterbatch shows percentage reflectance over the 300-2,500 nm wavelength spectrum for a carbon black pigment (red line) and NIR-reflective black (blue line). UV extends to 380nm, VIS from 380-780nm, IR >780nm.

Image: Colour Tone Masterbatch

does not inhibit NIR sorting. He says that the overall absorbance in the NIR range of a combination of pigments (each of which considered NIR-sortable on their own) can reduce reflectance more than would be expected.

Sorting problems

Although it is true that NIR spectroscopy can have difficulty sorting plastics containing carbon black, some commercial-scale recycling facilities use technologies other than NIR, according to Dominique Strässler, Global Segment Manager Plastics, **Cabot Corporation**. "For example, so-called 'mid-infrared (MIR) scanners' offer significant advantages for positive identification of, among others, carbon black-containing black plastics," he says.

"We [Cabot] believe that the value provided by carbon black will result in carbon black remaining as the black pigment of choice in packaging applications," says Strässler. "The use of carbon black pigment is the best way to colour the mixed colour fraction of recycled plastic. Black plastic has been popular among packaging producers because it enables the use of skeletal waste, factory scrap and recycled plastics in products without creating a colour that is considered unattractive to consumers."

Strässler also expects carbon black to continue to dominate in black plastics where high tint strength and other properties, such as UV and weathering protection, are important, including automotive, electronics and consumer goods, plastic pressure pipes, agricultural films, wire and cable, and conductive plastics.

He also says that plastics customers are looking for increased "sustainable content" in products and reductions in environmental footprint. "As a result of this, we are working both on exploring options to make and formulate our products with recycled and/or renewable content and on assessing our greenhouse gas (GHG) footprint, with the main goal of reducing it," he explains.

The company has already published GHG emissions intensity (Scope 1 and 2) and has initiated a cradle-to-gate life cycle analysis of its carbon black products. "Once this analysis is complete, we expect to be able to provide Scope 1, 2 and 3 GHG emission estimates and other environmental aspects for various carbon black product grades." (Learn more about the GHG Protocol and the Scope 1, 2 and 3 emissions **HERE**.)

Recycled options

Cabot also offers carbon black masterbatches, including masterbatches made from recycled materials, through Cabot Specialty Compounds. It is building a new specialty compounds facility in Cilegon, Indonesia. Expected to start up by the end of this year, it will add 20,000 tonnes of annual global capacity for specialty compounds. The company says the facility is being designed to reduce environmental impact. It will, for example, use recovered waste-heat energy from Cabot's existing carbon black manufacturing facility that is located on the same site.

Other carbon black suppliers are also expanding manufacturing supply, with **Birla Carbon** adding facilities in China, India and Hungary to come online in 2024 and **Orion Engineered**

The Secret to Highest Quality in Cross-Linking Polymer Compounds

Installing a post-extrusion polymer mixer to achieve an even distribution of cross-linking agent in a temperature-controlled and hyper-clean environment while protecting particle integrity

Three important features combine to differentiate a post-extrusion mixer from other types of mixers and accordingly make a strong case for their place in your production line directly after the extruder. These features are a temperature-controlled liquid injection nozzle, a rotating jacketed drum, and a hyper-clean design.

One or more liquid injection nozzles provide the additional functionality of dozing polymer pellets with a cross-linking agent, such as peroxide, during the mixing cycle. The result is that each and every polymer pellet receives a defined dose of the cross-linking agent.

A post-extrusion mixer also considers two more critical aspects of polymer compound processing, temperature regulation and preventing contamination. A jacketed drum allows for the maintenance of a specific, preset internal temperature lying typically between 40 and 70 degrees Celsius.

Large hatches and a product discharge rate of 99.9% indicate a hyper-clean design. Also, special care should have been taken in the design of the seals. Furthermore, when the liquid injection nozzle is positioned to spray directly into the product, rather than the walls of the drum, any type of leftover, sticky residue can be prevented.

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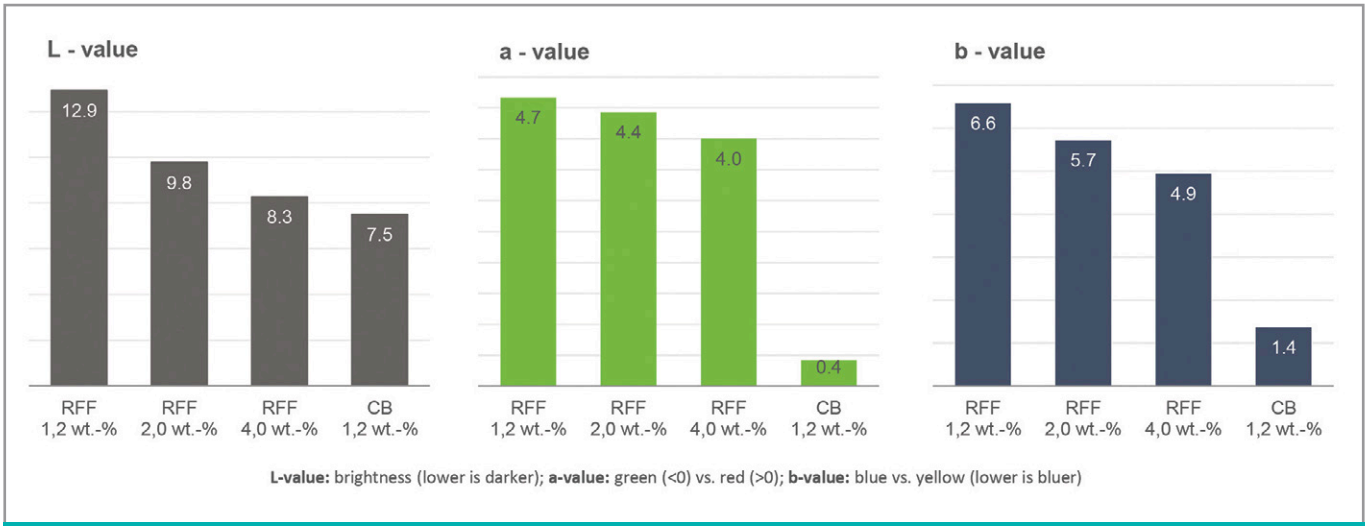

Figure 2: Chart showing L, a, and b values of black coloured PP compounds containing different loadings of UPM BioMotion RFF in comparison with carbon black
Source: UPM Biomaterials

Carbons expanding facilities in Italy and Germany. This expanded capacity will go into various applications, including tyres and plastics.

Lower footprint

Lower carbon-footprint alternatives to traditional carbon black use recycled sources. One method is to recover carbon black from used tyres. Birla Carbon, for example, is capturing carbon through pyrolysis of end-of-life tyres to make what it refers to as "Sustainable Carbonaceous Material", which it has trademarked as Continua carbon black. Birla has partnered with Circtec, which is building a pyrolysis plant in the Netherlands, to make the product.

Meanwhile, **Rowa Masterbatch** has introduced a new black masterbatch, Rowalid EcoPA-B095A Black rCB, using post-industrial recycled polyamide as a carrier for recovered carbon black (rCB) obtained from pyrolysis of tyres.

WF Recycle-Tech, a UK-based company, has patented a process for recovering carbon black from end-of-life tires. In 2021, the company partnered with Farrel Pomini to help develop the process.

Nebraska, US-based **Monolith** is converting natural gas into clean hydrogen and carbon black. The company says its process has a lower environmental impact because it uses 100% renewable electricity and a methane pyrolysis process that has low carbon dioxide emissions. The company recently completed the construction of a commercial plant in Nebraska and is aiming to expand internationally. It signed an agreement last year to pursue a joint venture with SK to produce clean hydrogen and carbon black in South Korea.

UPM Biochemicals has introduced its bio-based UPM BioMotion Renewable Functional Fillers (RFF), which are made from lignin from UPM's biorefinery.

One use of the RFF product is as an NIR-detectable black pigment in plastics. According to the company, measurements show that UPM BioMotion RFF can provide good black colouring of plastics for different applications. Increased loadings lead to darker sample appearance, while reddish and yellowish hueare said to reach almost carbon black levels.

Plastics containing the BioMotion RFF black pigment have demonstrated good thermal stability in recycling experiments and UPM says it is currently producing pilot-scale quantities for sampling.

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IMAGE: PETER MAPLESTON

*Batch mixer makers are introducing a raft of new equipment tweaks and features to improve versatility, uptime and product quality. **Peter Mapleston** finds out more*

Mixer innovations lift performance

Many of the leading suppliers of batch mixing equipment typically used for preparation of products such as PVC compounds and masterbatches showed their latest offerings and innovations at K2022 last month. Common themes included features to help reduce turn-around times between batches, modifications that facilitate blade changeover if the blade is damaged or excessively abraded, and updates that generally improve performance as well as health and safety – the latter a critical aspect when dealing with powders. Flexibility in design was also at the centre of many developments as, in most cases, mixers are extensively adapted to accommodate specific customer requirements.

One among the latest developments from **Zeppelin Systems** targets the mixing of titanium dioxide (TiO_2) into compounds and masterbatches. It describes this as one of the more difficult polymer sector applications as, since October 2021, TiO_2 has been classified within the EU as a carcinogen if inhaled on its own or in mixtures where the substance or mixture contains 1% or more of TiO_2 particles smaller than 10 microns.

"Special challenges require innovative solutions," says Zeppelin. It cites the example of a company wanting to produce a white PVC compound for window profiles. Due to the processing method in heating/cooling mixers, the TiO_2 has to be metered into the mixer in powder form. This is the only way to generate a bond to the PVC grain in the process of hot mixing at temperatures of up to 130°C. After subsequent cooling to a storage temperature of 40 to 50°C for silo storage, the pigment has completely attached itself to the plastic particles – which are now significantly larger at 100 to 300 µm – and exposure to free TiO_2 powder is prevented.

