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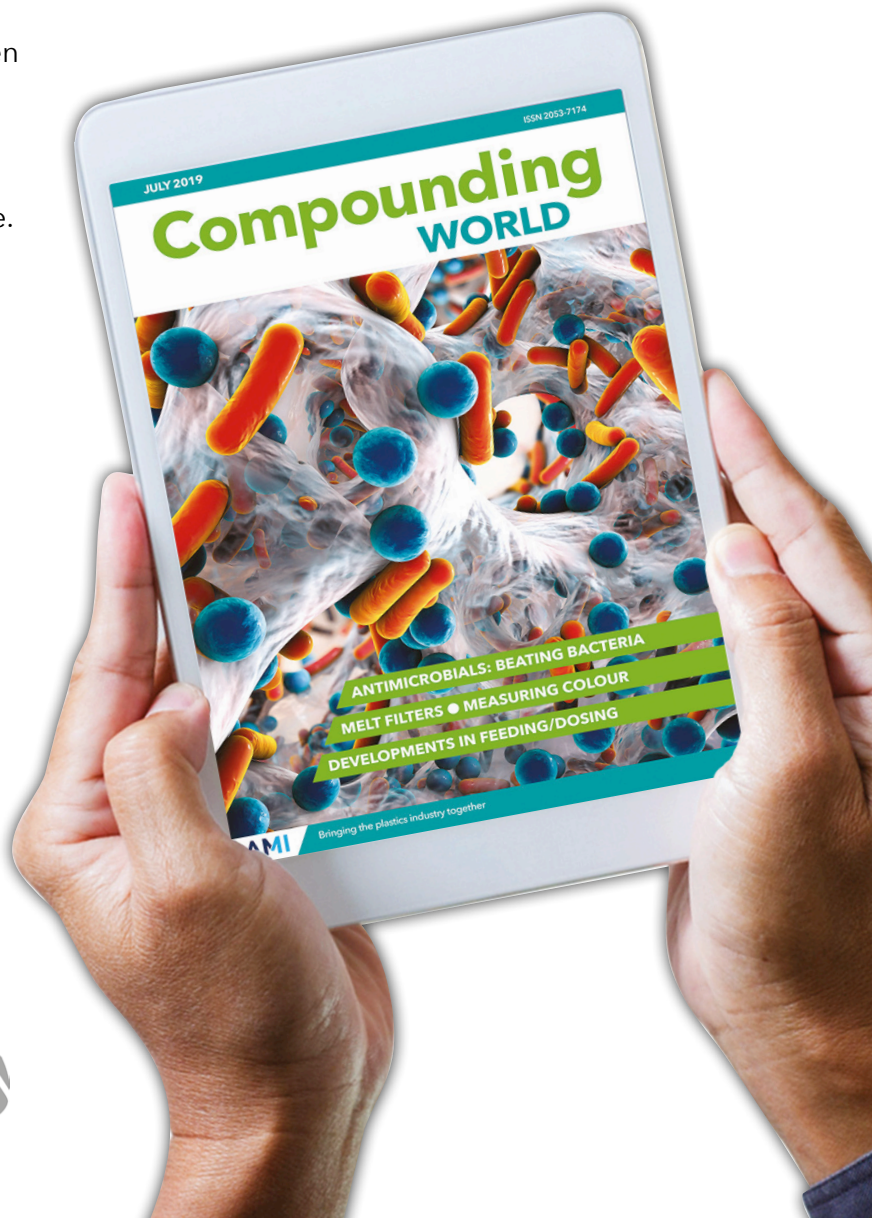

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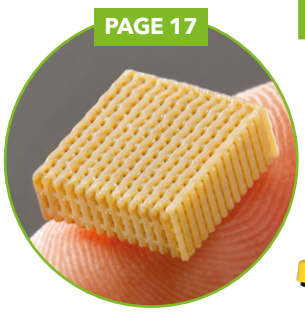

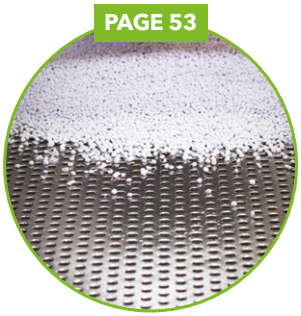

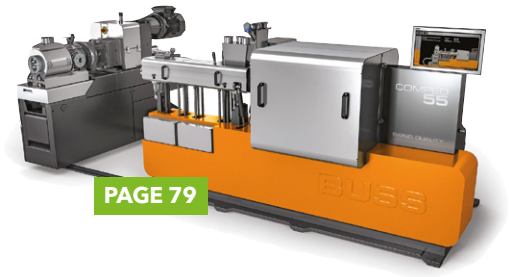

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Sirmax invests in bioplastics

Sirmax is expanding its activities in sustainable compounds with the acquisition of a 70% stake in bioplastic compound manufacturer Microtec, which is based at Mellaredo di Pangia in Italy. The company has a capacity of around 8,000 tonnes/yr and generated sales of around €19m last year.

According to Sirmax, it is investing around €20m to acquire the majority share in the company and to further expand production. Plans will see the construction of a new building and the addition of two new Coperion compounding lines to the current four. Capacity will be doubled to 16,000 tonnes/yr in the first phase of the investment but Sirmax says the new building is sized for 10 lines and a potential capacity of 40,000 tonnes.

PHOTO: SIRMAX

Above: Microtec founder Diego Lombardo (left) and Sirmax CEO Massimo Pavin seal the €20m bioplastics deal

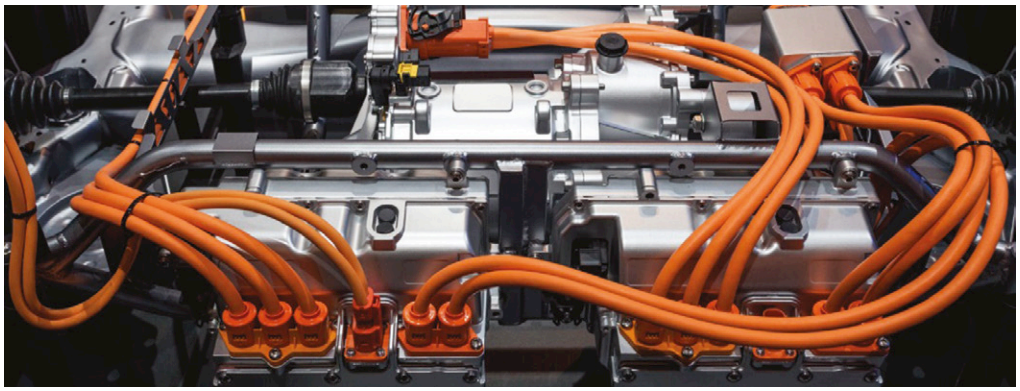
Microtec was originally established in 2012 by Diego Lombardo (who remains with the business and retains the outstanding 30% share) to produce bio-based and compostable plastics for packaging applications.

Sirmax CEO Massimo Pavin said the company has acquired the firm as part of its response to demands for circular economy solutions from its customers. "The synergy between Sirmax and Microtec will allow us to develop bio-based materials for traditional application areas, such as the automotiveand household appliance sectors," he said.

The investment is part of an €80m three-year plan by Sirmax that will also see it more than double capacity to 40,000 tonnes/yr at the recently acquired SER plastics recycling operation at Salsomaggie Terme in Italy and set up a 14,000 tonnes/yr PP recycling facility at a newly established SER North America site alongside its compounding operation at Anderson in the US.

› **www.sirmax.com**

PHOTO: COLLOIDS



Collids is targeting EV connectors with new signal orange T-Tec masterbatches

Orange is the new black

Colloids has expanded its range of speciality T-TEC high performance polymer masterbatches in signal warning orange. The product line now includes masterbatches for PEEK, PPSU, PSU, PEI, PA 10T, PA 12, PBT, PA 6T and PA66, with PA46 and PA610 in the final stages of development.

Signal warning orange is now the colour specified by automotive OEMs for high voltage cable and connector applications in battery-electric, hybrid and plug-in hybrid electric vehicles, notably under-the-bonnet electrical components, conduits and charging plug units.

The company said the development work was carried out by its R&D team at Colloids Plastic (Suzhou) in China in response to local market demand.

The T-TEC range is available in Colloids' proprietary universal carrier or in a polymer-specific carrier.

› **www.colloids.com**

Rebrand for Maag

Switzerland's Maag Pump Systems has announced that its Automatik, Ettlinger, Gala, Maag, Reduction and Scheer brands are to be bundled together under the Maag Group umbrella brand.

The move follows significant growth of the group through acquisition in recent years and will be presented externally for the first time at K2019. It sees the creation of four centres of excellence: Pump & Filtration Systems, Pelletising Systems, Pulverising Systems, and Recycling Systems.

› **www.maag.com**

Benvic buys Dugdale

Benvic Europe has acquired Dugdale Compounds, which was hitherto the largest independent PVC compounder in the UK. The move is Benvic's sixth acquisition in just over 18 months, following the purchases of Vinyloop, Plantura and Modenplast in Italy, Alfa PVC in Poland and Ereplast in France.

"The integration of a major player like Dugdale within Benvic will allow us to significantly strengthen our operations in the UK and Irish markets, where the group has become a major player over recent years," said Benvic CEO Luc Mertens.

Headquarted at Chevigny Saint Sauveur in France, Benvic sales amount to €225m annually and it has seven production sites in five countries. Its key markets are the construction, packaging, automotive and medical sectors.

Based at Sowerby Bridge in the UK, Dugdale posted sales of around £36m in 2018 on volumes of around 26,000 tonnes of compound. Its main markets are construction, leisure, healthcare, electronics and transport. Dugdale Managing Director David Outen, Head of R&D Dr Jeff Ryan, and Finance Director Darren Rowell will all continue in their current roles.

› **www.benvic.com**
› **www.dugdalepvc.com**

PHOTO: DUGDALE COMPOUNDS

Dugdale Compounds is Benvic's latest acquisition

LB lifts capacity at Knapsack

LyondellBasell has started up a fifth production line at its site at Knapsack in Germany, adding 25,000 tonnes/yr of new capacity taking the total to more than 200,000 tonnes.

The move is the latest in a series of debottlenecking investment projects across its European operations. It makes the Knapsack site the world's largest PP compounding facility, according to the company.

The company said it expected demand for its lightweight polymer compounds to grow in automotive for both conventionally-powered vehicles, where they can contribute to reduced CO_2 emissions, and in the coming generation of electric vehicles.

› **www.lyondellbasell.com**

Indonesia boost for blockers

Holland Colours has expanded capacity for light blocking colourants at its site in Surabaya, Indonesia, in response to growing demand from the Asian market for PET packaging for long shelf-life milk and other dairy products.

"This expansion plan is far more than solely a matter of production capacity. It aims to give operations the most advanced equipment in the market in order to provide our customers and team members with the technology and capacity they need to grow in a sustainable way", said Henri Jacobs, director in charge of Asia.

Holland Colours has been active in colourants for 40 years and specialises in customer-specific products. In 2007, it introduced the first versions of advanced light barrier technology for monolayer PET UHT milk packaging under the Holcomer brand.

› **www.hollandcolours.com**

Automotive first for BASF Vision

BASF's semi-crystalline Ultramid Vision high transparency PA is being used in a car interior for the first time in this window regulator module for an unnamed German OEM.

The part was developed by BASF together with Valeo. Aside from transparency, the Ultramid Vision grade offers good temperature, chemical and scratch resistance and can be combined with other PA grades using multi-component moulding methods.

"Due to its excellent properties, Ultramid Vision was a focus for us from the outset," said Sebastian Laukat, Project Manager at Valeo. "The balanced characteristics profile in terms of mechanics and processability in conjunction with the high scratch resistance and UV stability were ultimately the decisive factors."

› **www.ultramid-vision.basf.com**

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Modern Dispersions invests

Modern Dispersions, a US supplier of thermoplastic compounds and concentrates, has announced production capacity expansions at two manufacturing facilities.

The company is adding a 133mm twin-screw extruder and ancillary equipment to increase capacity for engineered compounds and masterbatches at its facility at Fitzgerald, Georgia, US. Due to startup by Q2 2020, the new line will meet strong demand growth in the automotive, electrical components and electronics packaging markets.

The company will also bring on new capacity for black masterbatch at its site at Leominster in Massachusetts, US, next year.

Modern Dispersions has also announced the installation of a 50mm Steer twin-screw pilot line at the same location with 1,500 kg/hour of capacity for development of new PA, PC and PET formulations and to support initial scale-up and pre-production needs.

› **www.moderndispersions.com**

European Commission will classify TiO_2 carcinogenic

The European Commission has decided to move ahead with plans to classify titanium dioxide (TiO_2) as a category 2 carcinogen due to potential inhalation hazards.

The decision follows last month's Competent Authorities Meeting for REACH and CLP Regulations and goes against the advice of the majority of its members, according to the VDMI (the German association representing mineral pigment and masterbatch producers).

It follows a change in the legal process for CLP amendments to allow fast tracking into law as a "delegated act". This means the classification will come into force if no objection is raised by either the European Parliament or Council of Ministers within two months.

"Delegated act" procedure could fast track adoption

PHOTO: SHUTTERSTOCK

VDMI and other opponents of the classification argue that TiO_2 is not toxic but is hazardous due to its particulate nature so should be addressed via occupational exposure limits. They argue that applying the Category 2 carcinogen classification will mean that products – such as plastics and paints – will be labelled as hazardous even where there is no risk of TiO_2 inhalation. Recycling and waste is one area of critical concern, says VDMI, as any product containing more than 1% of TiO_2 will become a hazardous waste and could not be recycled.

› **www.vdmi.de**

Penn Color grows in Europe

Penn Color opened its expanded facility for production of PVC and engineering plastics colour and additive masterbatches at its site in Venray in the Netherlands this month.

The $12m expansion includes a customer innovation centre, which will be focused on a new rapid digital colour matching and prototyping system, as well as laboratory, warehouse and office upgrades.

The plant will produce masterbatches for use in PVC profiles and siding, calendered PVC films and various engineering polymer applications, in addition to thermoplastic masterbatches for packaging, water-based inks and coatings for wallcoverings and floorings.

› **www.penncolor.com**

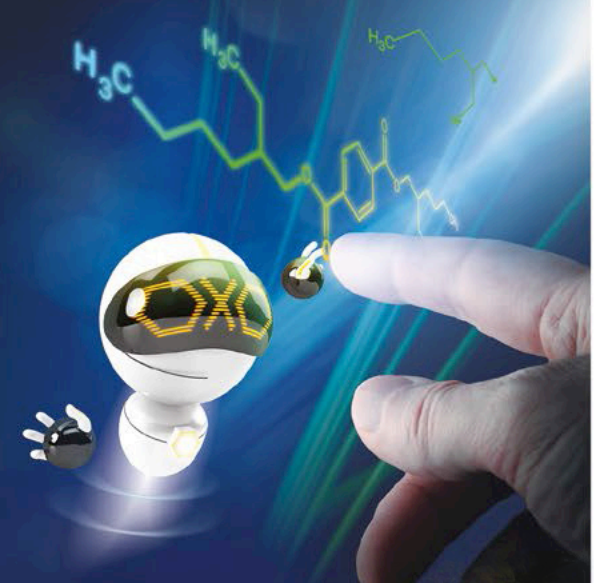
10,000tpa PHA project underway in Russia

Taif JSC Group, a Russian petrochemicals producer, has announced the start of the construction phase of its 10,000 tonnes/year polyhydroxyalkanoate (PHA) bioplastics project in the special economic-industrial zone of Alabuga in Tatarstan.

The company plans to award the contract for construction of the plant by the end of the year and to start production in 2H 2021. In the longer term, capacity may be doubled, said the company.

The project will use technology licensed from Italy's Bio-on to transform agricultural waste, including molasses and sugar cane and sugar beet syrups, into PHA polymer. The two companies signed an agreement in October 2018.

› **www.taif.ru**



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Oxoplast.com/en/plasticizers/adoflex

Grupa Azoty

Ford/Roechling share insight at LFTs 2019

Engineers from Ford and Roechling will detail the development of the company's D-LFT MegaBox multi-functional luggage compartment – which will be launched on the upcoming Puma car – at AMI's Long-Fibre Thermoplastics conference in Dusseldorf in Germany in December.

The MultiBox is the first composite multi-functional luggage compartment box to be put into a series production vehicle by Ford. Manufactured using compression insert moulding by Roechling Automotive, the part glues to the rear vehicle floor and can be purposed to hold luggage, spare wheel or Li-Ion battery according to the specific vehicle specification.

PHOTO: FORD MOTOR CO

Ford's D-LFT MultiBox luggage compartment system will be detailed at Long-Fibre Thermoplastics 2019

The thinking, development and production of this novel component will be explained by Meltem Öztürk and Egemen Erbil from Ford Otosan in Turkey, Matthias Hellriegel from Ford Motor Company in Germany, and Egon Moos from Roechling Automotive.

Attendees at AMI's third Long-Fibre Thermoplastics conference, which takes place on 4-5 December 2019, will also hear from material and technology experts from LFT specialists including Borealis, Celanese, Fraunhofer, Lotte Chemical, SABIC, SKYI Composites and Xiamen LFT Composite.

To find out more about Long-Fibre Thermoplastics and to book a place, download the conference brochure: **bit.ly/LFTs2019**

Teijin opens plant in Thailand

Teijin has begun operations at its compounding plant and technical centre at the Bang Pa-in Industrial Estate near Ayutthaya in Thailand.

Teijin said it "is positioning the new technical centre in Thailand as a development hub for the ASEAN region". The intention is to accelerate its business expansion by strengthening product development capabilities, particularly in the Chinese and ASEAN markets.

The plant is the Japanese company's third resin-related R&D hub in Asia – it has others in Japan and China.

› **www.teijin.co.jp**

PolyOne reclaims black

PolyOne has launched OnColor RC Environmental Black, a colour concentrate made using a reclaimed carbon black sourced from scrap rubber from end-of-life tyres.

According to Bolder Industries, which manufactures the carbon black pigment, production uses 90% less water and 61% less electricity while emitting 90% less CO_2 than manufacture of virgin carbon black.

PolyOne said that OnColour RC Environmental Black passes all relevant REACH and RoHS requirements. Applications are envisaged in the automotive, appliances, electronics and office furniture market.

› **www.polyone.com**


PHOTO: POLYONE

PolyOne's latest OnColor product uses reclaimed carbon black

Italian plastics machinery sales slow in first half

Amaplast, the Italian plastics machinery association, released mid-year figures showing that the country's trade in plastics machinery continued to decline in 1H.

Overall, the association said imports were 17% down on 1H 2018, while exports were 5% down.

The decline is mainly the result of a slump in trade with Germany, which is Italy's largest import and export partner for plastics machinery. Imports and exports fell by 26% and 33% respectively, Amaplast said.

Most other European national markets were also down for Italian exporters, as was South America. North America was slightly up but by far the strongest markets were in the Far East and Middle East, with China showing a 39% increase, Thailand 55% and Indonesia more than doubling albeit from a low base.

› **www.amaplast.org**

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Lanxess opens €20m China plant

Lanxess has officially inaugurated its new €20m compounding facility at Changzhou in China. The facility produces the company's Durethan and Pocan high-tech compounds, which are used mainly in the automotive, electrical and electronics sectors.

"This facility was built to address several strategically vital markets," said Hubert Fink, Member of the Lanxess Board, at the opening ceremony. "In the automotive industry, lightweight materials become ever more important in new mobility. At the same time, the electrical and electronics sector sees an increasing need for best-in-class flame retardant, easy flow and easily processable grades."

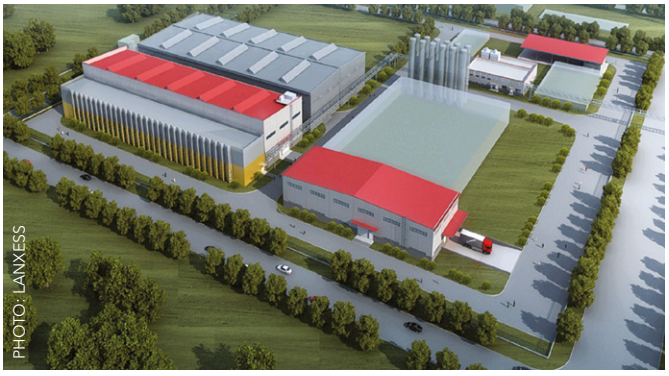
PHOTO: LANXESS

The €20m Lanxess compounding operation at Changzhou in China

The new facility is part of the company's High Performance Materials business unit, which includes sites at Brion, Dormagen, Krefeld-Uerdingen and Hamm-Uentrop in Germany, Antwerp in Belgium, Gastonia in the US, Porto Feliz in Brazil, Jhagadia in India, and Changzhou and Wuxi in China.

› **www.lanxess.com**

NEWS IN BRIEF...

Turkish compounder **Epsan** has launched Eplon+, a new range of recycled PA compounds made from post-industrial materials. Eplon+ grades are said to offer heat-ageing properties that match prime PA compounds with similar mechanical properties. Applications are envisaged in the automotive and household appliances markets.
www.epsan.com.tr

Carbon nanotube producer **OCSiAl** has supplied a licensing agreement with **Skintech** of Brazil to supply its Tuball Matrix product in the country. Tuball Matrix is a pre-dispersed form of OCSiAl's Tuball graphene additive. Initial applications in the Americas are focused on electrostatic discharge flooring.
www.ocsial.com
www.skintech.ind.br

PureCycle claims carpet success

PureCycle Technologies said last month it has completed tests in the feedstock evaluation unit (FEU) at its site at Hanging Rock, Ohio, US, during which waste carpet was transformed into "clear, odourless, ultra-pure recycled PP."


PHOTO: PURECYCLE TECHNOLOGIES

Ultra-Pure recycled PP produced from carpet waste

The Hanging Rock site uses technology developed by Procter & Gamble, which PureCycle said "can remove virtually all contaminants and colours from used plastic, [and] has the capacity to revolutionise the plastics recycling industry".

A second phase is due online at Hanging Rock in summer 2021, which will process about 54,000 tonnes/yr of waste PP into 47,600 tonnes of virgin quality material. This is expected to find applications in packaging, home furnishings and others where recycled PP is rarely used.

PureCycle is also hoping to obtain a letter of non-objection from the FDA for use of its material in food grade applications. The company said that the first plant is now fully subscribed and it has initiated site selection for a large-scale operation in Europe.

› **www.purecycletech.com**

A TPU first for First Graphene

First Graphene and Steel Blue, a maker of work boots, have completed prototype trials for production of graphene-enhanced industrial safety boots using what is claimed to be a new TPU masterbatch "first".

The boots were manufactured using First Graphene's PureGraph 10 graphene powder infused in the TPU soles and foamed innersoles. According to the company, it is the first time the material has been successfully incorporated into a TPU masterbatch.

PureGraph 10 is characterised by non-aggregated, graphene nanoplatelets that ensure even dispersal.

› **www.firstgraphene.net**

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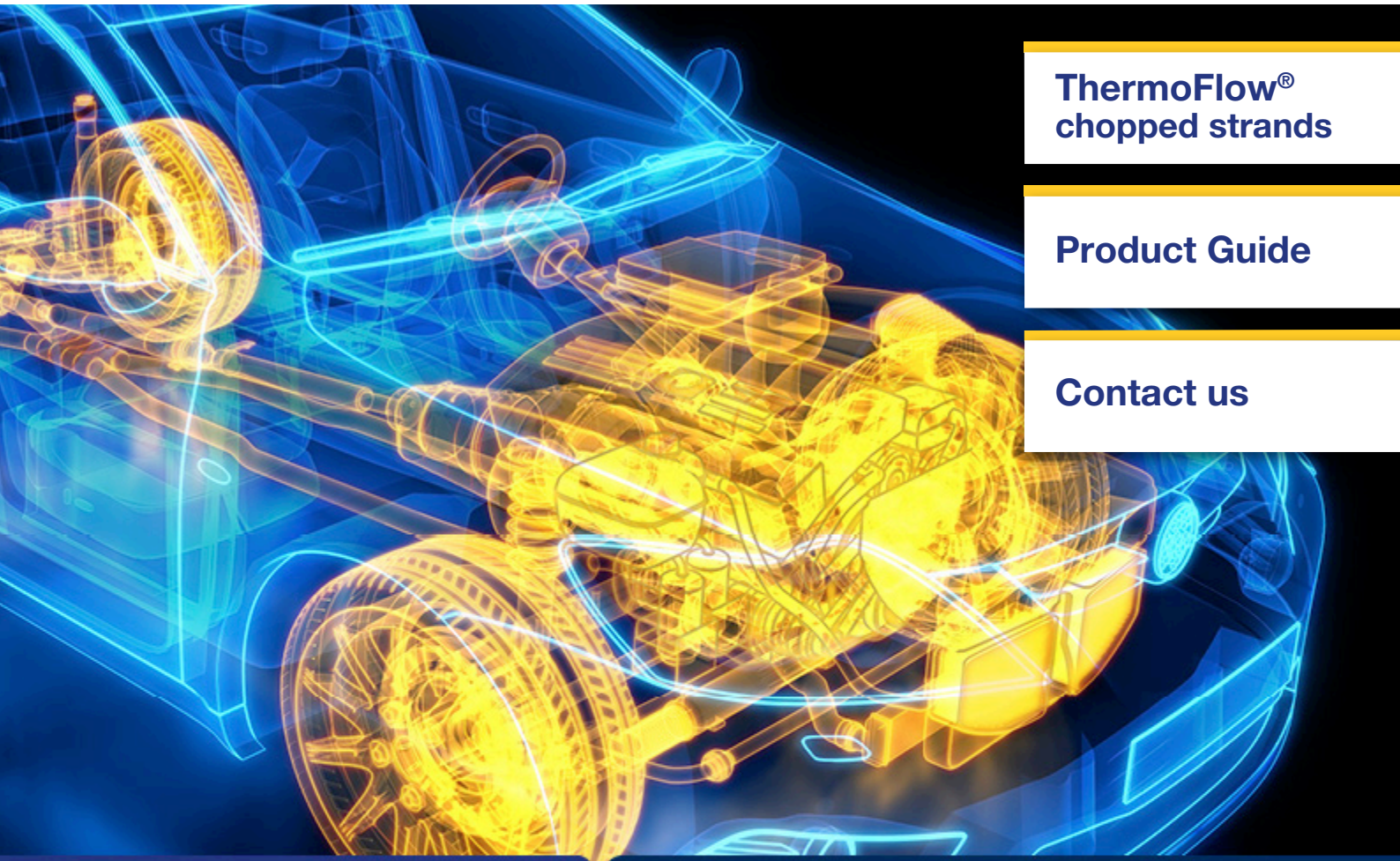

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PHOTO: LATI

Above: LATI is updating its pilot production plant

Coperion delivers for LATI pilot plant

Italian technical compounder LATI is updating its pilot production line at its plant at Torba. The project, which will be ready for start-up in May of 2020, includes an automated materials handling system engineered by Coperion.

LATI's product range is broad and includes high-performance structural, flame retardant, self lubricating and conductive compounds for sectors such as automotive, electrical & electronic, appliances, water distribution, and food contact. As a consequence, it handles a wide variety of raw materials.

Key requirements for the pilot plant included flexibility in operation, fast product changeover, and integration into the company's plant automation strategy. The Coperion solution includes bulk bag unloading, weighing stations, vacuum conveying lines and automated raw material bins handling with weighing systems, all of which interface with the existing Coperion K-Tron feeders of the pilot plant at the location.

"We were looking for a strong partner with extensive expertise in the field of difficult to handle and efficiently convey materials," said LATI CEO Michela Conterno. "With this new pilot line project they [Coperion] helped us tremendously to raise the bar for the complex tasks of handling such a large variety of products and additives as we have."

› **www.lati.com**

› **www.coperion.com**

FDA approval for Erema

The US FDA regulatory authority has granted food contact approval for recycled post-consumer HDPE made using Erema's Intarema TVEplus RegrindPro extrusion system at up to 100% content.

The Austrian machinery maker said the decision "opens up new opportunities to close the loop in food packaging made of HDPE".

The system uses HDPE which is 99% sourced from post consumer milk and juice bottles. In combination with the ReFresher anti-odour module, it achieves the purity needed for production of bottles, food dishes and similar products during a one-hour dwell time in the preconditioning unit of the recycling extruder.

The Intarema TVEplus RegrindPro technology has already been used in a commercially launched shower gel bottle.

› **www.erema.com**

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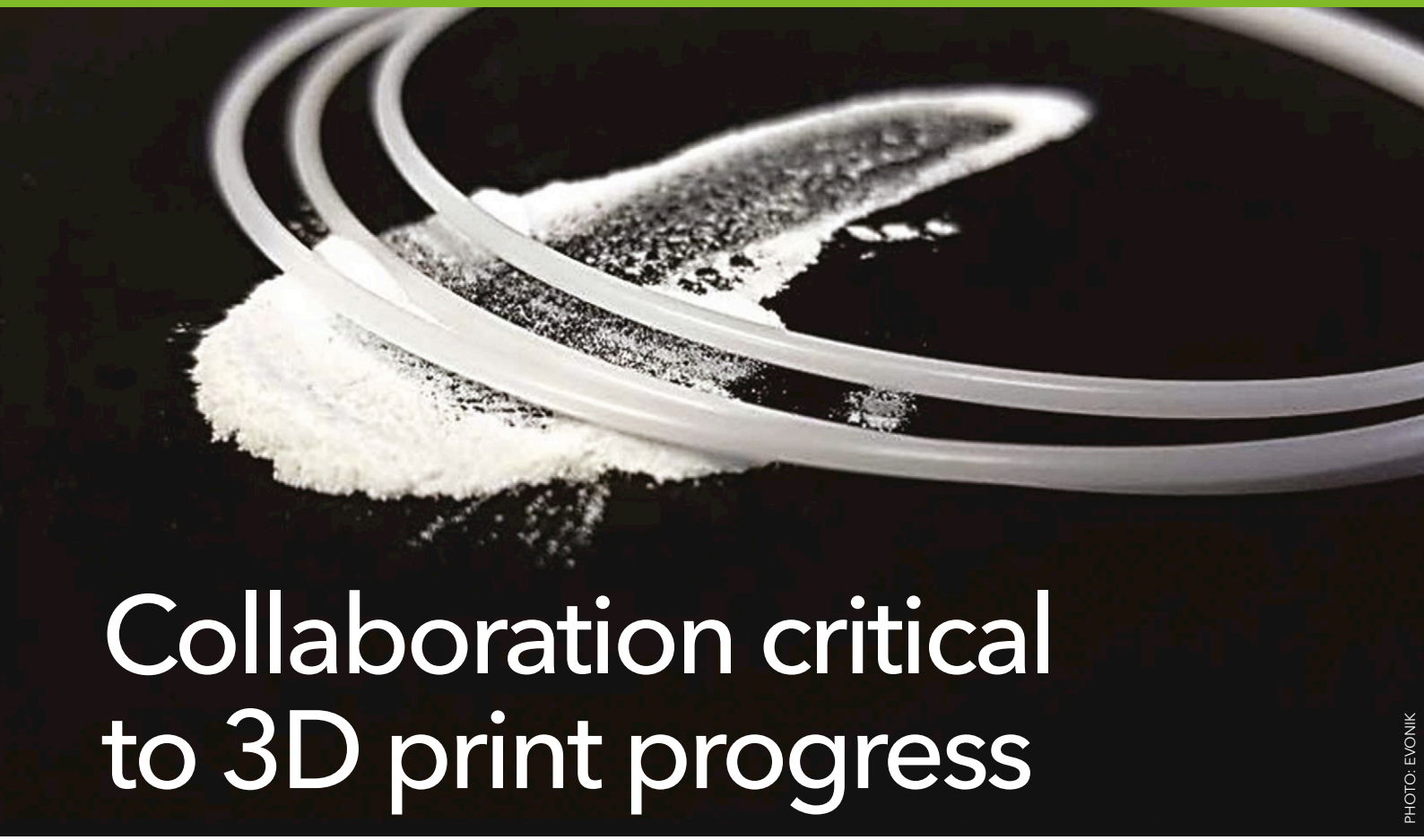

PHOTO: EVONIK

Collaboration critical to 3D print progress

Suppliers of 3D print polymers and compounds are forming alliances with equipment providers to move the technology into higher performance application areas, reports ***Mark Holmes***

To continue progress in development of compounds for the 3D printing – or additive manufacturing – marketplace many material manufacturers are forming alliances with equipment and systems developers. The driving force behind these collaborations is to use their complementary resources and know-how to meet ever more demanding applications for this emerging technology. These development alliances are already finding new ways to process compounds–and in particular reinforced materials–to extend 3D printing into higher performance applications.

DSM is one of the companies that has formed partnerships to launch all-inclusive 3D printing solutions that exploit its full material product line potential and support its entry into both pellet-based Fused Granulate Fabrication (FGF) and liquid-based Digital Light Processing (DLP) 3D printing technologies. The programme – the Trimax Collective – is claimed to be the first of its kind, offering customers a leased printer together with access to its materials and technology support for a fixed monthly fee. Available initially as a long-term lease option for stereolithography (SLA) printers, DSM says it will be extended to include additional technologies and short-term trials.

"The Trimax Collective allows us to tackle the two biggest barriers to the widespread adoption of 3D printing that exist today: high investment requirements and a lack of experience with additive manufacturing," says Hugo da Silva, Vice President of DSM Additive Manufacturing.

The new partnerships include collaboration with Netherlands-based **CEAD** to co-develop FGF pellet materials; DSM will use one of CEAD's printers for research and development and commercial purposes. Together, the two companies will explore the potential of FGF printing technology in applications for production of tooling and for the automotive industry.

The CEAD printer features an extruder system on a six-axis robotic arm from Comau, with control software from Siemens. The machine is also equipped with a milling centre and scanning unit for post-processing the parts directly on the machine. Using this equipment, CEAD and DSM will aim to create material profiles optimised for FGF printing. The cooperation also opens the door to advanced processes such as the combination of continuous fibres with highly filled polymers. ›

Main image: Successful development of 3D print materials means combining both materials and processing expertise

Right: This fibre reinforced footbridge prototype was produced using DSM materials for Royal Haskoning DHV

"The relationship between the 3D printing technology and the materials that are used in the process are key," says Maarten Logtenberg, Chief Executive Officer of CEAD. "Through this collaboration with DSM and their understanding of the materials, we are able to fully leverage the technology to its full potential."

Building bridges

A recent example of DSM and CEAD collaboration is a lightweight 3D printed FRP pedestrian bridge prototype for international engineering consultancy Royal HaskoningDHV. It consists of a glass filled thermoplastic PET (Arnite) combined with continuous glass fibres during the 3D printing process.

"FRP bridges are already well known for having a longer lifetime expectancy with lower life cycle costs compared to steel bridges," says Maurice Kardas, Business Development Manager at Royal HaskoningDHV. "What is new here is the use of a new 3D printing technology, enabling us to print large scale continuous fibre reinforced thermoplastic parts. Using this new composite thermoplastic material, we will be ushering in a new era for sustainability and push the boundaries of bridge functionality even further. By including sensors in the design, we are able to build a digital twin of the bridge. These sensors can predict and optimise maintenance, ensure safety and extend the life span of our bridges."

DSM also recently entered a partnership with **Origin**, a US-based open additive manufacturing company. It has already produced a material optimised for use with Origin's printer – Somos PerFORM HW – and says it has applications in aerodynamics and rapid tooling.

Other new 3D print materials from the company include Soft ToughRubber (STR), developed by **Adaptive 3D Technologies** and commercialised by DSM, and a flame-retardant Novamid AM1030 FR

PHOTO: DSM

filament. STR is a photopolymer mainly aimed at applications in footwear, textile and automotive due to its combination of softness and toughness. The new Novamid filament is said to be a sustainable solution for applications requiring flame retardant materials to meet regulatory requirements. DSM has also developed a new PBT powder, which it claims is the first to be made commercially available for selective lase sintering (SLS) printing processes.

Medical application

PLA bioplastic producer **NatureWorks** has also established 3D print development partnerships with a number of companies. Among these is **Adaptiiv Medical Technologies**, which offers a 3D printing software solution for use in photon, electron, and surface brachytherapy radiation treatments. Claimed to be the first FDA 510(k)-cleared 3D printing software solution for use in radiation oncology, the company has verified and validated Ingeo-based filaments.

Natureworks is also working with **Titan Robotics**, a leader in production-ready additive manufacturing machines and technology with expertise in both pellet extrusion and high flow filament extrusion 3D printing, and **MatterHackers,** which is one of the world's largest 3D printing retailers.

Matter Hackers was one of the beta-testers for Natureworks' Ingeo 3D450 breakaway support grade. This is designed for use in dual extrusion 3D printers with the company's Ingeo 3D850 and 3D870 grades and has been developed to meet the needs of the professional printing market. The company says that at printing speeds up to 100 mm/s, Ingeo 3D450 prints and cools without warping even across large sections of support structure.