TiO_2 pigments have a particle size of 0.01 to 1

Main image: Mixer makers are adding new performance-enhancing features to their equipment. Wall mounted liquid injection ports are among Mixaco's latest introductions

IMAGE: ZEPPELIN SYSTEMS

Right: The Zeppelin CMQ container mixer is designed to be cleaned very quickly

micron. This represents a challenge for dust-free processing, which needs to take place in dust-tight units. Zeppelin says that to process the mix without putting dust into the local atmosphere – and also to dehumidify it for further processing – it combines the mixers with a special aspiration and filter system.

"The Vent tec and HMA aspiration systems have proven their worth here," the company says. "In combination with the BVD and BVC jet filters, they ensure extremely good dehumidification of the mix while withstanding the pressure fluctuations, high temperatures and chemical stresses occurring in the process." Zeppelin says they work reliably even with the finest materials to ensure the maximum permissible dust content in the clean gas is not exceeded.

The CMQ container mixer shown by Zeppelin at K2022 also allows users to work in dust-free conditions. According to the company, processors benefit from the efficient mixing tool, low temperature rise and easy cleanability. "The dust cloud that remains in the free space of the mixing container is effectively aspirated before undocking," it claims. "A special sealing system between the container and mixing plate prevents dust from escaping and spreading further. This reduces the excess pressure, and the remaining dust is quickly and safely extracted over the entire container surface."

The two-stage sealing system initially only opens the mixing chamber to aspiration when the container is undocked, which prevents dust escaping to the outside. The wide area aspiration as well as an additional intake of external air via a filter system enables an efficient air exchange, Zeppelin says. Dust particles are transported "quickly and safely" out of the mixing chamber into a suitable aspiration system; aspiration openings are positioned to avoid cross-contamination.

Because the container is a movable mixing container, the operator can fill and empty it independently. Product remains in the same container throughout the entire process; this rules out the risk of contamination, ensures there is no separation during transport, and allows the batch to be clearly traced.

The CMQ is well suited to applications with frequent recipe changes. The flow-optimised mixing tool is claimed to homogenise extremely effectively while ensuring good dispersion with maximum material movement.

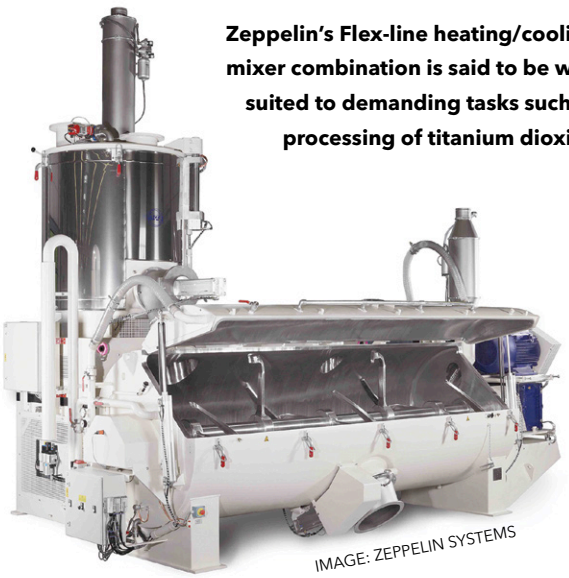

IMAGE: ZEPPELIN SYSTEMS

Zeppelin's Flex-line heating/cooling mixer combination is said to be well suited to demanding tasks such as processing of titanium dioxide

Complementary mix

At the end of 2020, Zeppelin Systems acquired MTI Mischtechnik, which had earlier declared insolvency. Zeppelin says the MTI portfolio ideally complements those of its own Mixing Technologies division as the two companies predominantly serve different market segments – both in terms of the focus of their technologies and each company's global coverage.

The MTI portfolio included heating, cooling and universal mixers for plastics processing and chemical applications. "Since the mixer solutions from MTI and Zeppelin are largely used in different industries, the overlap of the portfolio is small," says Rochus Hofmann, Managing Director of Zeppelin Systems.

Family-managed **Mixaco** – which has test centres at Neuenrade in Germany and Greer in South Carolina in the US – also designs and manufactures customer-specific mixer solutions alongside its range of standard products for universal mixing processes. At K2022, the company was showing some "tweaks" to existing equipment, as well as some new versions. For example, its i4 vertical container mixer now comes in two sizes in the i4 flex version. The unit was first shown at K2019 and can now accept more container sizes: 300, 450, and 600 l on the smaller version and 800, 1,000, and 1,300 l on the larger version. Both have an automatic system for recognising which size of chamber is coming in, based on rear-mounted limit switches and induction sensors in the shaft, so the

IMAGE: PETER MAPLESTON

Above: The latest Mixaco hot mixer variant features a larger outlet

operator knows which tool to install.

In the HMKM heating/cooling mixer range, models have been redesigned to create several standardised families of mixers. The discharge from the hot mixer has been enlarged –on one size variant it has been increased from 200mm to 300mm – to allow faster discharging and so reduced time between batches.

The heating mixer is now available in a new height:diameter ratio of 1:1. According to Guido Brand, who is a sales and marketing specialist at Mixaco, this improves thermal efficiency. Inlet ports for injecting liquids into the mix are now located in the walls, rather than on the lid, which improves mixing as the liquid components go straight into the mix vortex.

Meanwhile, on its horizontal mixers, blades can be changed more easily in the event of any damage. Rather than having to remove the entire shaft from the mixer, the damaged blade can now be unscrewed from the shaft in situ.

Mixaco also showed an updated laboratory mixer. First introduced around two years ago, it carries out heating and cooling in a single vessel. The single frame size accepts vessels of 5, 10, and 20 l capacity.

At Italy-based Battaggion, Sales Engineer Andrea Bassi highlights the turbomixer from group company **Valtorta**, which specialises in mixers for medium to low viscosity materials, typically PVC, masterbatch, and PTFE. He says the machine is recommended for producing seven batches per hour with the mixer filled to around 80% (around five batches for transparent PVC). Working faster, he says, carries the risk of burning the PVC. On the cooling mixer, he says blades have been optimised for different mixes and are easy to change.

Recycling solution

Germany's **Kreyenborg** recently installed a custom-manufactured mixing system for a customer needing to handle a wide range of regrinds. It says, due to the particular mixing requirements, this was a multi-faceted task. The customer needed to reuse different materials from different mills and shredders – and in various batch sizes in its production – so wanted a mixing system with a high level of flexibility, performance, precision, and reproducibility. At the same time, the unit had to have a small footprint and be easy to clean.

The Kreyenborg mixing system includes two of the company's established Universal Quick Mixers. These can be operated separately when smaller quantities are involved, or they can be connected and used together. For smaller quantities, this has

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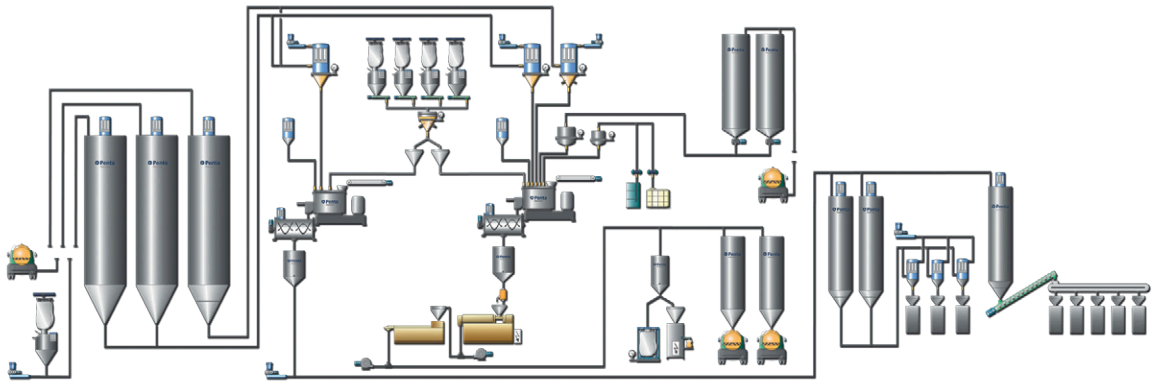

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Right: Kreyenborg's Universal Quick Mixers can be used as standalone or connected units

the advantage that mixing times can be reduced by around 50%, the company says.

This system is suitable for feeding using pressure-conveying systems when the two mixers, equipped with tangential inlets, act as cyclone separators. A filter module was installed downstream of the silos in the customised system to collect the conveyed dust. Homogenised material is discharged via two discharge screws into the big-bag filling stations. For the emptying of residue, and to facilitate cleaning of the system, the discharge screws can be rotated counter-clockwise.

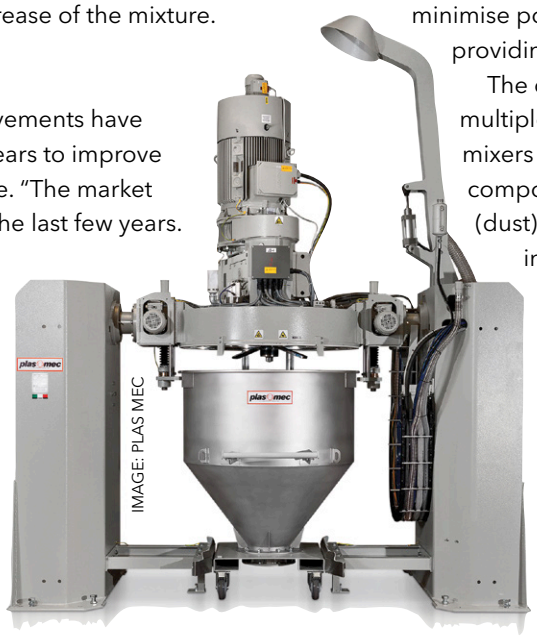
Italian machinery maker **Plas Mec** has been supplying powder mixing machinery for 55 years, during which it says it has built and delivered thousands of mixers and accessories all over the world. The company says one of its distinguishing features is its flexibility in designing, building and installing solutions for specific customer needs.

Plas Mec systems are based on several core pieces of equipment, including the company's TRM high speed mixer and HEC high efficiency cooler mixer. These can be combined in the Combimix HC design, where versions range from 200/800 to 2,500/8,500 l capacity. Systems can be equipped with numerous accessories related to the type of production and the needs of the customer.

The TRR container mixer is said to be a good alternative to conventional turbomixers for production duties requiring a high degree of versatility and needing a wide range of different recipes to be mixed with the same machine. Such applications include processing masterbatch, pigments, technical polymer compounds, and also powder coatings. The turbomixer is available in a High Power version for applications where high intensity mixing is required and there is the need for asignificant temperature increase of the mixture.

Changing markets

Plas Mec says several improvements have been introduced in recent years to improve performance and ease of use. "The market has changed completely in the last few years. It has become much more demanding and selective, and this is due to several factors: the evolution of the automation processes, the demand for productivity and efficiency, workplace safety, regulatory constraints, and competition. These are all aspects that have led to a transformation in the approach by the manufacturer and user of the plants," according to the company.



Right: Plas Mec's TRR mixer is said to provide an alternative to a turbomixer where high versatility is required

"Plas Mec has continued to keep pace with the needs of the customer and the market," the company claims. "Today, the hardest challenge is the difficulty in finding components on the market, especially electronic ones and this requires a great flexibility which Plas Mec can handle in a better way, since it has kept in-house the design of the automation."

UK-based solids handling equipment specialist **Ajax Equipment**'s vertical screw mixer combines a mass flow hopper design with high-rate vertical screw technology to provide efficient batch mixing and blending in plants with limited space. These Ajax mixers have a smaller footprint than horizontal batch blenders, with powder flow property testing used to establish design parameters.

According to Ajax, its vertical screw mixer combines mass flow (determined from powder shear tests) and an inbuilt vertical screw (which effectively promotes high recirculation rates and fulsome flow pattern) to exploit gravity and minimise power consumption while providing efficient mixing.

The company has supplied multiple 5.5-m^3 vertical screw mixers for blending a plastics compound in an ATEX Zone 22 (dust) rated working area, with the interior of the blenders designated as Zone 21 (dust). The design used special discharge features to utilise the central screw's rotation to provide discharge to two alternative discharge ports, each of which were required to totally empty the contents within five minutes. Twin

IMAGE: AJAX EQUIPMENT

Above: This pair of twin screw Ajax mixers are installed at a site rated ATEX zone 21 (internal Zone 22)

screw versions help increase capacity with no further head room requirements.

The Ajax silo mixer uses vertical screws to elevate powder, cascading the material on the bed contents and down the hopper section, which is designed for mass flow. Recirculation of the powder is achieved using screws that have a large entrainment section and include scoops to help reduce the headroom requirement of the hopper section, enabling relatively large volumes of solids to be held within the squat mixer.

US company **Marion Process Solutions** offers diverse blenders for a range of applications in the chemicals industry, including production of PVC compounds, colour concentrates, and TPEs, as well as powdered epoxy and phenolic resins. These include V-Cone Blenders, Double Cone Blenders and batch mixers.

The V-Cone blender is exactly what the name implies: a tumble mixer in the shape of a V. Marion says this design achieves high performance while providing maximum cleanability, especially since there are no internal moving parts to create pockets or product build-up. The V-Cone blender can withstand highly abrasive products and the gentle blending is said to be very suitable for delicate materials. It is particularly good at mixing powders.

The Double-Cone blender uses a tumbling motion within a small footprint and is also said to be easy to clean. Beyond the small footprint, the mix action provides the ability to easily mix large and small-sized ingredients. "Both cone mixers are smart choices when it comes to "high value" mixes, requiring a premium product," says the company.

Marion batch mixers are available from 42 to 17,000 litres capacity and are customised with features specific to the batch. "For example, we can alter the trough geometry, agitator design, main shaft seals, cover design and discharge," says a Marion spokesperson. "In addition, we offer dimpled jackets to the trough for heating/cooling. We can also design for vacuum/pressure, often needed in chemical mixing."

Typically, Marion says customers select batch mixers to handle two to five ingredients of any proportion. However, it says it has supplied batch mixers that have extended this up to 27 ingredients and reports excellent results.

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Performance compounds: delivering more from less

Whether for weight saving, cost or sustainability reasons, compounders are working hard to deliver more performance from less material, writes Peter Mapleston

IMAGE: LEHVOSS

Main image: LehVoss has developed a full range of high performance compounds to replace metals in production of cycle components, offering weight saving and extended durability

In a world increasingly aware of the limits of its resources, "make the most of what you have" seems a pretty sound mantra to follow in all walks of life. It certainly seems to apply to developers of performance polymers and compounds, where there is a common focus on making valuable available materials go further than ever, in their first lives and then later when they are recycled (despite recent claims by Greenpeace plastics can be and are being recycled.) This article takes a look at a few examples of what is going on within some high-performance polymer makers and their compounding customers.

Chemical additives such as POSS trisilanol phenyl have been shown to be effective in cutting-edge formulations using PPE, PPS, PES, polyimide, fluoropolymer, PAEK, and PEI resins, according to Joseph Lichtenhan, VP New Business Development at **Hybrid Plastics** in the US. "Their success results from the low percentage use level that in turn decreases compounding time, reduces viscosity, and improves filler dispersion," he claims.

"Performance filler additives such as carbon nanotubes, graphenes, nano-oxide powders, and fibre reinforcements require an innovative compounding approach because of their entangled, or agglomerated nature, their high surface areas, and the need to retain the desired nano-structural features. While also nanoscopic, POSS 'cage' chemicals are smaller than most additives and they thereby serve well as interfaces between those additives and polymer dimensions (segments, coils, chains)," he says.

According to Lichtenhan, the chemical features of POSS provide ease of use, along with conventional compatibilisation mechanisms such as solubility parameter matching, and take advantage of thermodynamic associations between the cage and polymer or filler surface. "POSS advantageously melts at or near the melting point of polymers [in which it is intended for use]. This melting provides the processing benefits of reducing torque and viscosity of formulations. For example, when the trisilanol phenyl POSS melts at 200°C, it is shear thinning, providing a viscosity range of 7,000-10,000 Pa.s," he says.

"When heated to 300°C, [the temperature around which most high-performance thermoplastics are processed], its viscosity is only 1-10 Pa.s, thus providing rheological reduction during compounding. Upon cooling, the cages re-solidify and provide reinforcement and modulus enhancement."

An example where such nano-additive technology has been realised is in production of aero-

space components. Southfied, MI, US-based Eaton Corporation has designed high-temperature conductive compounds for use in place of metals in aerospace fuel systems. One such material is a PEEK-based material with ESD properties that can be extruded into tubes and used instead of aluminium versions.

"To get a uniform dispersion of carbon-based nanomaterials in PEEK, the Eaton team relies on POSS as a functionalisation and dispersing agent," says Eaton Senior Technology Manager Javed Mapkar. "POSS additives also help to tailor the viscosity to assist with the tube extrusion process and achieve uniform product from batch to batch."

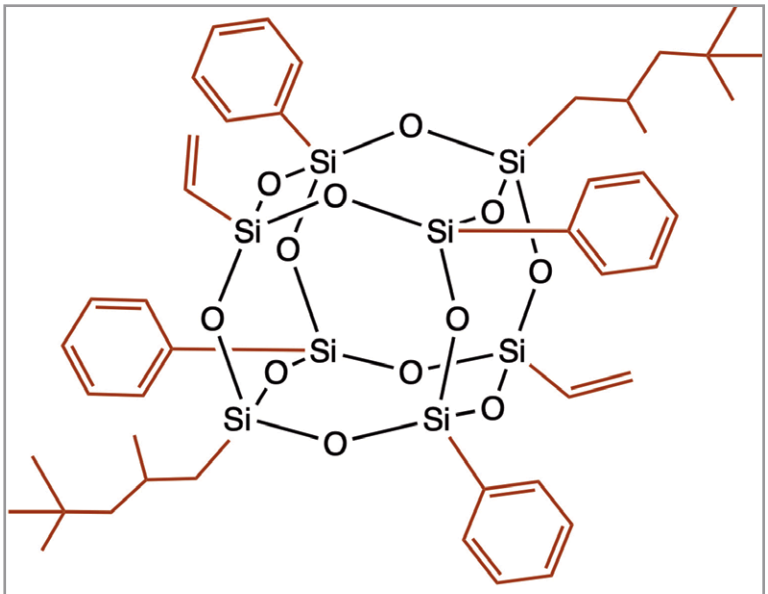


Figure 1: Hybrid Plastics' new HC POSS additives are heteroleptic cage structures that combine two or more different functional groups selected for particular purposes, such as dispersion, plasticisation or compatibilisation
Image: Hybrid Plastics

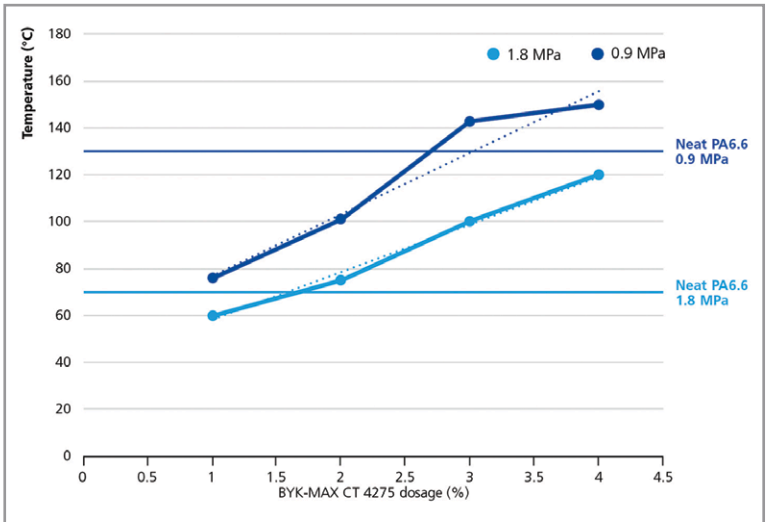


Figure 2: Chart showing the effect of Byk-Max CT 4275 on the heat distortion temperature of PA66
Source: Byk

Expanded platforms

Lichtenhan says Hybrid continues to expand its additive offerings to gain more powerful effects at very low loadings. A new platform known as heteroleptic caged (HC) POSS is currently under development and selective evaluation, he says.