According to Natureworks, the Ingeo 3D450 breakaway formulation can reduce or eliminate speed and buildability issues sometimes encountered with soluble support materials such as polyvinyl alcohol (PVA) or high-impact polystyrene

Below: Natureworks has partnered with 3D print equipment maker Titan Robotics

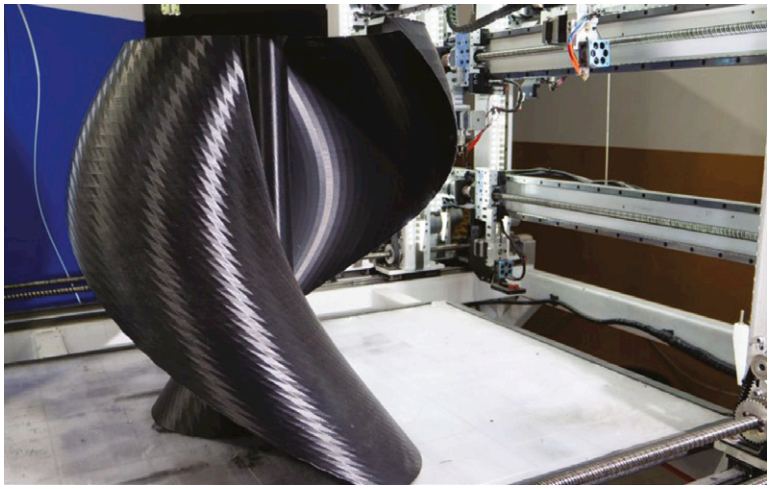

PHOTO: TITAN ROBOTICS

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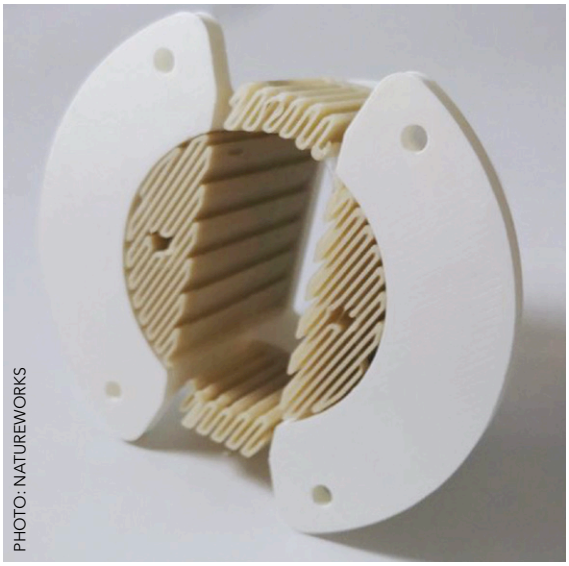

PHOTO: NATUREWORKS

Right: Ingeo 3D450 is the latest breakaway support material from Natureworks

(HIPS). Compared to these soluble supports, it also offers longer and more stable shelf life, reduced moisture sensitivity during printing, and reduces the need for post-processing with its clean breakaway from a build. The new grade is compatible with large format printers and, as the 3D450 breakaway supports do not require solvent baths for removal, its use avoids the size constraints encountered with needing to submerse a build.

High performance

Solvay has entered a research collaboration agreement with **Aerosint** to develop an economically viable SLS printing process for high performance polymers such as its KetaSpire polyetheretherketone (PEEK) and Ryton polyphenylene sulphide (PPS). These materials have the potential to open new opportunities for additive manufacturing in demanding applications, but their adoption with key powder fusion technologies such as selective laser sintering (SLS) has remained limited.

"SLS machines that can process high temperature polymers are carefully designed and assembled with sophisticated and expensive components," says Edouard Moens, Managing Director of Aerosint. "However, at present, there is a significant operating cost disadvantage during the build, which is the excessive waste of up to 90% of 'used-but-unfused' powder. Our patented spatially-selective, multiple-powder deposition system under development incorporates a non-fusible support material in each layer where expensive high performance polymers are not required, thereby reducing material waste to very low levels."

Solvay has been working with Aerosint for more than two years, supporting the development of the technology with advanced material, process and fusion expertise. "As with all innovative, groundbreaking technologies there are many challenges to overcome," says Brian Alexander, Global Product and Application Manager for Additive Manufacturing at Solvay's Specialty Polymers global business unit. "One of them is to develop and fully optimise high performance additive manufacturing polymer powders for use at high temperatures alongside non-fusible materials in a multi-powder deposition process. Not only will this technology make 3D printing of high performance polymers more affordable, it also will open up its enormous potential to become a competitive industrial process for AM system manufacturers in the medical, aerospace and automotive sectors."

Below: Solvay is working with Stratasys to develop optimised filaments for its FDM F900 3D printers

PHOTO: STRATSYS

Solvay is also collaborating with **Stratasys** to develop high performance additive manufacturing filaments for exclusive use in Stratasys' FDM F900 3D printers. "Stratasys' customers have been repeatedly asking for more varied, high performance materials, while many of Solvay's customers want our high performance polymers to be enabled for use on Stratasys' industrial 3D printing systems," says Christophe Schramm, Business Manager for Additive Manufacturing for Solvay's Specialty Polymers global business unit.

Solvay and Stratasys are currently developing a high performance additive manufacturing filament based on Solvay's Radel polyphenylsulfone (PPSU) polymer that will meet FAR 25.853 compliance requirements for use in aerospace applications. Both companies aim to commercialise this new filament in 2020.

Carbon innovations

Covestro is collaborating with **Carbon** – the developer of Digital Light Synthesis (DLS) technology – to offer 3D printing that can provide opportunities to produce three-dimensional, often complex shaped parts in a single step. DLS technology is claimed to be able to accelerate

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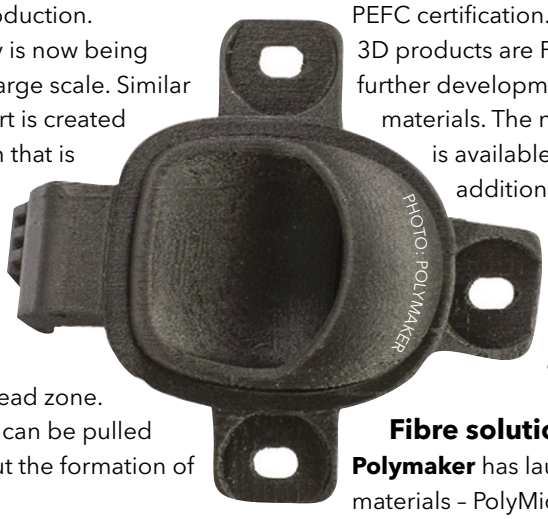
Above: Fizik's Adaptive cycle seat is printed using DLS technology from Carbon

production of parts up to a hundred-fold compared to previous 3D print processes.

Carbon has developed a novel polyurethane liquid resin for production of parts; Covestro is a key partner in the scale-up and high-volume production of this material.

Covestro's Patrick Rosso, Global Head of Additive Manufacturing, says the biggest challenge in the upscaling of additive manufacturing to series production lies in the supply of suitable materials in the required quality and quantity. By partnering with companies such as Carbon, he says the company can push existing scale boundaries and support various industries along the value chain on their way to digital mass production.

Carbon's DLS technology is now being used for the first time on a large scale. Similar to stereolithography, the part is created in a vat of liquid plastic resin that is cured by means of UV radiation. Where it differs is that oxygen is supplied from below through a light and air permeable membrane to counteract the curing and create a liquid dead zone. This means the printed part can be pulled continuously upward without the formation of individual layers.



Right: A door handle part produced for XEV's electric car using Polymaker fibre reinforced compounds

Development of new reinforced plastic compounds for use in 3D printing is expanding applications for the technology. **UPM** and **Carbodeon** are developing cellulose and nanodiamond reinforced raw materials for 3D printing for use in both FGF and FFF processes. Carbodeon Chief Executive Officer Vesa Myllymäki says that by joining forces the companies are able to combine the good mechanical properties and printing speed of nanodiamond-enhanced 3D printing products with UPM's cellulose-based 3D printing raw materials. The companies say the nanodiamond additives provide the part not only with improved stiffness and strength but also higher heat deflection temperature. In addition, printing speed is significantly enhanced due to the tailored thermal and flow properties of the compound while the fine cellulose fibres give some self-support to enable objects with round or other complex shapes to be printed without warpage problems.

Other benefits of cellulose biocomposites are wood-like post processing, according to Eve Saarikoski, Application Manager UPM Biocomposites. Printed parts not only have a pleasant matt surface but can be finished using standard wood processing methods. UPM Formi raw material grades are recyclable and available with FSC and PEFC certification. The first UPM/Carbodeon 3D products are PLA-based, with possible further developments on other thermoplastic materials. The nanodiamond modified PLA is available in black and iron-grey, in addition to 'natural' and 'pearl like'. The filament is available in 1.75mm and 2.85mm diameters to cover all machine types. Reel sizes are 1kg and 2.3kg.

PHOTO: CARBODEON

Below: UPM and Carbodeon have introduced a PLA filament reinforced with cellulose and nanodiamond additives

Fibre solutions

Polymaker has launched two new industrial materials – PolyMide PA6-CF and PolyMide PA6-GF – for extrusion-based 3D printing. The two new materials are both fibre reinforced polyamide polymers that display high strength and heat deflection temperatures. Both materials feature Polymaker's latest Fibre Adhesion technology, which boosts the layer adhesion of printed parts not only on the x-y axis but also on the z-axis.

The company says PolyMide PA6-CF is a carbon fibre reinforced PA6 offering the highest strength, impact resistance and heat deflection of all Polymaker 3D printing materials. With a heat deflection temperature of 215°C, it lends itself to automotive applications where strength and heat resistance are required from the material. It is also an ESD-safe material, making it a suitable candidate for printing electronic jigs and fixtures.

PolyMide PA6-GF is a glass fibre reinforced polyamide (PA6) that offers good mechanical properties, impact strength and stiffness. Again, the material is said to show good thermal and mechanical properties without sacrificing layer adhesion. It can be used to print parts suitable for use over a wide temperature range; it has been used to make custom laboratory equipment for operation at temperatures as low as -190°C.

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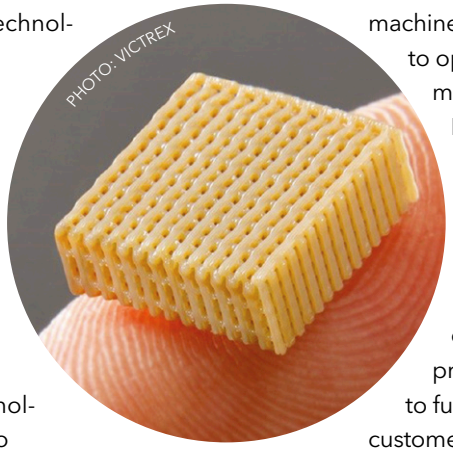


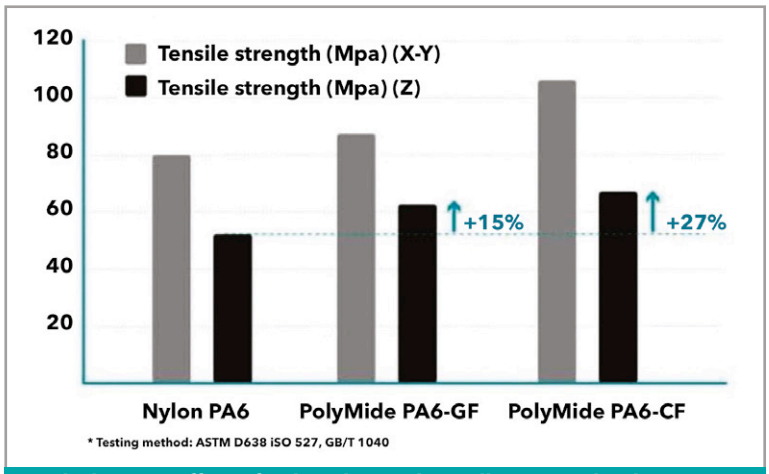
Right: This detailed porous structure is printed in Victrex PEEK using Bond3D technology

Polymaker's Fibre Adhesion Technology is claimed to improve layer adhesion of fibre reinforced materials by optimising the surface chemistry of the fibres. This achieves better dispersion and bonding to the polyamide matrix and results in improved strength in the z-axis and reduced mechanical anisotropy when compared to pure PA6 printed parts. This in-house technology was developed exclusively to combat the problem of adding fibres to filaments.

Lifting performance

Victrex has developed a number of new PAEK materials for use in 3D print filaments and powders. The company says that these new solutions deliver better results with improved mechanical properties in printed parts and offer easier printing than past attempts to use PEEK in additive manufacturing.

Victrex has invested in Netherlands-based machinery and software company Bond to optimise its polymers for additive manufacturing. "Our investment in Bond's 3D technology is a logical way to accelerate 3D printed PAEK/PEEK parts to market," says Jakob Sigurdsson, Victrex Chief Executive Officer. "We need to ensure that all the key elements, including material, process and hardware are aligned to fulfil our goal of enabling our customers to manufacture 3D printed PAEK components for critical high performance applications. We are now at a stage where the technology is sufficiently developed to embark on exciting development programmes."



Graph showing effect of Polymaker's Fibre Adhesion Technology on z-axis tensile strength
Source: Polymaker

Bond's technology is capable of printing complex, functional parts made of PEEK with good mechanical properties, including in the z-direction. This enables additive manufacture of high strength, isotropic parts with properties comparable to conventional moulded or machined PEEK parts. Victrex and Bond will initially focus their collaboration on demonstrating potential in spine repair and semiconductor applications. These will use commercially available products such as PEEK-OPTIMA from Invibio Biomaterial Solutions (Victrex's medical business) or Victrex PAEK thermoplastic.

In the future, this ability to print functional parts from existing PEEK grades may also have value in other traditional Victrex markets such as aerospace, energy and automotive. "We found that the market needs strong functional parts made from high performance polymers that can be used not only for prototyping but for production," says Gerald Holtvlüwer, Chief Executive Officer, Bond High Performance 3D Technology. "With our dedicated focus on 3D printing technology for high performance polymers, we were able to develop a technology to achieve the full strength of existing

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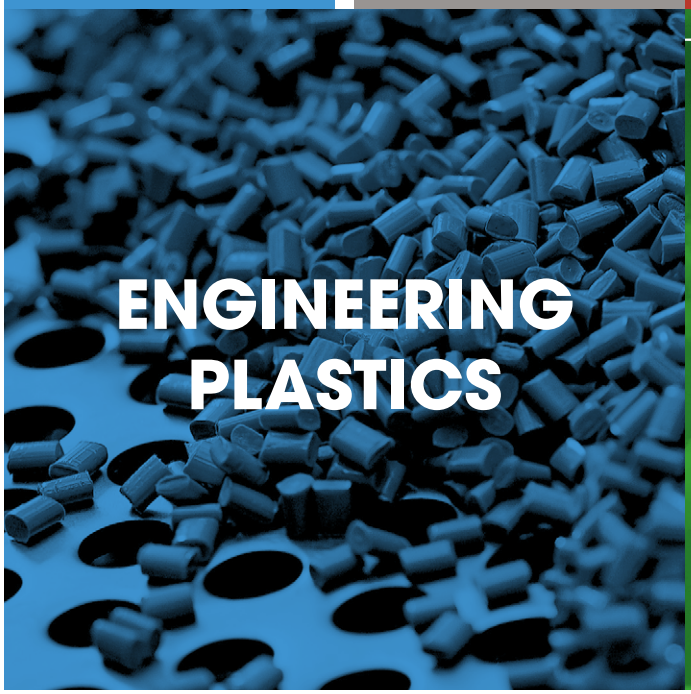

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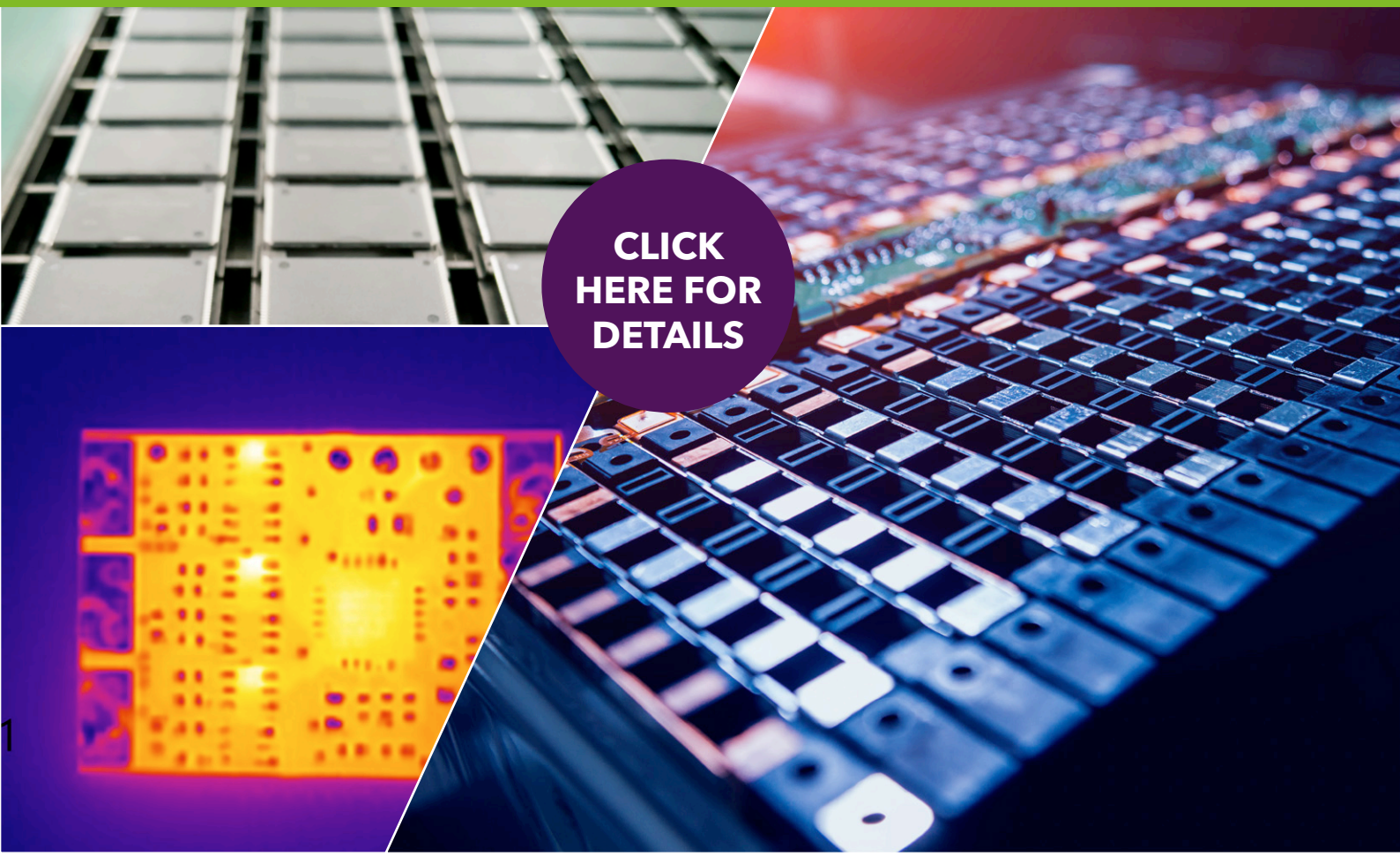

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PAEK and PEEK polymers. This includes the strength in the z-direction, which is the most difficult to achieve with high performance polymers in general and PEEK in particular."

Currently, Bond's 3D hardware and software are in the beta-phase. A development plan is in place for upscaling and installing additional 3D printing machines. This is expected to mark the next phase and drive the transition from development to first part qualification and early stage production.

Akro-Plastic has developed a carbon fibre reinforced compound for additive manufacturing. Akromid B3 ICF 30 9 AM is currently being successfully used by the IKV (Institute for Plastic Processing) in Aachen, Germany, in the melt deposition modelling (MDM) process. According to Akro-Plastic, the improved thermal conductivity of the carbon fibre reinforced compound means faster cooling speeds and has helped achieve a stable manufacturing process with high production speed.

Support development

SABIC has introduced AMS31F filament, a breakaway support material for fused deposition modelling. The new filament maintains rigidity during printing and provides good pliability during post processing to enable easier removal of scaffolds at room temperature, which can help reduce the time required to produce finished parts. The AMS31F filament is intended for use with SABIC's Ultem AM9085F high performance polyetherimide (PEI) filament.