HC POSS additives contain two or more different types of organic groups on the cage core. Each group serves a specific but different purpose, such as providing dispersion, compatibility, or crosslinking. These heteroleptic cages are targeted for use as compatibilisers of ingredients within the bulk polymer. One example (Figure 1) incorporates *i*-octyl groups that provide plasticisation, while the vinyl groups provide latent crosslinking, and the aromatics high temperature and resin compatibility.

"POSS is becoming a "go-to additive" for processing of aromatic thermoplastics when precision dispersion and reproducible formulation are required," Lichtenhan concludes.

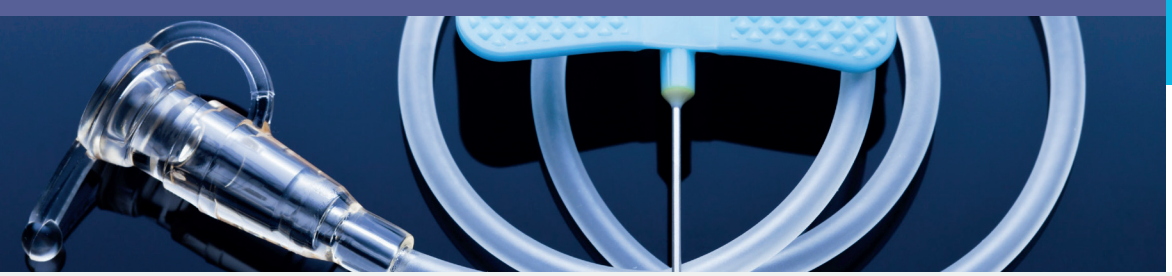
Last month, **Byk Additives** launched its Byk-Max CT 4275 organophilic phyllosilicate, which is aimed at various polyamide applications in sectors such as automotive. The company says the optimised surface treatment and novel morphology of the silicate provides improved dispersion and incorporation into the thermoplastic matrix "while ensuring near-perfect exfoliation in polar systems."

According to the company, the strong reinforcing mechanism provided by Byk-Max CT 4275 improves a number of performance characteristics, including flexural modulus, yield strength, tensile strength, and heat deflection temperature, while ensuring very good flow behaviour. This makes it possible to form thinner components and so reduce weight.

"In mineral and glass fibre-filled thermoplastic composites, the additive enables a lower total content of mineral and glass fibres without comprising the mechanical properties," the company claims. "In addition, Byk-Max CT 4275 will also have a positive effect on surface properties, scratch resistance and flow behaviour."

Byk says the new additive was developed specifically to increase the physical properties of polyamides while having minimal effect on density at the recommended dosage of up to 2.5%. It is said to be highly miscible in polyamides, especially PA6, requiring no special processing considerations.

The company highlights the constant pressure on suppliers to further improve the benefits of PA6 and PA66 in areas such as physical properties, ease of processing, density, and cost in order to continue efforts in metal replacement and to offer an alternative to higher cost engineering polymers.



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PA66 is often preferred over PA6 because of its heat resistance, but PA6 is less costly, and supply is not an issue, the company says.

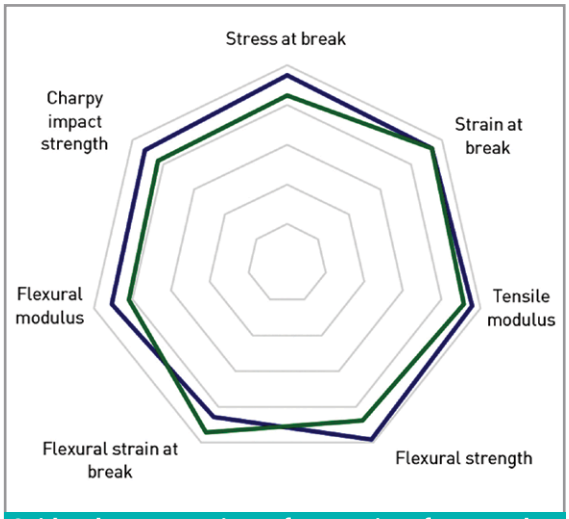
"Automotive and other applications require improved physical properties in polyamide compounds as well as improvement of HDT (heat deflection temperature) in neat PA6 to replace PA66," Byk says (Figure 2).

Sustainable gains

Compounding can make materials at the pinnacle of the polymer performance pyramid more economic to use and also more sustainable. The **LehVoss Group**, and its subsidiary recycling specialist WMK Plastics**,** offer the Luvotech eco product line, which is based on raw materials from mechanical recycling, for application with PC/ABS blends through to PEEK.

LehVoss says the technology employed (it refers to it as the eco compounding eXperience, or ecX) makes it possible to produce materials with "a significantly improved CO_2 balance sheet and a reduced overall environmental impact." Luvotech eco PEEK GF20, for example, has fewer than half the greenhouse gas emissions associated with it than a virgin compound in terms of weight of CO_2-equivalent per kg of material. Recyclate for this product comes mostly from scrap associated with extrusion and machining of stock shape parts.

LehVoss is also emphasising sustainability with the latest addition to its well-established range of long fibre-reinforced thermoplastics (LFT). It is based on DSM's EcoPaXX PA410, a PA that is 100% derived from renewable feedstocks.



Spider chart comparison of properties of two grades of 30% glass reinforced PEEK, one using virgin resin (blue line) and one a recycled Luvotech eco from LehVoss Group (green line)
Source: LehVoss

Sustainability is also an attraction in the range of high-performance compounds designed to replace metals in the field of cycle components, which the company showed as part of its K2022 display. These included high-strength materials with glass fibre and carbon fibre reinforcement; ultralight materials for consistent lightweight construction; tribologically optimised materials for minimising

Solvay's Ryton solution to solar panel design

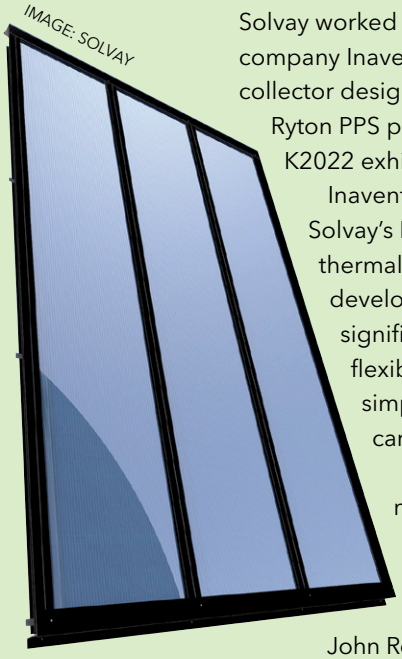


IMAGE: SOLVAY

Solvay worked with Norwegian solar energy company Inaventa Solar to develop a new collector design using a specially-developed Ryton PPS polymer, showing the part at the K2022 exhibition last month.

Inaventa Solar's B170 panel uses Solvay's PPS in place of metal in the thermal absorber sheet, which the development partners say provides significant benefits in terms of design flexibility, automated manufacturing, simplified handling, and lower carbon footprint.

"The main reason for replacing metals with polymers in our business is linked to the goal of making solar collectors with a lower carbon footprint," says John Rekstad, CEO of Inaventa Solar.

According to the developers, the polymer-based system's design flexibility also helps architects achieve a more seamless and aesthetic integration of the solar collectors into the roofs and façades of buildings, allowing them to replace other cladding components as active energy providers.

A new impact-modified Ryton grade is used for the application. It is said to display a combination of long-term heat resistance up to 160°C, high hydrolytic resistance and ease of processing.

Inaventa Solar says it aims to industrialise and commercialise innovative solar collector technology based on high-performing polymer materials. Following initial installations at buildings in Norway and other Nordic countries, the B170 will be available worldwide.

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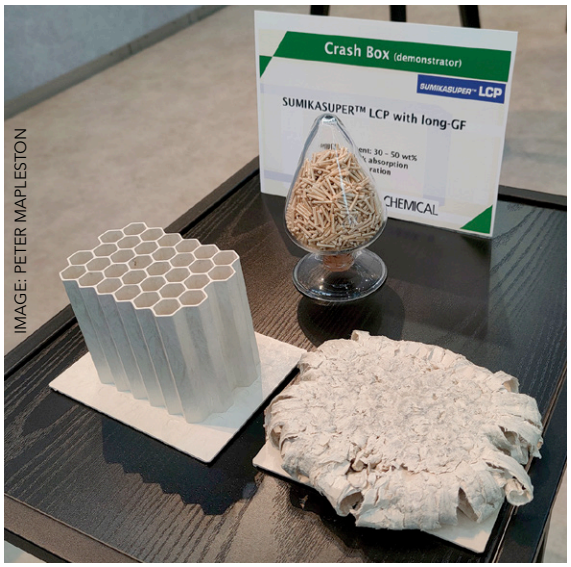

IMAGE: PETER MAPLESTON

Right: This automotive crash box demonstrator is produced in a long fibre reinforced LCP from Sumitomo Chemical. The part is shown before (left) and after impact

wear and friction; and technical recyclates to reduce environmental footprint. "The materials offer a metal alternative in terms of technical performance, component appearance and design freedom, as well as in terms of total cost and carbon footprint," the company says.

PPS developments

Claiming to offer the broadest range of PPS compounds, **Sun Chemical** showed new developments at last month's K2022 trade fair pitched at applications in automotive E-power trains, power electronics, lithium-ion cells and batteries for hybrid and battery cars, as well as for pipes for thermal management of both combustion and electrical engines.

In particular, it highlighted its newly-developed PPS Z-200-XP unfilled, impact modified, extrusion grade, which is designed for use in pipe and tube extrusion. "The solution offers high viscosity at the optimum level for the extrusion process, combined with high flexibility and elasticity, which enables a smooth heat-forming process, while maintaining chemical and heat resistance," the company says. It also presented the PPS Z-240 Black injection moulding grade for bus bar applications for hybrid and electric cars. It is said to offer high flow, good temperature and heat shock resistance, high dielectric strength, and very low dimensional tolerances.

Japan's **Sumitomo Chemical** is using carbon and glass fibres to further improve the performance of its liquid crystal thermoplastics (LCPs). A Sumikasuper LCP grade containing 45% carbon fibre, for example, is said to display very high modulus and high heat resistance. It has been used in components for a suspension system on a sports car test bed at Sumitomo, which are injection moulded with metal inserts for screw attachment to neighbouring components. The grade is also being used in a brake rotor disc, where it weighs around 50% less than a steel alternative and 30% less than aluminium.

Another grade, in this case reinforced with long glass fibre, shows promise for use in "top hat" type crash boxes for cars and is currently being proposed to several automotive OEMs, according to the company. Reinforcement levels of 30-50% are said to provide energy absorption properties on a par with metal versions. Crash boxes based on thermoplastics have been proposed before but Sumitomo says this solution provides a benefit of creating no debris in the event of a crash impact.

The winners list of the Society of Plastics Engineers Central Europe's 2022 Automotive Awards – announced just before K2022– included many parts made in high performance engineering thermoplastic compounds. The overall winner was a centre console including Grivory GVS-5H 50% glass fibre reinforced polyamide (a semicrystalline PA with partially aromatic copolyamide) from **EMS-Chemie**. The powertrain category was won by an EV flap module moulded in two parts and assembled in the mould; one part is moulded in a 30% glass reinforced PPS from Sun Chemical, and the other in a 30% carbon fibre reinforced PA6T/X from **Evonik**.

Solvay secured three third places: in the New Mobility Category for a connection ring insert moulded in Ryton PPS reinforced with 40% glass fibres; in the Enabler Category with a crash impact resistance module in Amodel PPA reinforced with 45% glass fibre; and in the Electronic Category for an inverter module overmoulded with a Ryton PPS compound containing glass fibres and minerals.

Cooling solutions

Plastic components that come into contact with water/glycol mixtures require special compounds, with good chemical resistance and low water absorption high on the list. "Heat resistant 30% glass reinforced

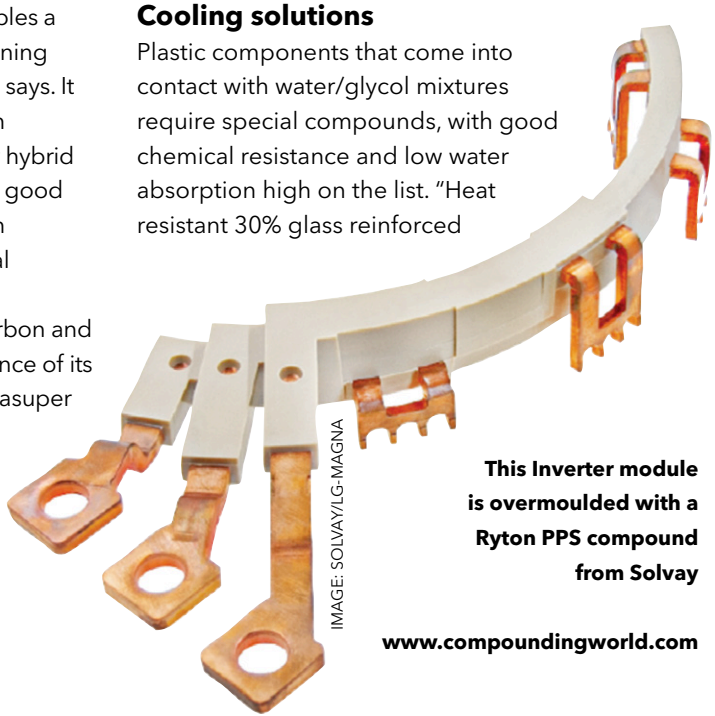

IMAGE: SOLVAY/LG-MAGNA

This Inverter module is overmoulded with a Ryton PPS compound from Solvay

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PA66, which is established on the market, reaches its limits here, especially in thermal management for the e-mobility sector," says compounder **Akro-Plastic** (another SPE winner with a bio-based Akromid Next PA66 reinforced with 35% glass used in a brake disc cover for a motorcycle). It suggests the use of compounds based on polyketone.

"Polyketone compounds inherently have very low moisture absorption, which means that the components show very good dimensional stability in a humid environment," the company claims. "The excellent hydrolysis resistance to water/glycol is one of the greatest strengths of Akrotek PK. With exposure based on the VW standard (TL 52682 over 1000h/135°C), only a very slight drop in material strength can be seen compared to PA66GF30 HSRL [Figure 3]. This brings a significant advantage when designing the component geometry. Thin component wall thicknesses with constant pressure conditions in the component can thus be realised without any problems."

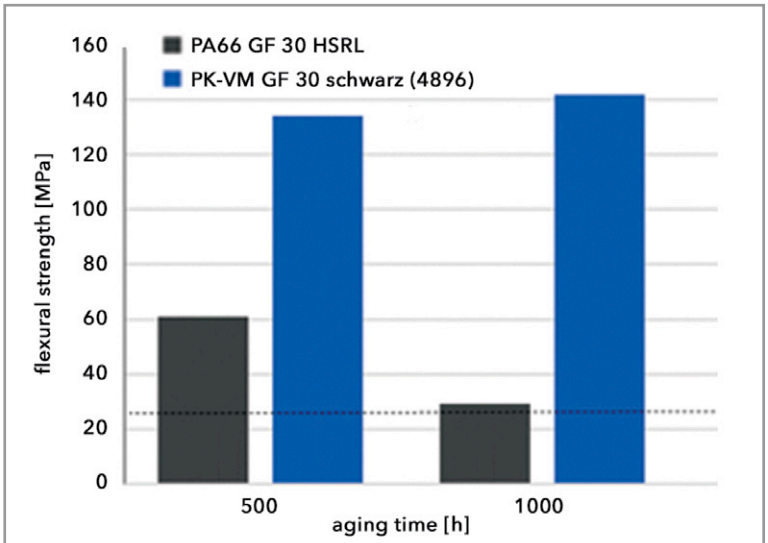
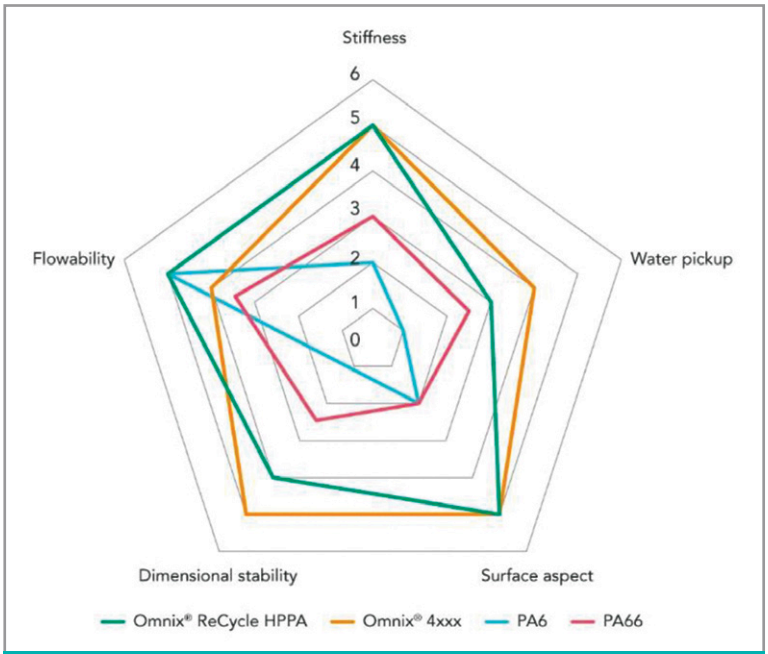


Figure 3: Comparison of hydrolysis resistance of 30% glass fibre reinforced grades of PA66 and a polyketone (Akro-Plastic's Akrotek PK), tested according to VW TL 52682 in glycol solution at 135°C
Source: Akro-Plastic



Spider chart comparison of various properties of Solvay's Omnix ReCycle HPPA compound against virgin Omnix, PA6, and PA66 grades
Source: Solvay

Akro-Plastic also points out that Akrotek PK components can be joined using common welding processes and exhibit high weld seam strength, even when these weld seams are under load. In addition, because PK is highly crystalline, it says short cycle times can be achieved in the injection moulding process.