An automotive oil pump printed with SABIC's Ultem AM9085F filament and new AMS31F support material

PHOTO: SABIC

"Using structural supports to print parts with complex geometries is essential, but it can also be quite challenging," says Keith Cox, Senior Business Manager, Additive Manufacturing, SABIC. "Remov-


PHOTO: WACKER

Right: A full colour model of a human liver created using the latest Aceo Imagine printer from Wacker

ing traditional supports from the finished part often involves time-consuming processes that can negatively impact productivity and quality. By offering a complementary support material for our Ultem AM9085F filament, SABIC is providing a complete material solution that helps customers save time and effort. Additionally, the ease of support material removal provides part designers greater flexibility in defining print orientation to optimise part performance."

SABIC's material formulation was developed for use with Ultem AM9085F filament to balance adhesion during printing with the ability to remove the scaffolding easily during post processing. Unlike competitive support materials that often require reheating to facilitate removal, SABIC's AMS31F filament separates at room temperature. The filament's white colour also provides a sharp contrast to the amber colour of the Ultem filament, which allows operators to identify the structures to be removed more quickly.

Bioresorbable focus

Evonik has launched Resomer filaments for 3D printing of bioresorbable medical implants. A selection of poly(L-lactide) (PLLA), poly (L-lactide-co-glycolide) (PLGA), poly(caprolactone) (PCL) and polydioxanone (PDO) grades are available as standard, with additional customised options available. Mechanical properties such as strength and elongation at break can be tailored to the target application, with bioresorption periods ranging from less than six months to more than three years.

"Our new, innovative line of Resomer filaments provide the flexibility and precision to optimise the 3D printing of medical applications across a range of markets including cranial reconstruction, orthopaedics and dentistry," says Dr Andreas Karau, Global Head of Biomaterials for Evonik. "Customers can also leverage the application technology expertise of our Medical Device Competence Center in the US and development labs in Germany and China to optimise product performance and streamline the commercialisation process."

Below: Evonik's Resomer filaments are intended for 3D printing of bioresorbable medical implants


PHOTO: EVONIK

Wacker has developed a new version of its Aceo 3D printing technology for silicone rubber. The new Aceo Imagine Series K2 printer features numerous technical improvements and new software, allowing three-dimensional objects to be reproduced more precisely and with high dimensional accuracy. The addition of multiple printing nozzles means the new printer can process up to four different silicone materials simultaneously, allowing entirely novel designs to be realised (for example, printing in different colours or hardnesses). It also helps in printing of hollow objects, which require support material.

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Conductive PLA filaments for 3D print applications

Researchers at Unipetrol RPA have developed electrically conductive PLA 3D print materials that process well in FDM equipment. They are now looking to apply their know-how to PP and recycled formulations

3D print technology is one of the fastest developing areas in the plastics industry, presenting opportunities to prototype products and even to print series parts for real-world applications. One of the most widely used technologies is fused deposition modeling (FDM). This melts plastic filaments and applies the molten polymer through a die to form a 3D product layer by layer. Polylactic acid (PLA) processes well in FDM equipment, making the bio-based polymer a material of interest for many developing specialty 3D print materials.

Czech company Unipetrol RPA is actively involved in development of new electrically conductive polymer materials suitable for the production of 3D filaments and especially for processing by FDM technology. The development materials are based primarily on bio-PLA polyesters with the company`s CHEZACARB conductive carbon black. The goal is to reduce the surface and volume electrical resistivity of the printed product.

Image: Unipetrol RPA

Unipetrol RPA's electrically conductive PLA filaments process easily without filament breakage

Overcoming challenges

One of the major disadvantages of PLA is its high rigidity and fragility, both of which are significantly increased when the material contains a high content of carbon black. This increased fragility makes large scale production of 3D printing filament impossible due to breakage during winding.

Another disadvantage is the strong suppression of electrical conductivity when carbon black is added to the pure PLA matrix. Due to its crystalline structure, it is impossible to achieve a lower electrical resistance than 10^{12} Ω. This means it is still an electrical insulator. However, Unipetrol RPA has managed to develop a new type of conductive compound based on PLA and conductive carbon black. It achieves sufficient toughness that the filament can be wound without cracking or breakage. The company's in PLA modification know-how means surface and volume resistance has also been significantly reduced, reaching values of 10^{5}-10^{4} Ω. This represents the transition between antistatic and completely electrical conductive properties.

The new PLA material has already been tested in large-scale production in cooperation with a leading Czech manufacturer of 3D printing filaments. Now Unipetrol RPA is working on the transfer of these materials from development phase to large-scale production, followed by a launch on to the European market.

Unipetrol RPA`s core activity is the production of polyolefinic and petroleum-based products, so the company is also steering its development to focus on modification of synthetic polymers for 3D printing. Current projects include development of suitable polymers for production of PP filaments with a low shrinkage and with ideal parameters for 3D print processing. Other running projects incude the development of materials for production of filaments based on polyolefin and polyester recyclate for less demanding applications. Launching such materials on the market will help to significantly reduce the environmental impact of plastic waste, together with offering a potential reduction in the production costs, it claims.

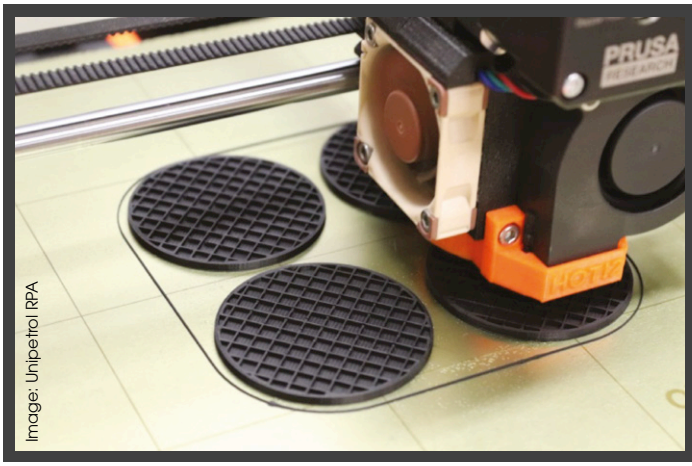

Image: Unipetrol RPA

The new conductive materials have been tested in commercial 3D print equipment

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Additives key to upcycling

***Recycling plastics back into high value applications can present challenges but additive technologies are available to help fix processing, performance and odour issues, writes* Jennifer Markarian**

The plastics industry has long been reprocessing much of its process scrap and a good trade has developed in post-industrial recyclate, but the growing mandate to recycle more means taking on post-consumer recyclate (PCR). That presents a number of challenges – PCR is a high variability feedstream that is typically comprised of a mix of resin types and colours with varying rheologies. In addition, the levels of additives remaining in the polymer are unknown and that must be given serious consideration. And there is a high possibility of bad odours and organic contaminants. It is a daunting prospect.

Fortunately, additive suppliers already have a handle on these problems. Many are working to put forward new products targeted to the industry need to move beyond recycling to upcycling. Part of that process it to educate recyclers and recompounders, who – especially in the US where PCR recycling is less widely practiced than in Europe – may be new to the benefits additives provide.

While demand for polymer additives is currently higher among European recyclers than those in the US, the US recycling industry is changing, says Robert Keller, Sustainability Manager at **BASF Plastic Additives**. "As public awareness and advocacy increases in the US, interest in increased recycling and re-use is gaining momentum, as evidenced by increased investments and acquisitions in the recycling industry and infrastructure," he says.

BASF researchers have developed additive formulations to enable "ready for recycle" virgin HDPE that is sufficiently well stabilised to maintain its properties through multiple extrusion steps. The degradation pathway of the HDPE under investigation was molecular weight increase and molecular weight distribution broadening and the researchers identified formulations that yield optimal molecular weight retention using a combination of a phosphite, phenolic antioxidant, and Irganox E201 (Vitamin E). They also found that formulations that provided the best melt flow control tended to be slightly more discoloured, with a higher yellowness index and more gas fade discolouration. However, they point out that colour is not typically critical in many applications using recycled resin.

Keller says that post-industrial plastics, with their better quality and more consistent supply, are already more broadly recycled than post-consumer resins. However, these novel additive solutions for PCR "aim to address the address variability in material quality and the polymer degradation accumulated over their lifetime of light and heat exposure."

BASF's researchers have investigated the antioxidant and light stabiliser combinations needed to

Main image: Even the best mechanical technologies will struggle to create high value plastics from PCR without additive modification

Baeropol T-Series blends can improve melt stability and reduce yellowing in recycled polymers

PHOTO: BAERLOCHER

re-stabilise recycled HDPE, using PCR from bottle crates. They found that re-stabilisation was certainly necessary; recycled HDPE without additional stabilisation exhibited complete failure in accelerated weathering tests after 2,000 hours of exposure. Restabilisation, however, was found to be successful in improving molecular weight retention and weatherability.

Keller says BASF is one of the founding companies in the Alliance to End Plastic Waste, but its goals extend beyond waste. "For BASF, circular economy is much more than waste management. The aim is to close cycles and use products and resources in the best way possible across the entire value chain," he says.

Recycling on the rise

Roberto Nunez, Special Additives Business Head at **Baerlocher USA** agrees that recycling awareness is growing in the US. "In the past year there have been tremendous changes," he says. "Brand owners want more recycled material, so – although it's difficult to make money in recycling – the industry is trying to improve the quality of recyclate to make it useable."

Stabilisation is a key area of activity. Baerlocher's new Baeropol T-blends are synergistic stabiliser blends formulated for use with both virgin and recycled polymers. They are designed to improve melt stability, minimise yellowness, and help maintain properties of the final part for longer. Specific blends are formulated for particular resin families, including T-Blend 1102 for HDPE and PP, T-Blend 1214 for HDPE and PP in higher temperature processes, and T-Blend 6102 for LLDPE and HDPE film.

In post-industrial recyclate, stabilisers help with upcycling to higher-end, tailored solutions, says Dr Robert Sherman, Special Additives Business Technical Director at Baerlocher. In PCR, however, greater variation is a challenge due to the potential for the presence of a variety of resins and organic residues. "Testing to see what is typically in a particular feedstream is important," he says. Baerlocher's US laboratory at Cincinnati in Ohio is equipped to determine what resin types are in a PCR stream. Staff can also test the response of a PCR stream to a particular T-blend and help determine what loadings will be needed to obtain the desired properties.

One of the components of T-blends is Baerlocher's Baeropol resin stabilisation technology (RST) additives. These are acid scavengers, but they also act as secondary stabilisers and lubricants. They can be used in formulations to replace phosphite stabilisers or along with phosphites to boost properties and lower yellowness.

The odour challenge

A common problem in recycled resin is odour – usually bad odour. **Addisperse** has developed odour elimination concentrates that chemically interact with malodourous volatiles in the vapour state. The concentrates are targeted at the common malodours in PCR, with the company claiming success in eliminating odours from PCR fish crates, recycled tyres and chicken coop mats, for example. The company's additives can also neutralise odour associated with natural fillers, such as lignin, algae, and cellulose, and with processing and reprocessing of polymers. It offers ON 106 as a free-flowing powder on a talc or calcium carbonate filler, and ON 108 as a PE pellet concentrate. The powder form is recommended for powder blends and for mixing with regrind prior to compounding.

Most odours in compounds are the result of amines and or sulphur volatile components formed

PHOTO: SHUTTERSTOCK

Right: Odour is frequently an issue in recycling of post consumer plastic scrap

by chemical reactions post-processing, says Paul Albee, Consultant for **Addisperse** (part of AFI Global). During injection moulding or extrusion processing, both the malodourous volatiles and the odour eliminators volatilise from the pelletised compound, and it is at this point that the odour eliminators neutralise the malodours.

Albee explains that the amount of concentrate required can depend on the intensity of the odour. "If 1% of ON 106 or ON 108 is not effective, we recommend a modified odour eliminator concentrate based on direct evaluation of the compound in question. This evaluation uses a non-vented, single-screw extruder to measure an odour rating. The compound is pelletised and collected in glass jars. The jars sit for 24 hours, then samples are evaluated by our odour panel for odour intensity, odour translation, and character," he says.

PHOTO: MILLIKEN

Right: These tote boxes are produced from recycled PP using DeltaMax modifiers from Milliken

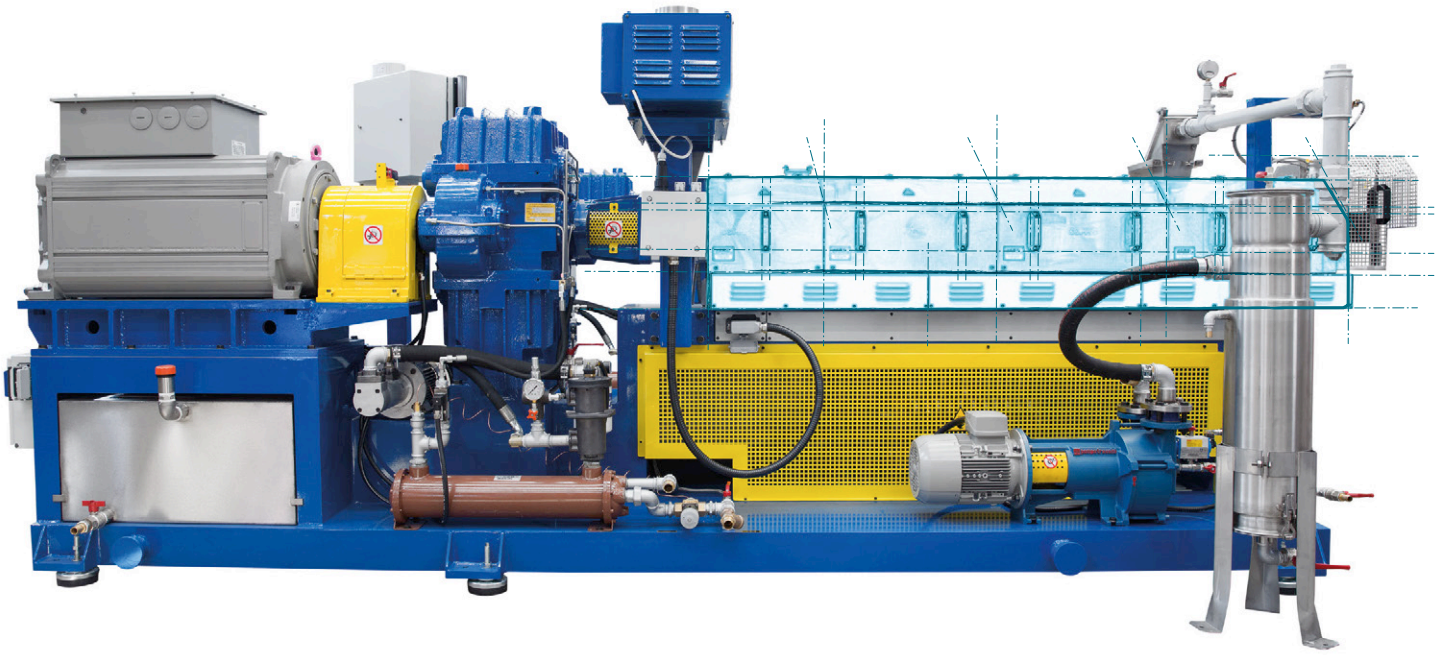
Struktol has a number of offerings in the area of odour reduction. Struktol RP 53 is described as a blend of odour-neutralising chemistries useful for problematic odours such as those from mercaptans (sulphur), amines, and phosphites in recycled polyolefins as well as other resins. Struktol RP 59 combines odour-neutralising chemistries and volatile organic compound (VOC) absorbers and is intended for difficult, high odour, and high volatile content compounds. The company says the additive is effective in plastic packaging to reduce odours from the packaging as well as for absorbing odours from the packaged product. Struktol RP 17 is a combination of a lubricant and an odour-neutralising mask that was originally designed to reduce odours in wood-plastic composites. The additive has since been modified for use in a wide range of recycled compounds that can need the combination of lubrication, mould release, and odour management.

Coming together

Recyclate often contains a mix of polymers and fillers and a lack of compatibility between them can cause poor mixing, rough surfaces, and poor properties. Additives such as coupling agents and compatibilisers can work at the molecular interfaces of dissimilar surfaces to improve properties and processing (and were detailed in the May 2019 **edition** of *Compounding World*.)

Viscosity-modifying and lubricating additives and processing aids also can also be effective in improving processing of recyclate streams. Combination products from Struktol, for example, include a Struktol RP 38, which is designed for recycled PP with a high level of PE, and TR 219, intended for polyester compounds contaminated with other resins (detailed in the September 2018 **edition** of Compounding World.)

Milliken, meanwhile, says its DeltaMax modifiers for PP enhance impact and melt flow properties of recycled PP resins and blends. Recycled



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Right: Ecopuro's Boundary Breaker additive (top) improved the surface finish in this flexible PVC garden hose project

compound producer Aaron Industries has introduced Jet-Flo Polypro, a high melt flow recycled PP compound for durable thin-wall parts such as housewares, using the additive to deliver a high melt flow index and good impact performance. Milliken says it will introduce the latest addition to its DeltaMax family at K2019.

A new additive introduction from **Ecopuro** is said to be neither a coupling agent nor a viscosity-modifying additive, but is claimed to solve similar problems. The company says its patented technology improves dispersion through mechanical action of the particles in the extrusion melting process. The inert additive – called Boundary Breaker – is said to function by creating turbulent flow at the boundary layer between extruder and melt, which helps break up and distribute contaminants, such as carbon particles, to create smoother surfaces and to allow higher levels of recycled content to be incorporated in a compound.

PHOTO: ECOPURO

PCR masterbatch

Another recent emerging global trend is increasing demand for masterbatches using 100% PCR as the carrier, says Doreen Becker, **Ampacet**'s Sustainability Director. "In the past, most companies were using masterbatches made with virgin resin and letting them down into PCR. Now, we see brands promising to use 100% PCR, which means they need masterbatches made with PCR."

This requirement comes with challenges, including the cost of PCR, which has risen significantly in the past year, and the quality of PCR, which is not always good and could get worse, says Becker. Contaminants in PCR include incorrectly sorted polymers as well as adhesives and other low molecular weight species. PCR containers might also have been used to hold something other than the original material and so could have multiple organic contaminants. And as more recycled plastics are used, they may enter the feedstream multiple times.

Contaminants and degraded material often lead to bad odour in PCR. Ampacet's Odor Scavenger 1000258-E is a wide-spectrum odour-absorbing masterbatch that is designed for PE-based PCR but could also be used in other resins, says Becker.

The company's BlueEdge masterbatch is designed specifically for challenges with recycled PET. "For water bottles, in particular, consumers

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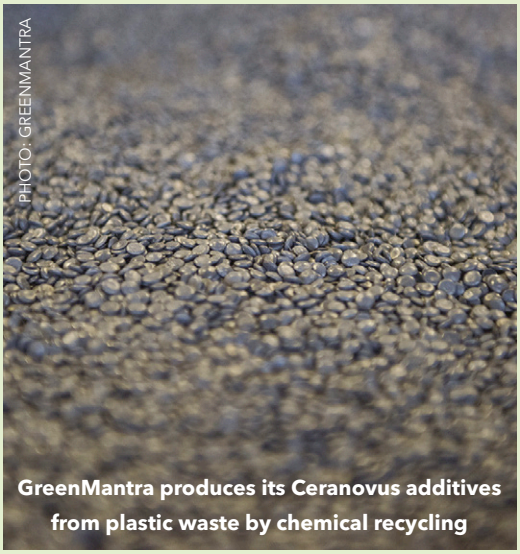

PHOTO: GREENMANTRA

GreenMantra produces its Ceranovus additives from plastic waste by chemical recycling

Despite the progress being made in mechanical recycling, developing a circular economy is likely to require other innovative approaches. Chemical recycling of polymers back to syngas feedstock and other monomers is attracting a great deal of interest and investment from major players.

Canadian company GreenMantra Technologies is one of the technology providers in this area. In May this year, for example, it began a joint project with styrenics manufacturer Ineos to chemically convert PCR PS into monomers to feed Ineos Styrolution's polymerisation process.

The company also has technologies to chemically recycle post-consumer and post-industrial LDPE, HDPE, and PP into waxes and additives for use in plastics and other materials, such as inks, asphalt, and roofing. Its Ceranovus A series of additives for plastics include A115, A120, and A125 for PE and A155 for PP. It recently began supplying them for PE and PP wood-plastic composite (WPC) lumber production, where they are claimed to increase strength and stiffness.

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want the bottle to be clear. Hazy, yellow or brown are not acceptable. The masterbatch counteracts off-colours in PCR. Including antioxidants in a BlueEdge masterbatch helps to prevent gel formation in PCR, which can result from degradation or contamination with other polymers," Becker says. Ampacet also recently introduced GreenEdge, which is designed to be let down into recycled PET from a green feedstream–recycled PET typically is sorted into colourless, blue, and green. It offers a PCR carrier option in both BlueEdge and GreenEdge products.

Becker says testing the PCR used in its masterbatches is important for maintaining quality and ensuring that the products are formulated correctly. She points to guidance on designing products for recyclability published by the US **Association of Plastics Recyclers** (APR), saying it is a really useful document for companies throughout the value chain to understand how materials, additives, and part design all affect recycling. The **detailed 74-page guide** is intended for the US market but much can be helpful for packaging designers in other regions, she says.

Becker also points to the importance of getting terminology right. As companies are seeking to meet commitments to certain levels of PCR, it is essential to correctly distinguish between post-consumer, pre-consumer or post-industrial (PIR) waste, and between regrind or in-house scrap, she says. "There is some confusion in the market around these definitions, but the ISO definition [ISO 14021-1999] excludes scrap or regrind from the definition of PIR. As a rule of thumb, if it is coming from the production process and is destined for the landfill, we consider it PIR," she explains.

From Ampacet's perspective, however, the outlook for PCR use going forward looks very promising. "We're excited about the technical innovations happening in sustainability right now," Becker says. "We expect major brands worldwide will increase use of 100% PCR dramatically in the next few years."

Below: PET bottle scrap frequently needs additives to improve eliminate haze or improve colour

PHOTO: SHUTTERSTOCK

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PHOTO: SHUTTERSTOCK

Above: Fire retarded WEEE plastics present particular challenges for recyclers

Handling flame retardants

With much of the media focus of plastics recycling on packaging, flame retardants aren't the first additives to come into consideration. In the electronics sector, of course, the picture is very different and flame retardants are a common component that have to be dealt with in Waste Electrical and Electronic Equipment (WEEE) and automotive formulations.

With future recycling very much in mind, Clariant recently announced an initiative to make its flame retardant additives more useful in recycled applications by planning for multiple cycles of use. The company's Exolit OP phosphorus-based, halogen-free flame retardant is one example, with a multi-year study carried out at the Fraunhofer LBF Institute in Germany confirming that PA6 and PA66 flame retarded with Exolit OP maintains a UL 94 V-0 rating when recycled multiple times.

The company says Exolit OP is also not subject to ecodesign application restrictions, such as the upcoming EU regulation for electronic displays based on EcoDesign Directive (2009/125/EC). This has the potential to limit the use of halogenated flame retardants in applications such as enclosures and stands for electronic displays, according to Clariant.

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Given their chemical composition, polyamides (nylons) have long been particularly difficult to color, since traditional colorants have tended to react with the polymer system and discolor due to the loss of conjugation in the colorant molecule. Keyplast RESIST range of colorants can be effective with unfilled, glass-filled, and flame-retardant grades of various polyamide types such as polyamide 6, 66, 46, and other high temperature engineering polymers.

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Inside the TiO_2 market

The TiO_2 market has seen considerable volatility over recent years. Future predictions remain challenging but demand is increasing and upward price moves seem likely. Peter Mapleston investigates

PHOTO: SHUTTERSTOCK

Titanium dioxide (TiO_2) is the most widely used pigment in the global plastics industry, with nearly 1.6m tonnes of the product being used annually in compounds based on all polymers and intended for many applications. However, in recent years, the market has become highly volatile. A variety of global factors are contributing to that, including the comings and goings of various Chinese capacities, plant outages, and general economic fluctuations. In addition, the ongoing argument in Europe over health aspects of TiO_2 is not helping calm the waters (see this month's news section).

Reg Adams at **Artikol** follows the TiO_2 industry closely and summarises the current situation in demand terms and quantifies the impact that has had on pricing. "Following anaemic growth of 0.6% in 2015, world TiO_2 demand increased by 4.4% in 2016 and by 5.3% in 2017, reaching a peak of 6.475 million tonnes. In 2018, world demand fell by 2.9% to 6.15 million tonnes and it is expected to rise again by 3.3% this year to 6.5 million tonnes," he says.

"The volatility of demand growth has been reflected in the volatility of TiO_2 pigment prices. The average price paid for standard rutile-type TiO_2 pigment in the US dropped to below $2.20/kg in early 2016 before bouncing back to $3.60/kg in Q2 2018," Adams says. "The amplitude of TiO_2 price oscillations has been even greater in Europe and the Asia/Pacific region, where prices have slipped back below the $3.00/kg level."

Some TiO_2 suppliers have been taking measures to address consumer concerns about price volatility, Adams says. Notable among these is Chemours, the world's largest supplier, which introduced its Ti-Pure Value Stabilisation (TVS) initiative at the end of 2017, offering regular customers long-term contracts at "equilibrium prices" that are adjusted in accordance with a pre-agreed and independently-determined index. Tronox has also begun offering longer-term supply contracts (in the order of 12-36 months) at more stable prices, he says.

"So far, there has been a reasonably good uptake on these propositions on the part of customers in the paint industry, but a relatively limited uptake on the part of customers in the plastics masterbatch sector. In a climate where spot prices are heading downwards, customers are

Main image: TiO_2 is a critical pigment for the plastics industry but users have had to deal with intense market volatility in recent years

PHOTO: VENATOR

Right: Venator's new Tioxide TR29 can be used in thin films for applications such as detergent pouches

naturally going to be reluctant to agree to a base price that is too far out of line with the prevailing spot market price," Adams explains.

In February of this year, **Chemours** introduced a new online portal for customers – called Ti-Pure Flex – saying it will offer a flexible approach for qualified customers purchasing its Ti-Pure TiO_2 without having to make a commitment to buy beyond the accepted order. Pricing and supply commitment can be locked-in for up to six months in advance.

Ti-Pure Flex is said to be akin to consumer portals such as Amazon and Alibaba, according to Bryan Snell, President of Chemours Titanium Technologies, with its offer of a "buy-as-you-need" approach. "It's super simple," he says.

Snell describes Ti-Pure Flex as an industry first and says it is intended for very different customers from those using its Assured Value Agreement (AVA) programme. Primarily, it is designed for those that don't need technical support – AVA customers get priority access to Chemours' technical expertise – and are comfortable with buying small lots in a dynamic pricing scenario. Ti-Pure Flex customers can still access the company's technical resources but they pay extra for it.

Targeting volatility

The AVA pricing model is based on global PPI adjustment over time. "It is amazingly consistent with historical pricing, but it eliminates the volatility," says Snell. Currently over half of all sales of the company's TiO_2 are made through AVA contracts.

AVA has worked better for coatings customers than for plastics customers, as it fitted better into their business model, Snell says. "In the plastics industry, a lot of transactions are ingredients-based. Quite a lot of plastics companies are now buying through Flex, but some are getting more familiar with the AVA concept. Overall, we are very pleased with the uptake of Flex and we expect uptake to accelerate in coming months."

Ti-Pure Flex is offered globally. Snell says there are currently customers using the service in around 110 countries in around 10 different languages. It provides standard pricing by grade and by region. Chemours says it will confirm orders within three business days. Features of the service will change as it matures, the company says.

The TiO_2 supply-demand picture is likely to support higher prices over time, says Snell. "It's about restoration of levels that will support future investment in new capacity." Market watchers have been predicting stronger pricing from the second quarter of 2020 onwards, he says.

Chemours continues to debottleneck its various production facilities and Snell says the company has further options for increasing capacity. "We have great process technology for very cost competitive debottlenecking at locations which also have low manufacturing costs," he says.

PHOTO: CHEMOURS

Above: Chemours Titanium Technologies President Bryan Snell says Ti-Pure Flex provides a "buy as you need" online pricing and supply option

At **TiPMC Consulting**, which provides information, marketing and technical services on the full TiO_2 value chain for financial analysts and business leaders, Managing Director Gerry Colamarino says the Chemours sales strategy separates customers between longer term, more stable pricing AVA contracts "and the majority of other customers purchasing through their portal, mostly on a spot basis, which is measurably higher pricing versus the AVA contract price." He says that as supply tightens, customers not on AVA contracts will pay a higher price and that will gradually increase global pricing.

"We see current demand levels well below trend line, mainly as a result of the recent destocking. Given the current uncertainty surrounding the global economy, it is difficult to precisely predict when pricing will turn upward. Margins have been severely restricted, as the global TiO_2 feedstock industry has been increasing prices during the recent downturn. This has produced increased floor pricing, with many TiO_2 producers, particularly Chinese producers, operating at very low profit margins," Colamarino says.

Performance pigment

Turning from supply and demand to product development, one company set to extend its product slate is **Venator**. At K2019 later this month, it will launch Tioxide TR29, which the company describes as its highest performing white pigment for low moisture applications and demanding processing conditions. "Combining ultra-low moisture content, with excellent dispersion

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PHOTO: TROMOX

Right: Tronox completed its acquisition of Cristal's TiO_2 business following agreement to sell the North American units to Ineos

properties and a high packing fraction, Tioxide TR29 is designed for use in the manufacture of highly technical thin films, and in engineering polymers where moisture sensitivity is a consideration," Venator says.

"Tioxide TR29 can be used to create masterbatches with a very high TiO_2 loading, while maintaining a high throughput rate and a low specific energy requirement – which can potentially reduce production and transportation costs compared to multipurpose masterbatch grades," says Dr Jörg Hocken, Global Application Manager.

In the manufacture of technical multi-layer films, the company claims, the low moisture content of Tioxide TR29 enables converters to produce thinner films with a reduced risk of lacing. "This enables the manufacture of high quality packaging materials that are less likely to fail from lower raw material utilisation, thereby helping to reduce plastic waste," Hocken says.

Integrated into moisture-sensitive engineering polymers, Tioxide TR29 can provide whitening properties without causing moisture or volatile-induced failure. Potential applications include earphones and smartphone shells, ski masks and air conditioning units.

Masterbatch option

Lomon Billions also has a new product entry. "Our latest innovation in TiO_2 pigments for plastics is Billions BLR-886 pigment made by the chloride process," says Julie Reid, the company's Marketing Director. "It's particularly suitable for polyolefin masterbatch, high-temperature extrusion coatings, cast films and engineering plastics."

Below: Lomon Billions is halfway through a 200,000 tonnes/yr chloride TiO_2 capacity expansion at Jiaozuo in China

Lomon Billions is on a continuing growth path that for the moment puts it in third place in the global league table of TiO_2 producers. Last year it announced an investment of around $285m in the construction of an additional 200,000 tonnes of capacity at its chloride TiO_2 pigment manufacturing site in Jiaozuo; its ambition is to grow its chloride capacity still further (most TiO_2 in China is produced using sulphate technology).


PHOTO: LOMON BILLIONS

The new capacity comes from two lines, each of 100,000 tonnes/yr capacity. The company says commercial production on the first line is already underway, the second line will be fully commissioned by the end of this year, with commercial production expected in H1 2020.

The company has also been growing through acquisition. In June, it acquired the Yunnan Xinli site in China to provide further chloride TiO_2 pigment manufacturing capacity. This site is currently being refurbished for restart this year and is expected to deliver around 60,000 tonnes/yr of additional chloride capacity.

"Our annual manufacturing capacity will grow from 700,000 to around one million tonnes/yr in 2019," says Reid. "The additional capacity at Jiaozuo, Xiangyang and Xinli strengthens our global competitiveness and will allow us to increase our chloride TiO_2 pigment portfolio to manufacture more high-performance chloride TiO_2 pigments for a wider range of applications, including growing our portfolio for plastics applications."

Cristal deal done

Meanwhile, back in April, **Tronox** finally completed its acquisition of Cristal's TiO_2 business. Tronox first made a bid for the business in early 2017, but it was blocked by the US Federal Trade Commission (FTC). The FTC dropped its opposition after it was agreed that Cristal's North American TiO_2 business would be sold to Ineos Enterprises. With this acquisition, Tronox now operates nine TiO_2

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Above: Widely used in paints, extenders could help TiO_2 go further in plastics colouring applications

manufacturing plants around the world, giving it the most diverse global footprint in the industry. It is the world's second largest supplier.

"Our newly combined, wide-ranging portfolio of TiOna TiO_2 products continues to offer a combination of desired high-performance characteristics for plastics producers," says Jeff Engle, VP, Marketing. "The joining together of Cristal and Tronox positions us to be in the right place with the right products for our customers."

At **Ineos**, Chairman Jim Ratcliffe says the acquisition of the Cristal units "is a great opportunity for Ineos to enter the pigments market and become the second largest producer of titanium dioxide in the key North American market." Cristal's North American business includes two plants in Ohio.

TiPMC Consulting's Colamarino says Tronox, Chemours and Lomon Billions "form a unique group not seen before in the industry, each bringing unique strengths, with capacity either over or near one million tonnes. Ineos is a new entrant into the industry, with a successful track record of buying undervalued assets and producing excellent cash flows. Ineos brings the advantage of being a private company, with new ideas, methods, and a strong balance sheet into the industry. It's an exciting time in terms of positive changes for an old industry."

Extending pigments

One way to make TiO_2 go further is to use mineral extenders. These are often used in paints, but less so in plastics. One company offering solutions for both is **FP-Pigments**. Its FP-500 Series Opacity Pigments contain what Andy White, Business Unit Director Paints and Plastics, says is "optimally spaced" TiO_2.

"In almost all plastics, the levels of TiO_2 are so low that the spacing is extremely sub optimal," he says. "Nevertheless, it is still the most effective at providing opacity and whiteness. FP-550 in masterbatch and FP 510 in PVC can be used to replace 10-15% of the randomly distributed sub optimal TiO_2 with optimally spaced TiO_2 and thus achieve a similar optical effect at a far lower cost."

White says FP Pigment works in a different way to conventional extenders, "which simply limit the space available to the TiO_2 and push it on average closer together. It is possible to use both technologies in certain applications to further optimise cost versus performance."

In addition, he says that, compared to conventional TiO_2, FP Pigment provides opacity and whiteness without white strength. "This can facilitate the enhanced chroma of coloured pigments in plastics applications when replacing TiO_2 with FP Pigment," he says. "Cost savings on reduced high-cost organic or mixed metal oxide pigments can then be considerable."

Under the weather

Typically, TiO_2 grades for plastics are characterised by high hydrophobicity, which ensures good mixing during compounding and easy distribution in the polymer matrix. However, not every grade of hydrophobic TiO_2 is suitable for production of plastics that are exposed to external weather conditions (UV radiation, humidity), according to Andriy Gonchar, Director at **RD Titan Group Innovative TiO_2**.

TiO_2 is a photocatalyst that absorbs UV radiation, he explains. When that UV absorption takes place in the presence of moisture a cycle of chemical reactions is initiated leading to the formation of extremely reactive free radicals. These can react with the molecules of the polymer matrix and cause its destruction. This process releases pigment particles enclosed in the polymer matrix, leading to chalking and loss of surface gloss.

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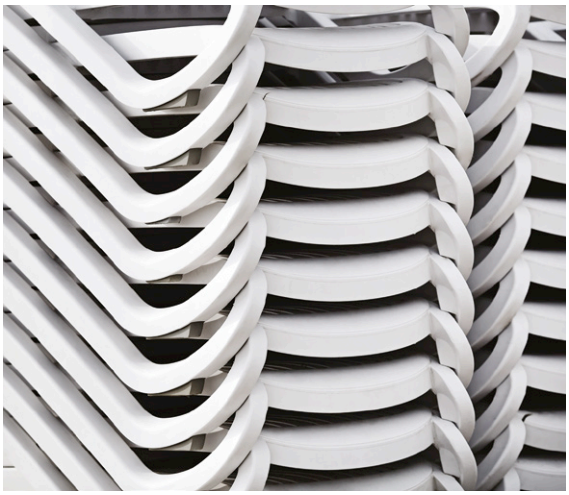

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Right: RD Titan Group Innovative TiO_2 claims to be tackling the challenge of weathering performance

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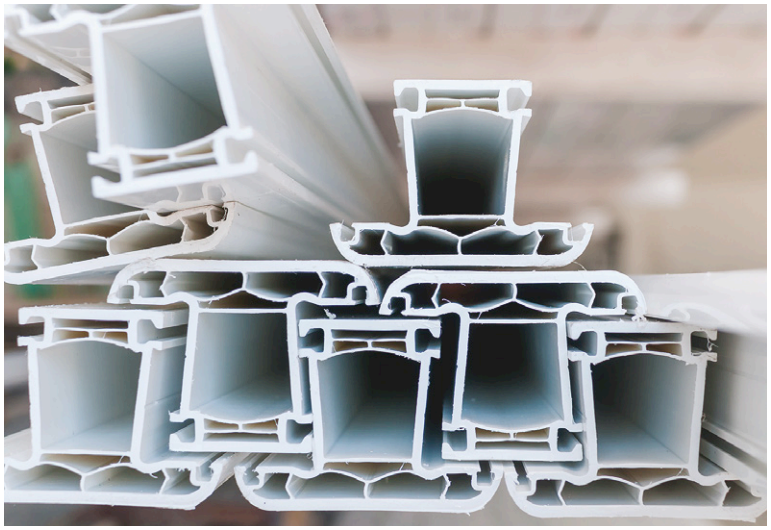

Above: The EU is about to legislate that all TiO_2-containing products such as window profiles carry health warnings

enon, TiO_2 manufacturers have developed special grades with reduced TiO_2 photocatalytic activity. Gonchar says this is typically achieved by introducing special dopants to decrease photocatalytic activity of the TiO_2 lattice or by applying inorganic surface treatments such as silicon oxide or zirconium compounds. The former are intended to act as a barrier on the TiO_2 surface while the latter capture the free radicals formed.

Gonchar says both TiO_2 lattice doping and surface treatment involve complicated operations with a lot of critical nuances to be taken into account. Therefore, he advises that users take care to evaluate the quality of offered products by conducting their own weathering tests – either accelerated or in real outdoor conditions.

RD Titan Group Innovative TiO_2 has developed its own technology for production of super-durable TiO_2. Its RP-72 grade production technology makes it possible to produce titanium dioxide with superior weather durability, according to Gonchar. It involves the combination of three technologies: TiO_2 particles are encapsulated in a dense silicon oxide; the crystal lattice is doped using a specially developed technology to reduce photochemical activity; and a "free radical scavenger mechanism" is applied to neutralise any free radicals that can form.