Recycled materials are now featuring in all sorts of plastics, ranging from commodity polyolefins for packaging through to high-end compounds. At the beginning of this year **Solvay** introduced a new Omnix high-performance polyamide (HPPA) compound family based on a minimum of 33% recycled content. The recycled stream consists of 70% PIR and 30% PCR, which Solvay says is "highly secured and has a controlled process by the supplier." The principal target market is household appliances.

Solvay describes Omnix as a family of polyamides that bridge the cost-performance gap between PA66 (or PA6) and polyphthalamide, PPA. "As Solvay's first-ever recycled-based HPPA with 50% glass fibre reinforcement, Omnix ReCycle is a real breakthrough in the market of polyamides for household appliances," says Claire Guerrero, Global Marketing Manager for Packaging Segment and Sustainability at Solvay.

"It [Omnix ReCycle] combines the outstanding mechanical properties of virgin semi-aromatic HPPA with better flow, lower water pickup and best-in-class surface aspect. In addition, its unique performance and sustainability profile offers an attractive material solution for brand owners and manufacturers who seek to increase the recycled content in their products without compromising dimensional stability, high stiffness, impact resistance and processability," she says.

Solvay says that in household appliance applications, Omnix ReCycle delivers higher durability than provided by standard PA6 or PA66 polymers and, because it yields parts with very good surface appearance, can also eliminate the need for painting.

Another target end use market for OmnixReCycle is automotive interior parts requiring high wear and tear resistance. ›

Driven by events

Italian compounder **Lati** says it has continued to develop new high-end solutions through the pandemic and the immediate post-pandemic period. "Recent political and economic events introduced further factors to be kept under control from availability of raw materials to sustainable development, to energy costs," the company says. "All these elements helped Lati to focus on some important product lines."

The company cites a new range of high-performance compounds featuring chemically or mechanically recycled base polymers. The LatiEco family features glass fibre reinforced flame retardant compounds, based on recycled PA6 and PA66 and fully approved by UL laboratories. "Flame retardant LatiEco grades are sought after by appliance and power management companies, as well as automotive players who are gradually introducing fire resistant plastics in under-the-bonnet applications for traditional autos as well as power storage or distribution and charging stations for electric vehicles," the company says.

Demands for higher chemical, mechanical and thermal resistance were the driving force in its development of a full range of special purpose compounds based on aromatic polyamide 9T. Lati says PA9T shows excellent compoundability and injection moulding ease, as well as good chemical resistance, low moisture absorption, and high continuous use temperature.

PA9T is used in its Laramid T line of compounds, which include thermally and electrically conductive, self-lubricant, flame retardant and reinforced grades for applications in the electrical and electronics industries, for structural parts working in harsh environments, and in "no compromise" automotive components.

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Staying in control inline

*Compounding production lines can be fitted with a variety of inline measurement systems that promise simplified control and improved quality. **Mark Holmes** reports*

IMAGE: COLVISTEC/SKZ

Main image: This lab-scale cascade recycling system uses an inline system developed by SKZ and ColVisTec to maintain colour consistency

Capturing inline product measurement and inspection data to provide real-time adjustment and correction of compounding process parameters promises much improved manufacturing outcomes. These include material waste reductions, higher levels of productivity, better quality end-products, and a more streamlined and less costly production process. Systems already exist to take on tasks as varied as monitoring rheology of the melt in the extruder or controlling and adjusting colour, through to inspection and sorting of finished pellets.

Leistritz Extrusion Technology, for example, developed its Inline Elongational Rheometer to deliver real time data on both shear and elongational viscosity, allowing the line manager to determine melt quality during the extrusion process and providing detailed insight into melt deformation and flow behaviour.

The technology and equipment was developed in cooperation with the Institute for Polymer Extrusion and Compounding at the Johannes Kepler University in Linz, Austria. It takes inline measurements during the extrusion process and delivers real time data on pressure, temperature, melt flow index (MFI) and intrinsic viscosity (IV). The company says such insight allows quality setting in the extrusion process to be adapted without the need to wait for laboratory results, avoiding material waste and time delays.

Measurement of both shear and elongational viscosity is possible inline and in a single step, according to Leistritz. While conventional rheometers can provide such data it says they result in material loss, since the sample is not returned to the production stream. In addition, it says elongational viscosity is typically measured in the lab rather than on the production line.

Leistritz says its inline rheometer can measure both shear and elongational viscosity in a single step, in real time and inline due to its hyperbolic slotted die. This creates a constant expansion flow, which was not possible previously. This die com-

IMAGE: LEISTRITZ

Above: A hyperbolic slotted die with intake and outflow section lies at the heart of the Leistriz system

prises an intake and outflow section, plus two transition zones. In operation, a melt sample is extracted from the extrusion line and diverted into the rheometer. The hyperbolic geometry of the slotted die creates a constant expansion flow while also preventing expansion, and avoiding pressure swirls and dead areas in the flow channel.

The slotted die enables constant monitoring of viscosities with shear rates from 10-10,000 s^{-1} and elongational extension from 5-75 s^{-1}. This ensures that both low and high viscosity polymer melts with or without fillers or reinforcing additives can be analysed. It is also possible to redirect temperature insensitive melts directly into the extrusion process after measurement to prevent material loss (thermally sensitive melts can be channeled out and recovered after measurement).

Application development

According to Leistritz, the Inline Elongational Rheometer offers greater accuracy and, compared to melt analysis in the laboratory, provides the ability to capture valid close-to-process data. This allows comprehensive documentation of melt quality in established production processes as well as improving insight into new applications such as development of polymer blends or fibre-filled compounds.

In the development of polymer blends, for example, Leistritz says inline measurement of full rheological data has not previously been possible. Melt flow rate data can be determined but it represents only one point on the shear viscosity curve and can lead to conclusions that result in waste of material, time and money. Having full rheological data available in real time allows polymer blends to be analysed and fine-tuned more accurately and quickly, it claims.

Leistritz says access to full real-time data also improves quality management by enabling the operator to take immediate remedial action. This can be especially useful in processing of fibre-filled compounds, where elongational viscosity data is important for melt quality settings. Differences between various PP fibre-filled compounds can often only be discerned when this parameter is established, the company says.

Leistritz says the inline rheometer has been developed with a focus on useability and can be added to and switched between existing compounding lines of any make. It can also be fitted as a stand-alone solution.

Recycling research

German plastics institute **SKZ** has just concluded a research project with instrumentation specialist **ColVisTec** exploring ways to improve colour control of recycled plastics materials using a feedback loop. "Only three years remain to achieve rising recycling rates that will be required in the European Union by 2025," say Franziska Eichhorn and Julia Klein, Team R&D, Experts of Polymer Recycling and Spectroscopy, of SKZ.

The researchers say that achieving these high rates is complicated by the fact that the same quality standards are applied to recycled material as to virgin material, while input material compositions can vary regionally and seasonally.

"Quality requirements are expected to be met across an entire batch. For this reason, when colouring compounds, a significant excess of colorant is often used to achieve the desired target colour to obtain a homogeneously coloured re-granulate in every case," they say. "To reduce this excess, SKZ and ColVisTec have developed a resource-saving and highly economical system solution."

To demonstrate the capability of the new system, a cascade system was set up on two twin-screw extruders simulating a small-scale recycling plant. Both extruders were coupled to each other via a melt line. The first extruder was used to melt the recycling material, while the

IMAGE: SKZ/COLVISTEC

Right: A study carried out by SKZ and ColVisTec aimed to develop an inline system to control colour in recycling of PP

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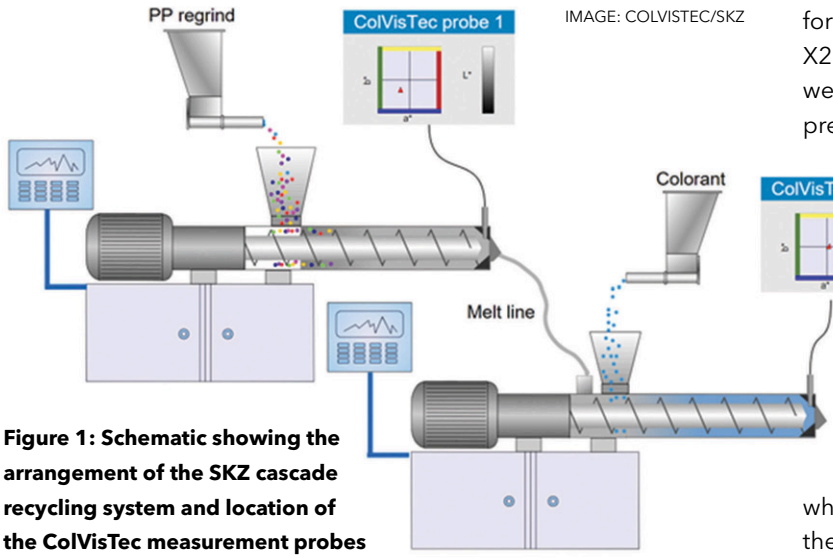


IMAGE: COLVISTEC/SKZ

Figure 1: Schematic showing the arrangement of the SKZ cascade recycling system and location of the ColVisTec measurement probes

second extruder coloured the polymer melt. At the die outlet of each extruder a colour measurement probe was installed in contact with the polymer melt (Figure 1).