More recently, RD Titan Group Innovative TiO_2 has developed an even more durable grade. RP-8829 is said to be exhibit twice the durability of RP-72 (determined as 5% acid solubility for RP-8829 versus 10% for RP-72).

Regulatory troubles

On the regulatory front, the European Commission is close to legislating that all TiO_2-containing products sold in the EU (cans of paint, PVC window-frames, packs of decorative laminate flooring, and the like) carry labelling with words and icons warning that the product contains a potential carcinogen (see this month's news section). The move is based on toxicological data from two studies in which laboratory rats developed tumours that became cancerous after living for several weeks in very concentrated atmospheres of TiO_2 dust.

"The validity of these studies has been challenged on many grounds," says consultant Reg Adams. He says critics have pointed to the exposure concentrations being extreme (240 mg/m^3), that the rat lungs were chronically overloaded, and that physiological clearance was impaired. It is also pointed out that human cohort studies assessing more than 24,000 people working in TiO_2 factories have not shown an association between exposure to TiO_2 at normal factory concentrations and an increased incidence of lung cancer.

"Nevertheless, the law-drafting process moves ahead inexorably since May 2016, when the recommendation for special labelling was first tabled," he says. "In mid-September 2019, the European Commission declared that it will be submitting the draft legislation for final approval by the European Parliament and the Council of Ministers. The enactment of legislation in the EU might set a precedent for similar regulations to be adopted in other parts of the world. In any event, it may well have a dampening effect on the potential growth of TiO_2 consumption in paint, plastics and other end-use sectors."

TDMA, the trade association representing TiO_2 manufacturers, says the chemical should not be classified as carcinogenic because the proposed mechanism of toxicity is not related to its chemistry, but rather to the size and shape of the particles, as well as to its low solubility. TDMA says "a vast body of scientific evidence" shows that TiO_2 does not cause cancer in humans (**https://tdma.info/titanium-dioxide-is-safe/**).

According to one news outlet, the European Commission says it has worked in close consultation with member states and various stakeholders and made "all efforts" to address their anxieties.

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The compounders' guide to K 2019

Part 2: Machinery and equipment

The world's biggest and most international plastics is just days away. K2019 opens its doors in Dusseldorf in Germany on 16 October and, as in the past, will be the place to see the very latest innovations in plastics materials, machinery and processing technology. However, the event is huge and has to be approached with a plan–our pre-event coverage aims to help you get the most from your time there.

Last month's preview focused on materials and additives of interest to compounders. This month we turn our attention to machinery and equipment. Over the next 24 pages we provide details on some of the newest developments in compounding machinery, feeding equipment and processing hardware. We also add in a few materials items that missed our September publishing deadline.

There is no doubt that the global economic and political environment has changed dramatically since the previous K show in 2016. Data from the German plastics machinery association VDMA–one of the key supporters of the K fair–as well as its Italian equivalent Amaplast and the US plastics industry association all show that the 10-year investment boom has come to an end. We also find ourselves having to deal with the potential fall-out of global trade wars, the uncertainty of Brexit, the challenge of a technology shift from internal combustion to electric propulsion in automotive, and intense anti-plastic campaigning against plastics packaging.

However, the K fair has taken place in challenging times in the past. On those occasions it showed the plastics industry's ability to showcase technologies designed to meet or exceed the demands of the day. It is likely that 2019 will be no different. Expect to see potential solutions to the big issues of our time–lightweighting, emission reduction, recycling, the Circular Economy. And expect to see contacts being made and business being done.

If you are planning to attend the show but are yet to finalise your travel and accommodation you need to act really fast. There are some useful weblinks at the foot of this page and plenty more in the "First Look" article in our August edition that may prove helpful **http://bit.ly/2TsqITm**

The *Compounding World* and AMI Magazines team will be at the show for the full eight days and will be gathering information for our post-event coverage in the November and December editions. We will also be reporting on the biggest news and innovations as they happen via our @PlasticsWorld feed on Twitter. If you want to be sure you keep in touch with developments join the more than 20,000 people already following us.

You may also be able to catch up with our editors and sales team on the AMI stand at the show – you can find us on Stand C11 in Hall 7. We will have information about our magazines, conferences, databases, consulting services and our new North American and European Expos available. Some of our industry experts will also be giving daily presentations covering compounding, masterbatch and recycling. You can learn more about those here **https://go.ami.international/book_ami_k2019demo/**

Dates: 16-23 October 2019
Venue: Messe Dusseldorf, Dusseldorf, Germany
Hours: 10:00-18:30 daily
Tickets: One-day €75, three-day €155 (€49/€108 online). All include free local transport and on-site wifi
Organiser: Messe Dusseldorf
Website: www.k-online.com

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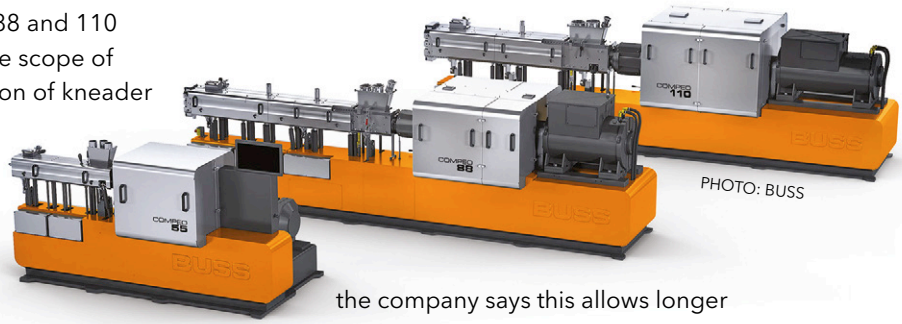

PHOTO: BUSS

Right: Buss will launch two new larger additions to its latest Compeo kneader line, which now offers 55, 88 and 110mm diameters

Buss will introduce its Compeo 88 and 110 compounders at K, extending the scope of application for its latest generation of kneader extruders. Together with the Compeo 55, which was launched last year, the new models take the Compeo family to three, each of which can be supplied with process lengths from 13 to 25 L/D.

The company will show a Compeo 110 model on its stand configured with an 18 L/D screw. The 110mm diameter machine provides an approximate throughput of 1,200-2,400 kg/h (the Compeo 55 offers 150-300 kg/h and the Compeo 88 600-1,200 kg/h). It will be equipped with a downstream side feeder and the company's new conical twin screw discharge unit. In this configuration, the system is said to be well suited to compounding of filled and reinforced thermoplastics – including natural fibre and bio-based formulations–as well as – production of HFFR cable compounds.

Configured with a 25 L/D screw, the Compeo 88 machine is said to be a good choice for compounding black or coloured masterbatches. For such applications, it can be fitted with one or two additional side feeders. Buss says a European masterbatch manufacturer took delivery of a Compeo 88 in the run-up to the show.

Buss claims that the Compeo compounders provide high-intensity mixing and can handle high filler contents with precise control of the temperature of the compound. The machines use a modular design, which allows cost-effective configuration of optimised lines. Typical applications can range from production of thermally sensitive thermosets to demanding engineering polymers with processing temperatures of up to 400°C.

One of the key features of the Compeo kneader design is its ability to combine conventional three or four-flight kneading elements with new elements comprising two or six flights and to place them in any desired position within the process section. Combined with increased specific torque, the company says this allows longer mixing zones to be used without an increase in energy input.

› **www.busscorp.com**

Brabender and **Brabender Messtechnik** will show their latest solutions for lab scale processing and rheology measurement, including a first showing for the TwinLab-C 20/40 standalone twin-screw extruder. Featuring a modular design that can allow it to be used for a wide variety of applications, it will be equipped with the Brabender web-based MetaBridge software. This provides ease of operation via a touch screen and enables simultaneous retrieval of measurement results via various desktop and mobile devices.
Also new to Brabender's product portfolio is the MetaStation. This torque rheometer can be used as a drive unit for various measuring mixer and extruder attachments. Other items on display include the AQUATRAC station, which can determine water content precisely using a capacitive water-selective dew point sensor (meaning no chemicals or consumables are required).

› **www.brabender.com**

Below: Coperion will show the latest version of its ZSK MC18 compounding extruder, optimised for easier operation

PHOTO: COPERION

Coperion and **Coperion K-Tron** will present the latest developments in their compounding and materials handling product lines. Coperion will show two redesigned versions of its high-end ZSK twin screw compounders, a new SP series strand pelletiser and demonstrate its energy-efficient FluidLift ecoblue pneumatic conveying technology. Coperion K-Tron's new introductions include a redesigned K3 vibratory feeder.

The re-designed ZSK Mc^{18} extruders on display will include 45 and 70 mm screw diameter models, both offering specific torque of 18 Nm/cm^3. Mechanical and electrical features on these updated models have been optimised to enhance operation and improve efficiency, according to Coperion. Both will be equipped with ZS-B Easy side feeders and ZS-EG Easy side devolatilisation units, which are claimed to significantly speed up maintenance processes by enabling fast removal and reinstallation on the process section for

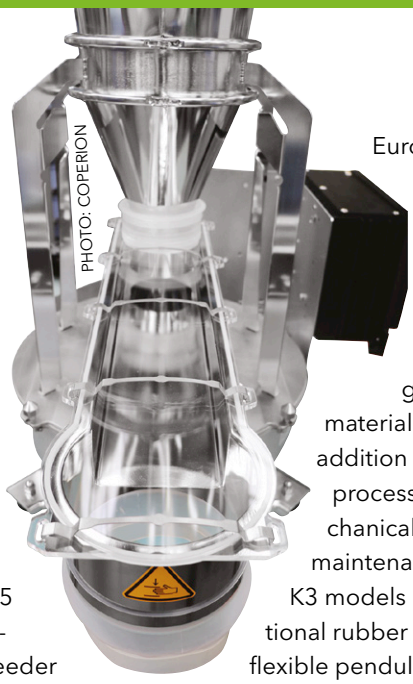
PHOTO: COPERION

Right: The Coperion K-Tron K3 series vibratory feeder will be demonstrated for the first time in Europe

cleaning or screw changes with just a few hand movements. The new machines also use single-part heat insulation covers in place of the traditional three-part designs. The new covers are said to be easier to handle and can be detached without removing the cartridge heaters.

The ZSK 70 Mc^{18} will be shown with a K3-ML-D5-V200 vibratory feeder and a ZS-B Easy siude feeder with a K-ML-SFS-BSP-100 Bulk Solids Pump (BSP). The ZSK 45 Mc^{18} will be equipped with a gravimetric K2-ML-D5-T35 twin screw feeder and ZS-B Easy with a K-ML-SFS-KT20 twin screw feeder for high accuracy feeding at low feeding rates.

Coperion Pelletizing Technology will show a dual bearing SP 240 strand pelletiser, which the company says has also been reworked to simplify handling. It incorporates a new cutting tool-free gap adjustment technology that is said to make fine adjustments simpler, faster and more precise. It can also help reduce maintenance downtimes. The cutting tools are now installed closer to each other to enable a shorter unguided strand length in the pelletiser, which gives better cutting results especially with soft materials. This new arrangement also results in less dead space which, together with optimised edges and fewer free surfaces, provides improved cleanability. The complete cutting area is also accessible without tools for cutting unit exchange. Other changes include a straight intake that allows feeding of the strands without deflection as well as improved sound-proofing.

Coperion K-Tron's redesigned K3 Vibratory Feeder line will be getting its first showing in Europe. The K3-ML-D5-V200 vibratory feeder will be demonsrated as part of a recirculating system with automatic refill provided by a P-Series vacuum receiver and a compact vacuum pump.

Vibratory feeders are said to be a good choice for feeding recycled material or flakes as well as for the addition of glass fibre in compounding processes as there is no wear on mechanical components, near eliminating maintenance. The key new feature of the K3 models is the replacement of the conventional rubber or spring shock absorbers with a flexible pendulum technology. This ensures movement only in the direction of motion, rather than the more usual 360° agitation.

Internal sensors measure acceleration, displacement, load, current and temperature at up to 25,000 times per second while a fast-acting controller adjusts the vibratory drive signal to maintain clean sinusoidal displacement for optimal mass flow. The combination of the pendulum drive technology with Coperion K-Tron's SmartConnex control system also results in optimised energy consumption. The company says power consumption can be as low as 20W for feed rates as high as 6,000 kg/h.

Coperion K-Tron will also show an SWB-300 weigh belt feeder. This simply-constructed gravimetric feeder is said to provide reliable and highly accurate control. The company says feeders of this type can reliably handle large volumes of bulk materials with various flow properties, making them suitable for processing of a wide variety of materials, including recyclates.

A FluidLift ecoblue pneumatic conveying process for plastic pellets completes the Coperion display. The company claims that, compared to conventional systems, the FluidLift technology results in less abrasion of the pellets so helps to keep dust or strand formation to the minimum. Energy consumption is also reduced.

› **www.coperion.com**

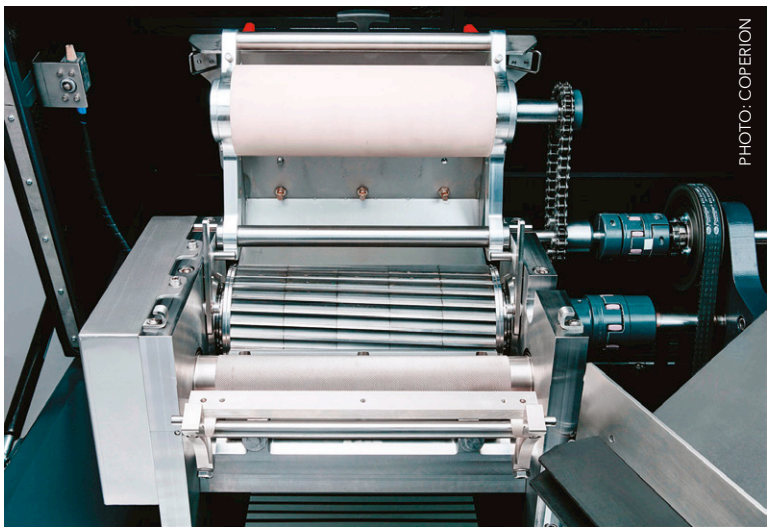
PHOTO: COPERION

Below: Coperion Pelletizing Technology's SP240 model features a redesigned cutting chamber

Farrel-Pomini will be exhibiting together with parent company HF Mixing Group with the centre point of its display being a compounding tower system with live Synergy Control. Key features of the control include touchscreen control of feeding, integrated control of upstream and downstream equipment, automatic start-up and shutdown of all equipment, and remote monitoring and support tools.

The company's stand will also include several

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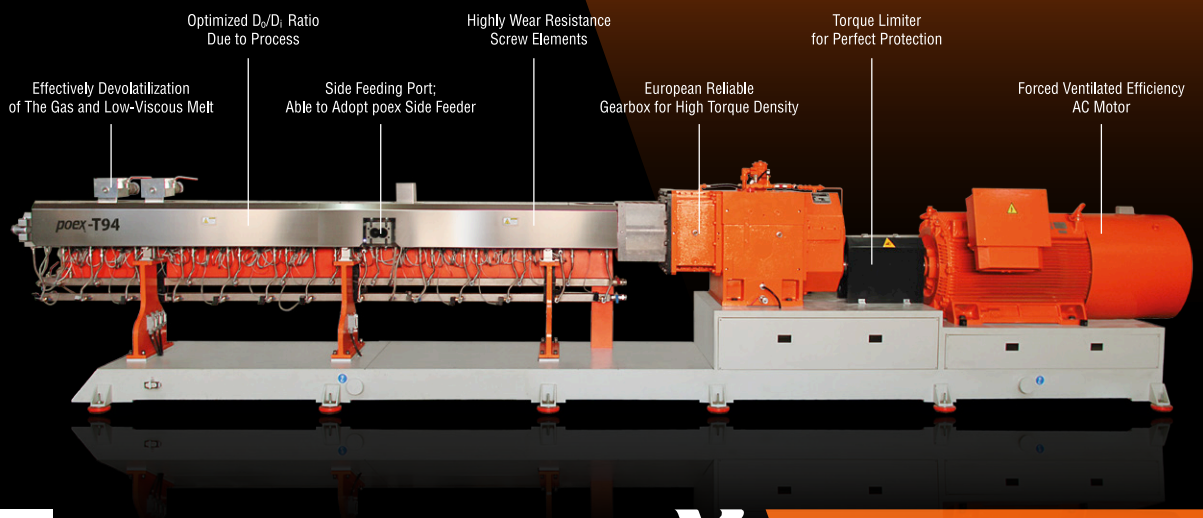

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PHOTO: FARREL-POMINI

Right: Farrel-Pomini will demonstrate its Synergy control in a compounding tower system

interactive stations demonstrating its capabilities in processing of a variety of challenging and highly filled formulations, including PVC, bioplastics, black and white masterbatch, and calcium carbonate filled and flame retarded polymers.

HF Mixing will show its new Advise 4.0 Mixing Room Automation solution. This is a modular and scalable system for mixing room automation that covers everything from raw materials storage, manual and fully automated weighing of small components, mixing, downstream equipment and storage. Automation systems are available for individual areas and machines, with separate applications selectable according to requirements. Standard interfaces within mixing room automation systems enable easy connection to ERP systems and laboratory equipment.

› **www.farrel-pomini.com**

Below: Feddem will show a FED 26 MTX machine with extension unit

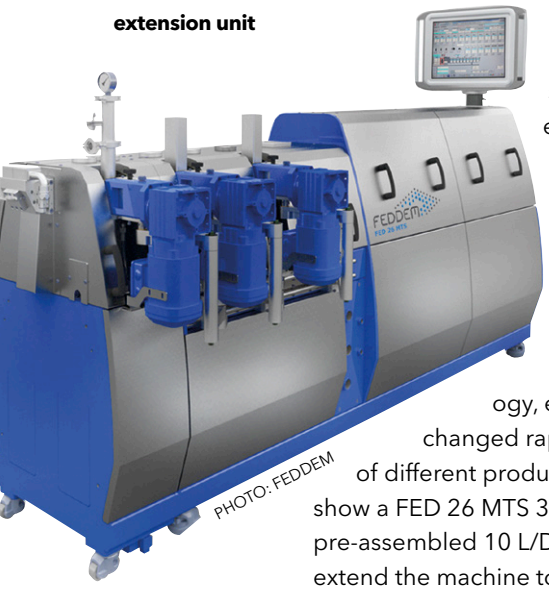

PHOTO: FEDDEM

Feddem will show how its MTS and MTV line of twin screw compounding extruders can meet the increasing demand for fast product changeovers. While it can supply compounding lines tailored to a specific compounding task, it says its MTS and MTV designs, together with its ICX Technology, enables configurations to be changed rapidly to handle a wide range of different production tasks. During K, it will show a FED 26 MTS 32 L/D extruder with a pre-assembled 10 L/D unit that enables the user to extend the machine to 42 L/D. The company says it is possible to lengthen or shorten the processing unit to meet the needs of the compounding task within hours.

The company, part of Feddersen Group, will also focus on its newly-developed technology for production of pultruded long-fibre thermoplastics (LFTs). It can now offer five-strand systems with production rates starting at around 7 kg/h for laboratory and development work through to 60-strand systems for large scale production at rates in excess of 1,000 kg/h. The technology has been developed in partnership with sister company Akro-Plastic, which already has an ICX LFT production line in operation.