The probes were connected to an InSpectro X2 unit from ColVisTec. "This is a high-resolution UV/Vis inline spectrometer for process monitoring that can monitor two measuring channels in parallel," says Fuat Eker, Director of Sales, Marketing and Customisation at ColVisTec. "It is designed for 24/7 use in production environments containing, for example, dust, splash water, temperature changes and vibrations. The measuring probes used have been specially developed for the operation in extruders and are suitable for melt temperatures of up to 400°C and 250 bar melt pressure."

To develop the control loop, various PP regrinds (not pre-sorted in terms of colour) were presented for colouring with masterbatch. With the InSpectro X2, residence time distributions in the extruder were determined by adding a tracer pigment at a precise time and with a specific dosing.

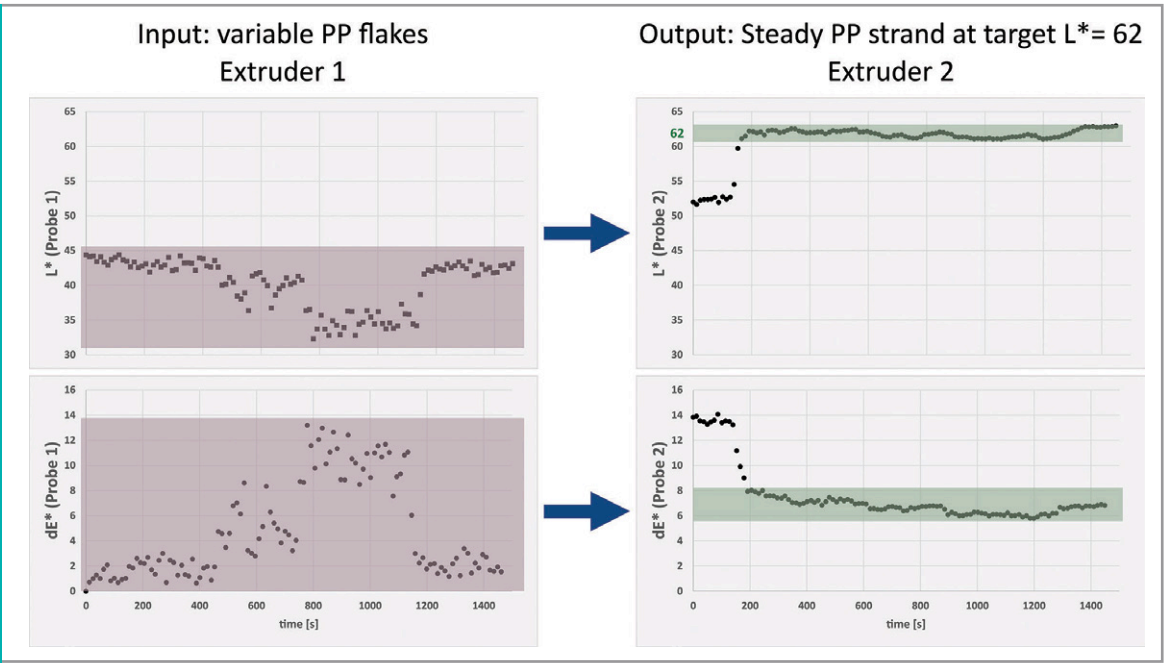
The colour fluctuations of the material within a recycling batch are high, usually up to two units on each colour axis. In some industries a much smaller colour difference may be required, for example dE* of less than 1. Current methods add excess colorant to achieve a uniform colour, but an investigation at SKZ has shown that often this excess is far beyond the concentration of colorant at which the colour would already be saturated. So, if the fluctuation of the base material is measured and the residence time of the extruder is known, variation can be compensated for through a controlled variable addition of colorant.

The research team says that software has been developed that allows the specification of a desired setpoint for any colour axis. The basis for this is the colour variation of the recycled material detected at the die outlet of the first extruder determined with probe one. The addition of masterbatch for colouring is varied based on these colour values, with the result being a constant colour value for the recyclate end product.

In an example trial run, PP regrind was used in light and dark blends with around 12 units of variation in L* (lightness). For the trial run, a value of 62 was specified as the target value for L*. The first extruder was fed with the light PP compound at the beginning, followed by the dark PP compound (after approximately 700s), then switched

Figure 2: Test results from the SKZ/ColVisTec research project show variation in L* within individual batches and at batch changes (Figure 2, left) and the results achieved using the automatic colour control system (Figure 2, right)

Image: ColVisTec/SKZ



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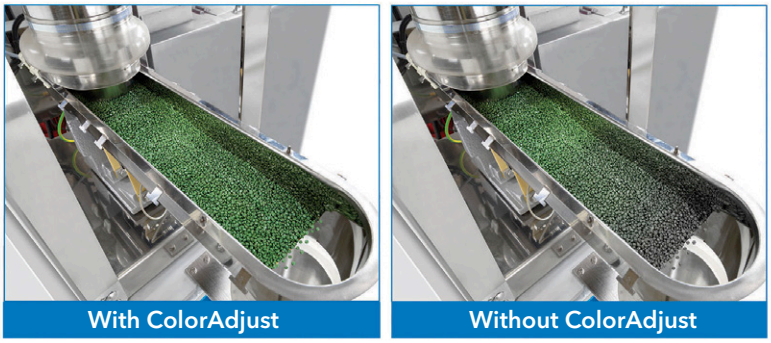

Above: KraussMaffei's ColorAdjust system can automatically monitor and correct even minor colour variations during compounding

back to the light PP compound (after approximately 1,200s). Large fluctuations in L* were observed within the individual batches, as well as the batch changes (Figure 2, left).

The small and large fluctuations in brightness were automatically compensated for by the colour control system over the duration of the process to maintain a constant L* of 62 (Figure 2, right) by means of variable addition of colorant. To complete the proof of the automated control, a constant result was achieved in a further experiment on the colour value b*, also with fluctuating starting material.

SKZ and ColVisTec the concept of automated colour control with the use of inline colour measurement has been successfully implemented. At this point, the system is tailored to a single colour axis but the researchers says it will be possible to extend the present concept to three-dimensional colour control. This will require several feeder units and a further development of the software, the requirements for which are currently being determined. The experimental data also indicates that in some circumstances it should be possible to reduce the complexity of the setup to only one measurement point.

The project was supported by the Federal Ministry for Economic Affairs and Climate Action (BMWK), through the German Bundestag. Interested companies are now invited to learn more about the possibilities of the new system within the framework of cost-neutral trials at SKZ.

Controlling colour

The ColorAdjust system from **KraussMaffei** combines a colour measuring device with photospectrometer technology and machine control to

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Below: Ampacet Liad has integrated its Spectro 4.0 in-line spectrometer and SpectroMetric in-line continuous colour correction system

IMAGE: AMPACET

ensure precise, reproducible colours in plastic compound production. The company says the system is designed for contactless monitoring of colour variation, but can also compensate for minor deviation by directly adjusting the colour setpoint.

According to KraussMaffei, the colour setpoint is rapidly achieved when starting the compounding process after a stoppage, as well as in the event of colour changes. With start-up scrap and reject material minimised, the company says ColorAdjust can ensure sustainable and efficient production of reclaim material, contributing to savings in time and money.

The ColorAdjust system comprises two key elements. First, a spectral photometer determines the colour of the cooled reclaimed pellets in the vibration chute and transmits the corresponding data to the machine control system. The data values are used to control the second system component – the colour metering unit. This is typically equipped with four colour and four metering devices but, on request, can be expanded to six colours to cover the entire colour spectrum that the human eye can distinguish.

The colour can be added in masterbatch or liquid colorant form. The ColorAdjust system adjusts the colours fully automatically without operator intervention and, due to its integration into the twin-screw extruder control system, can be operated from the central control panel.

Designed primarily for processing rather than compounding applications, **Ampacet Liad** has introduced the Spectro 4.0 Smart Technologies range of continuous inline quality control solutions for colour management. The first of two products in the lineup is Spectro 4.0 Smart, a colour measurement system for extrusion and moulding processes that helps control colour variation using real-time colour data. The system uses a fibre optic probe that can measure and automatically adjust for colour variations even when using post-consumer recyclate and regrind material.

"Parts can now be measured instantly, thanks to a fibre optic sensor that communicates real-time colour data," says Doug Brownfield, Commercial Director, CISystems/Liad. "Spectro 4.0 Smart enables companies to reduce the cost of quality due to colour issues and faciliates collection of historical data to improve future productivity."

Spectro 4.0 Smart's differential spectrophotometer compares the colour of the new product to a reference colour in real-time. The fibre optic probe performs reflection measurements but multiple and interchangeable probes are in development for simultaneous multi-point measurement of haze, opacity and transmission and to allow selection from differential or absolute testing modes. The inline system also includes automatic built-in calibration against drifts and ambient illumination.

Spectro 4.0 Smart can connect with another product in the range, the SpectroMetric system for advanced colour accuracy technology. This incorporates the ColorSave 1000 masterbatch feeder to adjust masterbatch dosing automatically, in real-time, ensuring colour consistency.

SpectroMetric runs on L*a*b* specifications, not on set LDRs, and continually monitors for the lowest possible colorant usage rates to maintain correct colour specifications. The system automatically adjusts for colour variation and operates within tight colour tolerances to reduce colour usage and costs.