› **www.feddem.com**

ICMA San Giorgio will be placing the emphasis of its display on the role of its twin screw compounding equipment in recycling systems. One example is its One-Step Upcycling concept, which uses just one compounding extruder to convert post-industrial or post-consumer plastic films or rigid parts and converts them to high value compounds through the addition of fillers, modifiers, reinforcements and additives. It claims that its approach is simpler than alternative two-step systems while providing more flexibility for current and future requirements.

The company will also highlight the results of an EU-funded project it has participated in to develop direct extrusion options for recycling. Ecoimpatto and Ecosheet-Pro systems are designed to produce high performance end products from plastic scrap materials. Turnkey plants for production of bio-based compounds will also be promoted.

› **www.icmasg.it**

Koch Technik will show its latest SLT and MCT controllers for use with its volumetric mixing and dosing stations. The new units use a 7-inch touch screen and offer an extended recipe memory, simple recipe management, password and user hierarchy, alarm outputs for optional fault detectors and an alarm history. A USB output is provided to allow data loading, backup and software updates while an Ethernet connector allows integration with central dosing controllers using Koch's visualisation software. The units also offer compliance with the OPC-UA communication standard, allowing straightforward data exchange between machine feeders and Manufacturing Execution Systems as part of a smart manufacturing set-up.

› **www.koch-technik.de**

KraussMaffei will introduce four new large additions to its ZE BluePower range of twin screw compounders and demonstrate and a smart inline system for production of coloured compounds as part of an integrated manufacturing system turning recyclate to finished automotive trim parts.

The four large ZE BluePower machines will be

PHOTO: KOCH-TECHNIK

Right: Koch-Technik will show its latest mixing and dosing controllers

available immediately in 98, 122, 142 and 166mm diameter variants, offering throughputs of up to 2,500 kg/h. In common with the smaller machines, the new models feature a 1.65 OD/ID diameter ratio, which results in a 27% increase in free volume compared to the previous ZE UT machine series. Torque density is up by 36% to 16 Nm/cm^3.

The new models also share the same modular screw and barrel design, which includes a wide range of 4D and 6D barrel sections as well as numerous side feeder and degassing units and exchangeable wear resistant liners. They differ only in using screw unions instead of clamping flanges on the housing elements, required due to their larger size. The company has also replaced the cartridge heaters with ceramic types.

The smart colour compound production system will be shown as part of a "Circular Economy" injection moulding exhibit. PP buckets produced on the KraussMaffei stand will be reground then fed to a twin screw compounder, where talc and a colourant will be added. The upcycled granulate will then be used to injection mould an Automotive A-pillar support.

The compounding system comprises a ZE 28 BluePower compounding extruder which is supplied with red, yellow and blue Rowasol liquid colourants from Rowa via an inline colorant system developed by OPM Mechatronic. This uses an eccentric screw dosing system to meter the colour in accordance with real-time measurements from a ColVisTec spectromphotometer located close to the extrusion die. The dosing modules are managed by the control system in the extruder.

› **www.kraussmaffei.com**

Labtech Engineering will show a 26mm twin screw extruder, which will be demonstrated with feeders, cooling bath and pelletiser, and a new miniature system for compounding and production of filaments for 3D printing.

The company, which specialises in laboratory scale extrusion equipment, says the 26mm extruder shares all of the features of its 16 and 20mm models, including a modular clamshell barrel with easily removeable wear inserts. Barrel modules are joined by bolts, with each 4D section containing cartridge heaters and water cooling channels. A particular feature of the design is that only the barrel inserts are in full contact, allowing an air gap to be maintained between each module body. This is claimed to allow greater flexibility in temperature along the processing unit, which can be of benefit when handling challenging or sensitive materials.

The machine on display will be an LTEM26-48 Maxi Compounder with a 48 L/D screw configured as part of a complete compounding system. It will feature gravimetric feeding on the main port and side feed and will be completed with an LW-100 water cooling bath and LZ-120/VS strand pelletiser. The latter can run at feed rates of up to 70mm/min and can product pellets from 0.5-6.0mm in length.

The company will also show its new system for development of 3D printing filaments. The Ultra Micro 3D Filament line comprises a 5mm diameter 40 L/D twin screw compounding extruder, water bath, puller and winder. Designed for very small sample production, the machine is powder fed and can produce standard 1.75 and 2.85mm diameter filaments. Labtech says it plans to introduce a larger version built around its 12mm diameter extruder which will be able to accept pellet and pellet/powder feeding.

› **www.labtechengineering.com**

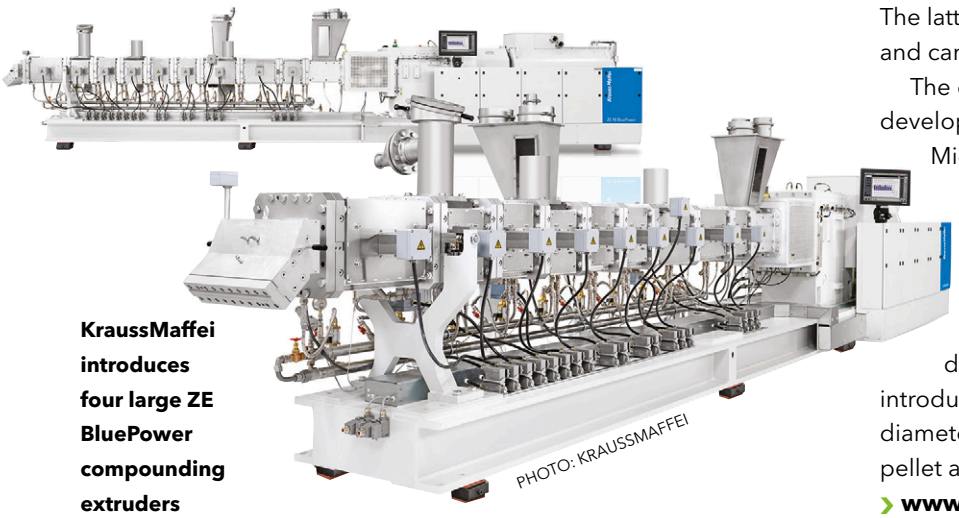

PHOTO: KRAUSSMAFFEI

KraussMaffei introduces four large ZE BluePower compounding extruders

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PHOTO: LABTECH ENGINEERING

Right: Labtech Engineering will show its LTEM26-48 twin screw compounder

Maag Group's stand at K for the very first time brings together all of its members – Automatik, Ettlinger Kunststoffmaschinen, Gala Industries, Maag Pump Systems and Reduction Engineering Scheer. The move is aligned with its recent decision to focus its business around four "Centres of Excellence" focused on Pump & Filtration Systems, Pelletising Systems, Pulverising Systems and Recycling Systems.

The company will also present a number of its latest product developments, including the new Ettlinger ERF 1000 high performance melt filter. Designed for very high throughput recycling applications, the machine is equipped with four filter drums providing a total of 6280cm² of filtration surface – twice as much as its previous range-topping ERF 500 model.

The new model offers a throughput of up to 10,000 kg/h and brings the ERF product line up to four, starting with the ERF 200 for throughputs up to 800 kg/h. In common with all machines in the range, it can be equipped with the company's super fine 60 micron screen. It is a self-cleaning machine that works with a rotating drum and scraper to remove trapped contaminants. A new feature on this largest model is the ability to remove the filter drums individually without halting production.

Below: Ettlinger's range-topping ERF1000 screenchanger will be displayed on the Maag Group Stand

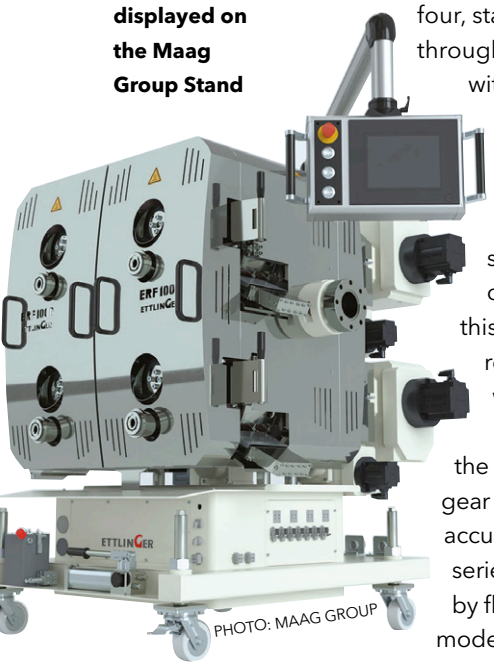

PHOTO: MAAG GROUP

The company will also present the recently introduced Maag F-Series gear pumps, available in the high dosing accuracy DX "Dosix" or the FX "Flexinox" series, which is said to be characterised by flexibility in operation. All seven models in the range feature a modular construction, which is claimed to provide flexibility in configuration and easier cleaning and maintenance access. Gear shafts, bearings and seals are interchangeable with previous models.

› **www.maag.com**

Moretto will present a number of examples from its range of materials conveying and dosing equipment, including a new line of equipment for micro level dosing as well as its latest gravimetric systems. DPM units are available with up to four hoppers and use a pulsed dosing technology to handle low level additions of masterbatch or additives. The company says the use of pulsed dosing means the equipment is not affected by vibration, so allows direct mounting on the processing machine. In addition, it means no mixer is required in multi-component configurations.

Also aimed at masterbatch and additive dosing, the DPK precision loss-in-weight unit uses load cells and an optimised control algorithm to maintain dosing accuracies of ±0.03%, according to the company. Features include a transparent hopper that can be removed without the need for any tools. Meanwhile, DGM Gravix units can be configured for gravimetric dosing of up to 12 materials and throughput rates of up to 12,000 kg/h. They can be combined with Rotopulse micro dosers and and are claimed to provide accuracies of ±0.1%.

› **www.moretto.com**

Motan Colortronic will launch its SpectroPlus dosing and blending unit at K, a versatile machine that can handle granules, recyclate, powder, liquid and flake materials. The new unit has been developed specifically to meet the needs of the compounding and extrusion sectors.

SpectroPlus models are available in either gravimetric or volumetric versions, or as combination types. They can be configured with up to eight dosing modules and are suitable for both starve-

Aimplas, the Spanish plastics technical institute, will be highlighting a number of projects it has been involved with, many focused on the area of sustainability and the circular economy. Head of Compounding Luis Roca will be available to discuss reactive extrusion modification of PLA for food packaging applications while Extrusion Researcher Mapi Diego can speak about the latest developments in compostable plastic materials. The institute will also be sharing some details on its work to develop new and improved sorting and treatment systems for waste from different industry sectors, including agriculture and food processing, packaging, automotive and PVC. It will also present some active and smart packaging solutions using sensors, improved barrier, additives and absorbents.

› **www.aimplas.net**

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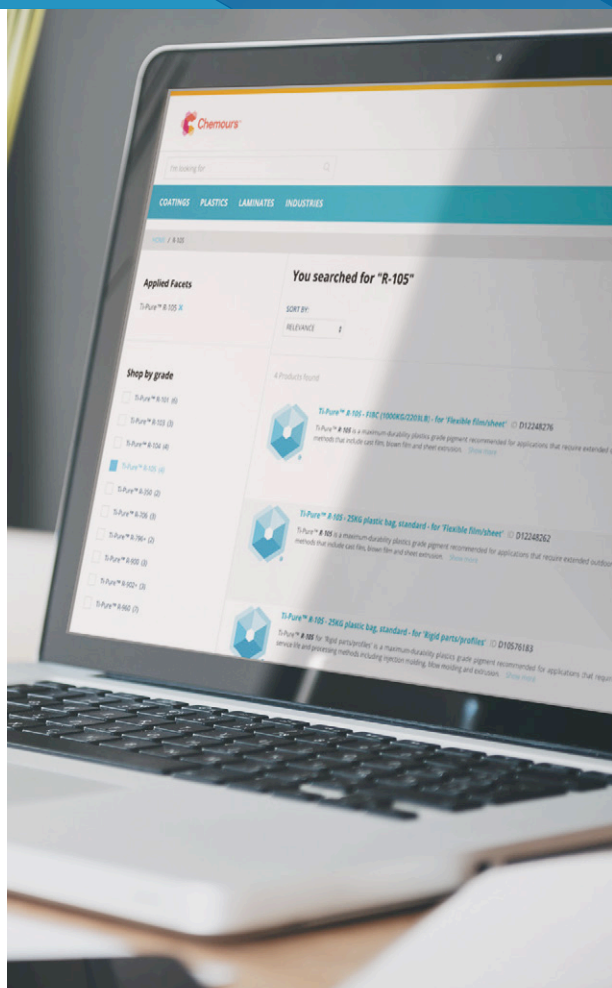

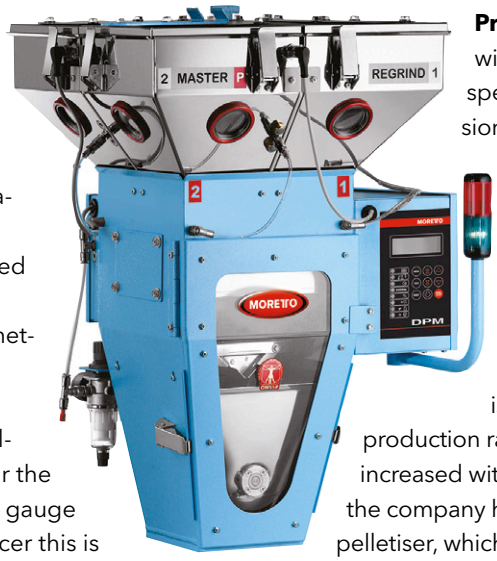

PHOTO: MORETTO

Right: Moretto claims its DPM series micro level dosers can maintain accuracies of ±0.03%

fed and flood-fed applications. Installation direct on the extruder is possible while the total height has been kept to the minimum to allow easy integration into existing installations. Dosing modules are exchangeable and can be removed without tools. In addition to modules for bulk solids, gravimetric supply hoppers with dosing pumps for liquids can be used.

Motan Colortronic has developed a new load cell system for the SpectroPlus. Comprising strain gauge load cells and a digital transducer this is said to be easy to calibrate and offers low susceptibility to external interference. The SpectroNet control system is also new and can be used with dosing modules from Motan Colrtronic and from third party suppliers.

› **www.motan-colortronic.com**

Plasmec, which is marking its 50th anniversary this year, will show two of its latest mixing systems: a Combimix-HC-800/2500 and a TRR-1500/FV container mixer. The Combimix-HC is said to be well suited to technical mixing applications such as PVC or WPC dry blend production. Combimix-HC models are available in 11 sizes covering the range from 200/800 to 2500/8500 litres capacity and offer high outputs due to the optimised TRM high speed mixer and HEC cooling technology. The TRR container mixer provides an alternative to conventional turbomixers for masterbatch, pigment and technical compound preparation. It is particulatly suitable for applications requiring the flexibility to handle a wide range of different recipes on the same machine.

› **www.plasmec.it**

Below: Dosing modules on Motan Colortronic's SpectroPlus units are easy to replace

PHOTO: MOTAN COLORTRONIC

ProTec Polymer Processing will be demonstrating a high speed retrofit for its LFT pultrusion lines that can lift output from 30 to 50 m/min. The upgrade incorporates an additional preheater and optimised die geometry, which allows the temperature to be adjusted more quickly to ensure that very good fibre impregnation is maintained at higher production rates. Cooling capacity is also increased with an additional water bath and the company has made some changes to the pelletiser, which is designed to cut the strands at high speed to the lengths of 6-12mm.

ProTec's LFT pultrusion lines can be designed to handle any thermoplastic matrix, while reinforcement options include glass, steel, aramid and carbon fibres. It is also possible to incorporate recycled materials and additional fillers if required.

The company will also be showing Batchmix 50 and Batchmix 350 batch dosing units from its SOMOS series, which comprises fourteen models offering throughputs from five to 3,000 kg/h. The smallest unit in the range – the Batchmix 50 – provides a throughput of up to 50 kg/h and can dose up to four components. Larger models can handle up to twelve components. A number of precision dosing devices are available to handle various pellet and regrind blends.

› **www.sp-protec.com**

Schenk Process adds a new smaller model to its ProFlex C line of feeders for the compounding and masterbatch industry and introduces a second variant of its Simplex FB flat bottom feeder for flake and fibre materials.

The Proflex C100 model is a new smaller version of the company's established Proflex C feeder, joining the established C500, C3000 and C6000 units. Designed for continuous feeding of bulk materials such as powders, pellets, granule and fibres into smaller compounding and masterbatch extruders, the company says up to five C100 units can be grouped around a single feed inlet. Consistent and accurate feeding is ensured by the use of a flexible wall liner that is massaged at eight points to prevent sticking and bridging while the feed hopper can be exchanged without the need to disassemble the feed screw.

The Simplex FB 650 flat bottom feeder joins the FB1500 unit introduced three years ago. It is a modular loss-in-weight machine designed for

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PHOTO: PROTEC POLYMER PROCESSING

Above: ProTec will demonstrate an LFT line upgrade that more than doubles output rates

handling light and fluffy materials such as plastic film flake and natural or carbon and glass fibres. The unit features a stainless steel construction with bottom driven vertical and auxiliary agitators.

› **www.schenckprocess.com**

Schwing Technologies will launch the Vacuclean Compact, a small format fully automatic vacuum pyrolyisis system for cleaning of metallic components such as compounding extruder parts and screen packs. Designed to take a load of up to 50kg, the compact unit measures 210mm by 120cm by 100cm and weighs 750kg, including integrated catalytic converter, vacuum pump and controller. The new machine is said to be energy efficient and to minimise environmental emissions and is Schwing's response to demands for smaller and lower cost cleaning systems for plastic processing machinery parts that can be installed at the point of production.

› **www.schwing-tech.com**

PHOTO: SCHWING TECHNOLOGIES

Right: Schwing's Vacuclean is a compact integrated pyrolysis cleaning system for machine parts

Sikora will be demonstrating a Purity Concept V optical laboratory pellet inspection system at the show handling samples from some of its customers. The company is also inviting visitors to bring along examples of their own production for testing. The system comprises an automated light table that allows the plastic pellets on a sample tray to be moved through the inspection area and inspected by a colour camera. Within seconds, a projector optically marks all contaminated pellets directly on the sample tray. The system can detect and statistically evaluate contaminants such as black specks from 50 microns in diameter on the surface of transparent, transclucent and coloured materials. It can also detect colour deviation.

The company will also show an X-ray based Purity Concept X laboratory system configured for detection and inspection of metal inclusions in coloured pellets that would be invisible with optical systems. The Concept X system can detect contaminants on the surface as well as inside the pellets. Application examples include inspection of compounds for insulation of HV cables, according to Sikora.

Inline inspection options on show from the company include a Purity Scanner Advanced system, which will be shown at K for the first time as a "Twin Pack" system. This high throughput version uses a combination of X-ray technology with up to four black and white and/or colour cameras to detect metallic contamination inside pellets and colour deviations and black specks on the surface of pellets at throughputs of up to two tonnes an hour. Contaminated pellets are identified and then automatically sorted out using Sikora's Professional Data Analysis Management (PDAM) software. This provides statistical evaluation of detected contamination, sorted by size and frequency, during production as well as an image gallery of the pellets that have been detected by the optical and X-ray cameras.

› **www.sikora.net**

AMI, publisher of *Compounding World*, will launch its new data services at K2019. Over more than 30 years, the company has assembled a global database containing individually verified information for more than 20,000 named plastics processing sites.