Feedback loops

US-based **Equitech International Corporation** manufactures a colour instrument that can measure colour directly in molten polymer in an extruder. Currently the operator uses this information to make decisions regarding adjustment to the extrusion process. However, to achieve maximum

IMAGE: EQUITECH INTERNATIONAL

Right: Equitech's ruggedised fibre-optic probes can provide direct measurement in the melt stream of an extruder

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IMAGE: SIKORA

Right: Sikora's PurityScanner Advanced system is designed to provide 100% inline inspection of pellets

benefit, the company is working to use this colour data in a feedback loop to automatically control the addition of colorant to the process to maintain a target product colour.

Several factors present challenges to implementing true closed-loop control, the company says. Firstly, it says the extrusion equipment market is highly fragmented and there are many different vendors of extruders and feeders for dosing the pigments. Extruders may be single-, twin- or multi-screw and come in a wide range of output capacities while feeders may be gravimetric or volumetric and allow for multiple colorants to be dosed into the extruder for a specific recipe.

The company says there are also a multiplicity of vendors of plant-control software packages to which the data and results will need to be communicated. It says it has found that no two manufacturing sites handle process data in exactly the same way, so flexibility in the communications capabilities of software developed in a project will be vital.

Equitech says it is currently developing algorithms that utilise in-line, real-time ultraviolet-visible (UV-vis) spectroscopic data as feedback for closed-loop process control, together with an interface/control module that will manage the communications between the process and the in-line instrument. The control algorithms and interface/control module will also enable the utilisation of other types of in-line instrumentation and further expand the implementation of real-time product control of extrusion operations. These could include near-infrared and Raman spectroscopy, as well as melt viscometry.

The company offers two probe types for use in the plastics industry. The Large Area Surface Probe (LASP) is a non-contact probe used to measure colour of sheets, films and other solid surfaces. The Reflection Polymer Melt Probe (RPMP) is a contact probe intended to measure colour directly in the molten polymer at process conditions up to 5,000 psi and 500°C.

Pellet inspection

German inspection systems maker **Sikora** has developed its PurityScanner Advanced system for optical online inspection and sorting of plastic pellets. The company says raw material shortages and price increases mean that demands in terms of quality control of pellets are increasing. "Even the smallest, critical contamination are reliably detected and sorted out by the system," says Ralf Kulenkampff, Head of Sales – Plastics at the company. "Both the detection and the ejection behaviour of contaminated pellets are perfectly coordinated."

Sikora says that, due to the modular concept of its systems, different camera types can be used depending on the material to be inspected. In addition to optical 25 micron high-resolution optical cameras, which detect black specks and discolouration, an X-ray camera can be installed to detect metallic contamination.

Common systems in use in the market have up to two optical cameras. However, these reach their limits due to relatively low coverage once the contaminant is outside the cameras' field of view. Integrating a third black and white camera can significantly increase the detection rate in such applications and is an option Kulenkampff claims is unique to the Purity Scanner Advanced design.

Detected contamination is removed using a blow-out unit. Sikora has developed a hybrid blow out function to allow customers to optimise the by-catch to suit their own particular requirements. For example, it is possible to define in advance which contaminants are uncritical and select a smaller blow-out unit for these to reduce the by-catch. This could include small, light-coloured black specks that frequently occur in the material. On the other hand, a larger blow-out unit can be specified for critical contaminants, such as metal fragments, which can impair the functionality of the subsequent end-product.

"The interaction of reliable detection and hybrid blow-out ensures the highest material quality," says Kulenkampff. "At the same time, production processes are optimised, and the reduced by-catch contributes to cost-efficient and sustainable production."

CLICK ON THE LINKS FOR MORE INFORMATION:

- **www.extruders.leistritz.com**
- **www.skz.de**
- **www.colvistec.de**
- **www.kraussmaffei.com**
- **www.ampacet.com/liad-smart**
- **www.equitechintl.com**
- **www.sikora.net**

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COPERION: STS EXTRUDERS

Coperion's STS Mc11 line of twin screw extruders provides performance at a competitive price. This brochure describes the full features of the range, from the recently launched 90 kg/h 25mm diameter laboratory model to the 4,200 kg/h 96mm version.

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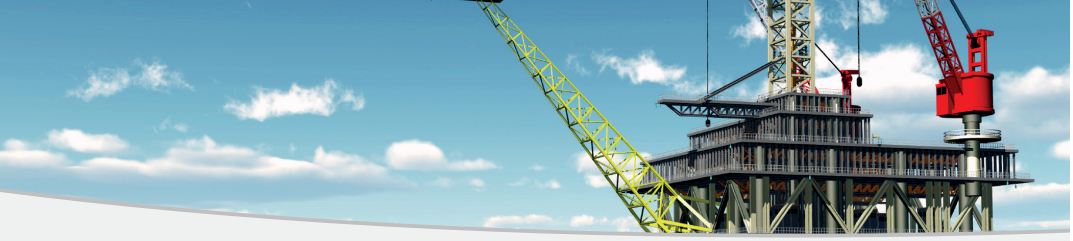

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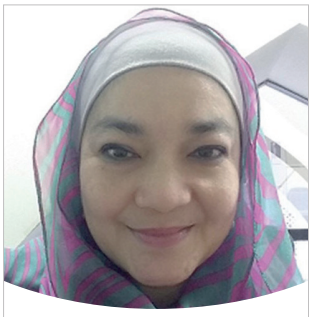

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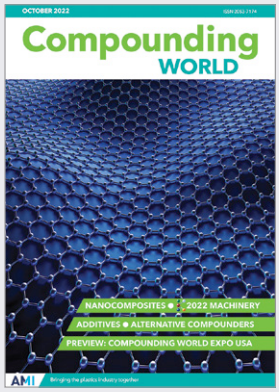

Compounding World October 2022
Compounding World delves into nano additives in the October edition. The cover story looks at new developments in graphene and CNTs. Other features cover additives for recycling and alternative compounding technology. Plus a preview of K2022 machinery exhibitors.

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Compounding World September 2022
The September edition of Compounding World contains features on colour pigments, developments in bio-based plastics, new antioxidants and stabilisers. The issue also includes an extensive preview of materials and additives from major exhibitors at the K2022 exhibition.

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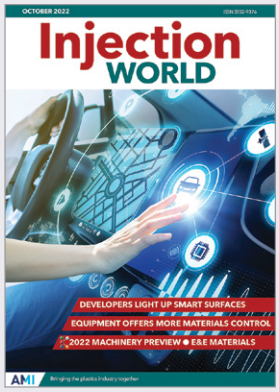

Injection World October 2022
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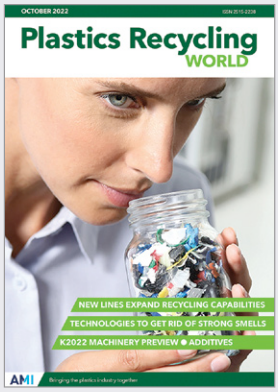

Plastics Recycling World October 2022
The October 2022 edition of Plastics Recycling World looks at the latest technologies for removing odours from recycled plastics. This issue also explores the latest developments in recycling extrusion lines and additives. Plus, we preview the US Plastics Recycling World Expo.

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Pipe and Profile October 2022
The October edition of Pipe and Profile magazine looks at the latest advances in pipe inspection. This issue also explores new developments in material handling equipment and PVC-O pipe technology. Plus, a preview of some of the new material introductions to see at K2022.

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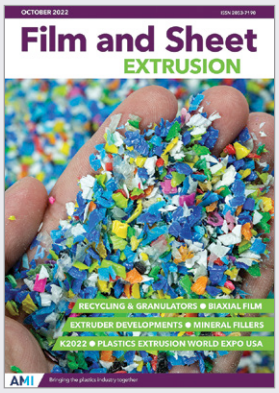

Film and Sheet October 2022
The October issue of Film and Sheet Extrusion takes a look into the world of plastics recycling technology, with other features covering extrusion machinery and biax film. Plus there are previews of K2022 materials and AMI's Plastics Extrusion World Expo North America.

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GLOBAL EXHIBITION GUIDE

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	23-26 November	PlastEurasia, Istanbul, Turkey	https://plasteurasia.com/en/
	1-3 December	Plast Print Pack West Africa, Accra, Ghana	www.ppp-westafrica.com
2023	**17-19 January**	Swiss Plastics Expo, Lucerne, Switzerland	https://swissplastics-cluster.ch/
	1-5 February	PlastIndia, New Delhi, India	www.plastindia.org
	17-20 April	Chinaplas 2023, Shenzhen, China	www.chinaplasonline.com
	30 May – 2 June	Equiplast, Barcelona, Spain	www.equiplast.com
	14-15 June	Compounding World Expo Europe, Essen, Germany	www.compoundingworldexpo.com/eu/
	5-8 September	Plast 2023, Milan, Italy	www.plastonline.org/en
	26-28 September	Interplas, Birmingham, UK	www.interplasuk.com
	20-21 September	Injection Molding & Design Expo, Novi, MI, USA	www.injectionmoldingexpo.com
	17-21 October	Fakuma, Friedrichshafen, Germany	www.fakuma-messe.de
	8-9 November	Compounding World Expo USA, Cleveland, USA	www.compoundingworldexpo.com/na/

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28-30 Nov 2022	Fire Resistance in Plastics Europe, Cologne, Germany
29 Nov-1 Dec 2022	Polymers in Footwear Virtual Summit, Online event
7-8 Dec 2022	Oil & Gas Non-Metallics Europe, London, UK
8-9 Dec 2022	PVC Formulation Asia, Bangkok, Thailand
24-26 January 2023	Thermoplastic Concentrates, Orlando, FL, USA
21-22 February 2023	PVC Formulation North America, Cleveland, OH, USA
28 Feb -1 March 2023	Compounding and Masterbatch Asia, Bangkok, Thailand
6-8 March 2023	Cables Europe, Cologne, Germany

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