At the show, it will introduce a new data subscription service and demonstrate a suite of enhanced software tools that will give subscribers better access to critical information. The company says a number of its larger clients are already taking advantage of the new web-based search and analysis tools; it has now rolled out options for smaller clients that may require more targeted access to processor data.

Visitors to the AMI stand will also be able to find out more about the company's digital magazines (including *Compounding World*), conferences and international exhibitions. In addition, they will be able to take part in a number of daily speaker sessions, where some of the company's experts will cover topics such as recycling, compounding and masterbatch.

› **www.ami.international**

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Wednesday 4th December 2019

08:30 Registration and welcome coffee
09:30 Opening announcements

SESSION 1 – THE FUTURE FOR LFTs - NEW APPLICATIONS AND INNOVATIVE DEVELOPMENTS

09:40 **AMI Spotlight: Technology trends and market opportunities for LFTs in Europe**
Mr. Chris Smith, Editor-in-Chief,
COMPOUNDING WORLD, AMI, United Kingdom

10:00 **Case Study: Using D-LFT technology to produce a ground-breaking multifunctional box for the Ford Puma luggage compartment**
Mr. Meltem Öztürk, Exterior Trim Design & Release Engineer, and
Mr. Egemen Erbil, Exterior Trim Supervisor,
FORD OTOSAN, Turkey
Mr. Olaf Jacobi, Safety Senior Engineer, and
Mr. Matthias Hellriegel, Body Exterior Integration Supervisor
FORD MOTOR COMPANY, Germany
Mr. Simon Alexander, Technical Account Manager,
ROECHLING AUTOMOTIVE, Germany

10:40 **New developments in semi-structural parts using long-glass-fibre polypropylene**
Mr. Olaf Herd, Global OEM Manager Automotive,
CELANESE SERVICES SALES GmBH, Germany

11:10 Coffee break

11:50 **Weight and cost reduction – development of new lightweight and cost-effective applications for automotive safety structures using advanced long-fibre polypropylene technologies**
Mr. Marco Bernsdorf, Business Development Manager,
LOTTE CHEMICAL, Germany

SESSION 2 – OPTIMISING THE PRODUCTION OF LFTs

12:20 **Design concepts for LFT pultrusion lines**
Mr. Klaus Hojer, Business Development / Account Manager,
FEDDEM GmBH & Co. KG, Germany

12:50 **Modern plastics processing on highly flexible LFT pultrusion lines**
Ms. Karin Luxem, Area Sales Manager Asia / Pacific,
PROTEC POLYMER PROCESSING GmBH, Germany

13:20 Lunch

SESSION 3 – ASSESSING THE PERFORMANCE OF LFT MATERIALS AND COMPONENTS

14:50 **Predicting the short-term performance and life-time of long-fibre reinforced thermoplastics**
Mr. Julien Cathelin, Application Development Engineer,
SABIC B.V., The Netherlands

15:20 **Numerical simulation validation for long-fibre behaviour in injection moulding**
Mr. John Lin, Account Manager,
MOLDEX3D, Taiwan

15:50 **Studying the importance of carbon fibre length in injection moulded parts**
Mr. Wolfgang Stockreiter, Senior Scientist,
BOREALIS POLYOLEFINE GmBH, Austria

16:20 Coffee break

SESSION 4 – WHAT NEEDS TO BE DONE TO GROW THE LFT MARKET?

17:00 **Roundtable Discussion:** A facilitated solution-focused discussion held with speakers and peers to explore challenges and opportunities. Topics to include: Automotive design trends and opportunities, materials selection and optimisation, concentrates vs compounds, optimising production and reducing costs

18:00 Networking Cocktail Reception

Thursday 5th December 2019

08:30 Welcome coffee
09:00 Opening announcements

SESSION 5 – ADVANCES IN FIBRES AND SIZING TECHNOLOGIES FOR LFT APPLICATIONS

09:10 **Degradable glass fibre as reinforcement for LFT products**
Mr. Tomi Kangas, Sales and Marketing Director,
ARCTIC BIOMATERIALS OY, Finland

09:40 **Make impossible things - Innovations in fibre and sizing chemistry for Long Fibre Thermoplastics**
Ms. Colleen Kennedy, Global Product Manager LFTP,
OWENS CORNING, United States

10:10 Coffee break

SESSION 6 – MAXIMISING THE PROPERTIES AND PERFORMANCE OF LFT COMPONENTS

10:50 **Long-fibre thermoplastics - applications and challenges from a design and processing perspective**
Dr. Sachin Jain, Director,
SKYi COMPOSITES PVT. LTD (India), India

11:20 **Case study - pushing the limits of LFT performance with carbon fibres and advanced polymers**
Mr Ji Mingyuan, CEO,
XIAMEN LFT COMPOSITE PLASTIC Co., Ltd, China

11:50 **Hybrid solutions: examining the zero-waste production of tailored blanks for over-moulding with LFTs, using UD tapes**
Mr. Rien van den Aker, Director,
VAN WEES UD AND CROSSPLY TECHNOLOGY B.V,
The Netherlands

12:20 Lunch

SESSION 7 - UPDATE ON SUSTAINABLE SOLUTIONS FOR RECYCLED LFTs

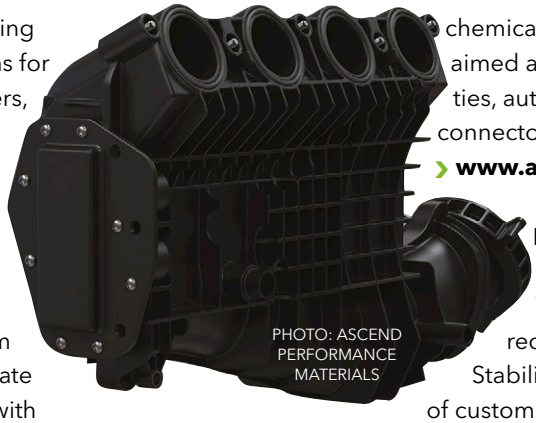
13:50 **Recycled, sustainable, discontinuous fibres for LFT pellets**
Mr. Geoff Foulds, Senior Development Engineer,
COVENTIVE COMPOSITES, United Kingdom

14:20 **Direct processing of recycled carbon fibre – a sustainable approach**
Mr. Sascha Kilian, Research Engineer,
FRAUNHOFER-INSTITUT FOR CHEMICAL TECHNOLOGY ICT,
Germany

14:50 Closing remarks and coffee

AMI reserves the right to alter the programme without notice.
The latest programme, including any new speakers, changes to the schedule, and any amendments to pricing and terms and conditions can be viewed on our website: ***www.ami.international***

We carried a detailed preview of the polymer materials and additives of interest to compounders in the September edition of Compounding World (you can read that HERE). Over the next eight pages we take a look at some of the new introductions that missed last month's publication deadline.



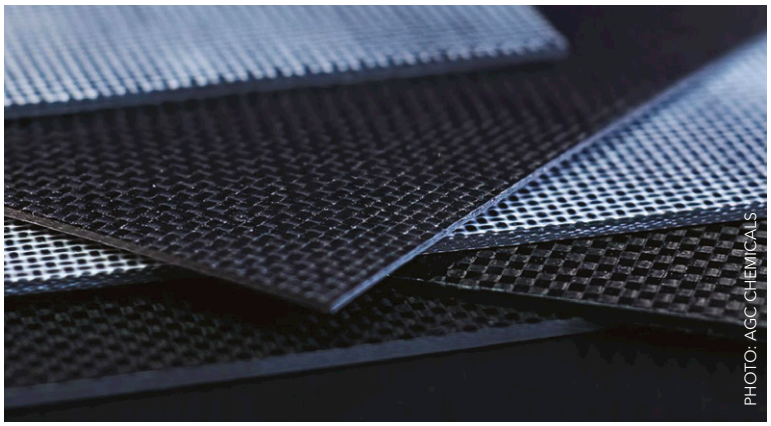
Right: Vydyne XHT is a new heat stabilised PA66 resin family from Ascend

AGC Chemicals will be showing some of the latest applications for its functionalised fluropolymers, including their use as compatibilisers and for improving impact and wear resistance. In bends and composites, for example, the Fluon+ materials can carry functional reactive groups allowing them to compatiblise blends to create high performance polymers with some fluoropolymer characteristics or to enhance fibre-matrix adhesion in composite structures. Meanwhile, AGC's fluoropolymer-modified PEEK compounds are said to display improved flexibility, impact resistance, wear resistance and better electrical properties than standard grades. They are suitable for production of semi-finished products, gears, cable sheathing and films.
› **www.agcce.com**

Ascend Performance Materials will introduce a new family of heat stabilised PA66 resins – Vydyne XHT – as well as extending its line of long-chain PA products. Vydyne XHT heat-stabilised PA66 is said to use a multi-stage heat stabilisation technology to allow it to withstand prolonged extended exposure at up to 230°C. It is available in four glass-reinforced grades that are said to offer good flow, making them suitable for production of injection moulded automotive parts such as charge air coolers, integrated air intake manifolds, exhaust gas recirculators and resonators.

The company will also launch a new line of PA610 and PA612 long-chain polyamides, which are characterised by low moisture absorption, high chemical and UV resistance and are aimed at applications such as cable ties, automotive cooling and fuel connectors, and sporting goods.
› **www.ascendmaterials.com**

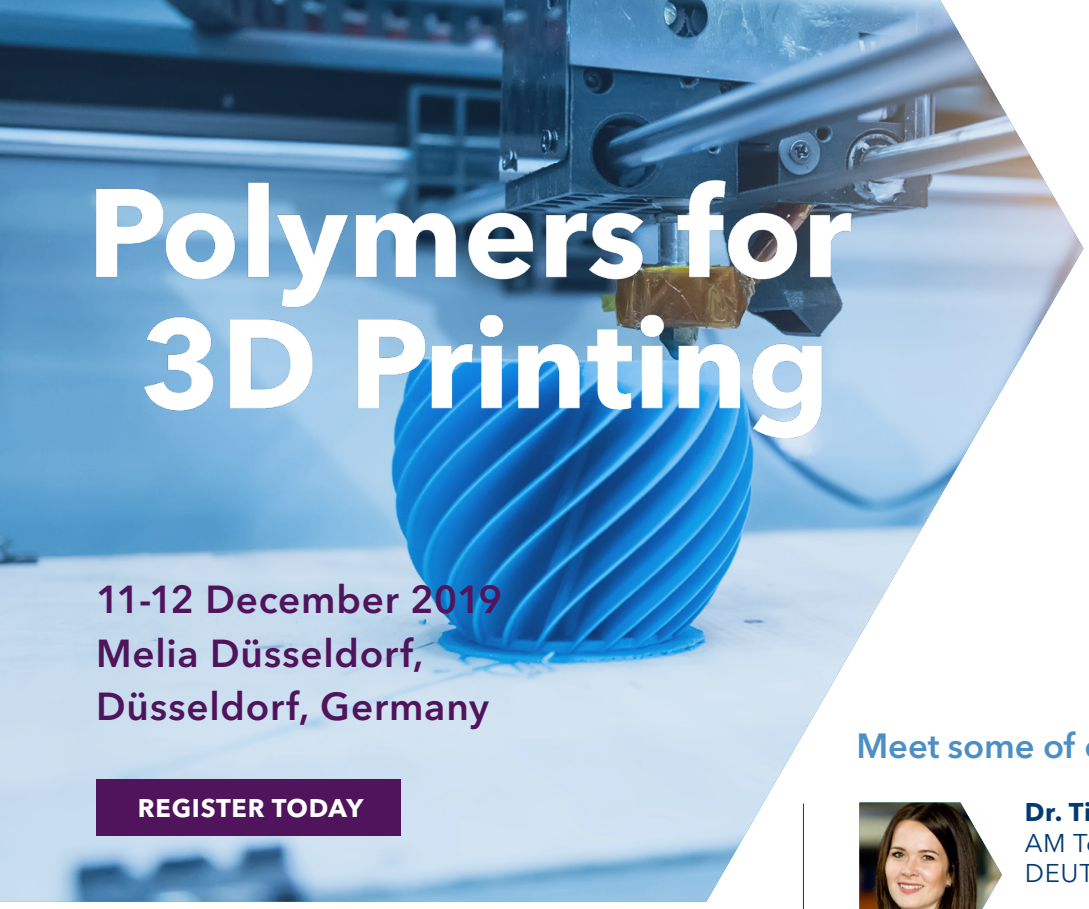
Below: AGC Chemicals will present fluoropolymers for enhancing composite matrix-fibre adhesion



Baerlocher's K display will include its Baeropol T-Blends for polymer recycling and its RST (Resin Stabilisation Technology) family of customisable stabiliser packages. It will also be demonstrating the use of its recycling additives in a demonstration in conjunction with machinery maker Erema and recycling technology company APK. Running in the Erema Circonomic Centre, it will show upcycling of low-value, difficult-to-recycle consumer film waste into a material suitable for construction sector applications.
› **www.baerlocher.com**

Epsan will launch a new range of technical compounds based on PA sourced from post-industrial waste streams. The Turkish compounder says Eplon+ products supplement its existing Eplon recycled PA grades, extending the scope of application into areas requiring higher performance or improved thermal resistance. Eplon+ grades are said to provide the same heat ageing properties as prime PA compounds and near matching mechanical performance. The new compounds are aimed at aplications in the automotive and household appliance markets where compliance with the principles of the circular economy is becoming more important.
› **www.epsan.com.tr**

Finke will show a number of developments in the area of colour masterbatch. Firstly, it will present an expanded range of coloured masterbatches for laser marking applications. These Fibaplast combination masterbatches offer both colour and laser marking function and are available for PP, PE, PET, PC, ABS, PLA, PA6, and PA12. They complement the standard laser marking additive masterbatches the company offers for use with a separate colour masterbatch. The company will also show a comprehensive range of masterbatches for colouring bioplastics, including options for both biodegradable and durable compounds. Finally, it



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Right: Parts produced using Finke's multi-layer colouring technology and post consumer plastics


PHOTO: FINKE

will provide more detail of the multi-layer processing technology it has developed for production of coloured parts manufactured using post consumer plastics. This uses a coloured virgin outer layer with a core of non-coloured recyclate.

› **www.finke-colors.de**

FKuR will present two new glass fibre reinforced additions to its Bio-Flex and Terralene ranges of bio-based plastic compounds as well as some new additions to its Terraprene line of TPEs. Bio-Flex GF30 is a PLA-based compound with a glass fibre content of 30% that combines a relatively high stiffness of 8,400 MPa with tensile strength of 70 MPa and notched impact strength of 6.4 kJ/m². It is said to be suitable for applications requiring good mechanical performance without resistance to high temperatures or flame retardancy. Terralene GF30 is based on Braskem's bio-based Green PE. With a glass fibre content of 30%, it provides a stiffness of 4,800 MPa.

New additions to the Terraprene TPE compound family include SI 701 and SI 801, which offer a bio-based content ranging from 55% to 75% They are available in Shore A 40 to 80 hardness values with properties similar to conventional TPE-S grades. Terraprene CI 250 84A and Terrapene CI 450 93A are two oil-free TPEs with Shore A hardness values of 84 and 93. They provide a soft-touch surface and resist kinking and deformation, allowing them to substitute TPE-O and PVC in some injection moulding applications.

› **www.fkur.com**

Right: Ventilation covers are a possible application for Bio-Flex and Terralene glass reinforced compounds from FKuR


PHOTO: ISTOCKPHOTO/SADEUGRA

Grafe will present a number of new additions to its range of masterbatches, including colour and stabiliser combination products for PC/ABS, a new line of anti-static masterbatches and compounds, and a number of specialty products for developers of PLA-based 3D print filaments.

The new colour and additive combination masterbatches build on the company's portfolio for automotive ABS applications, extending that to PC/ABS blends. The latest grades exhibit higher UV stability at lower dosage levels, providing potential to reduce the cost of the final formulation.

Grafe will also show its latest anti-static masterbatches, which can be used to manage electrical discharge as well as to minimise dust attraction to cosmetic surfaces. Available in a range of carriers, the masterbatches provide an immediate and long-lasting anti-static effect in the range from 10E6 to 10E9 ohms, the company claims. Typical dosage levels are in the range from 2-5%. The company will also launch its new Percolen PA 4300

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PHOTO: GRAFE

Above: Car interiors are a potential application for Grafe's latest anti-static masterbatches

EC electrically conductive PA compound, which is intended for production of injection moulded electronics housings and covers.

In the 3D print area, the company will be presenting the "Colour on Demand" service it has developed together with Dutch filament producer ColorFabb. That allows users to specify RAL and Pantone colours in PLA for fast delivery in volumes starting from 2kg. It will also be promoting its other additive masterbatch options for the 3D print filament market, including conductive and laser marking additives and carbon fibres.

› **www.grafe.com**

Lehmann & Voss, which marks it 125th anniversary this year, will present a number of recent applications demonstrating the value of its materials in 3D printing, light-weighting and performance enhancement. In the former category – 3D print – it will show a demonstrator part produced by Italian boat building innovator Ocore in its Luvocom 3F PAHT CF. This carbon fibre reinforced grade is one of four different high performance 3D print filaments produced by the company.

Two light-weighting applications will be displayed. KOKI Technik Transmission Systems subsidiary CarNaTrix is using a grade from its Luvocom 25 range – which is based on DSM's ForTii Ace high temperature resistant PPA resin – to produce gearbox selector forks. And Hyundai Advanced Materials is using its Luvotech 3-50154 to produce large format sunrrof frames. This PA6 blend compound is produced using a proprietary extrusion technology with flow enhancement additive and a special "flat" glass fibre and is optimised to minimise distortion.

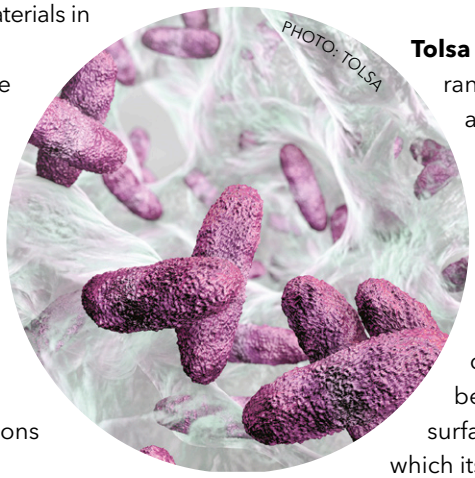
The company will also present its Luvobatch stabiliser, flame retardant and blowing agent additive masterbatches. Luvobatch PE AO 0077, for example, is formulated to increase the thermal stability of PP; Luvobatch PA HS 9611 and PA AO 0043 are copper stabilised products intended to extend life of PA at high temperatures. The company says a PA6 containing 5% of PA AO 0043 in PA6 will retain 70% of its original mechanical properties after exposure for 240 hours at 175°C.

› **www.luvocom.com**

Solvay Performance Polyamides will show the latest developments in its Technyl PA66 product line, including the introduction of two new application specific products: Technyl Orange and Technyl Blue. The former is a colour-stabilised line aimed at electrical connector applications in the electric and hybrid vehicle market; the latter is also aimed at electric vehicles but at their more demanding cooling system applications. The company will also unveil its HUB by Technyl product development support initiative. This combines upgraded MMI Technyl Design predictive simulation, application performance testing and Sinterline 3D-printing services. (The Solvay Performance Polyamides business in Europe is being acquired by Domo Chemicals as part of a deal expected to close before the end of the year. BASF is buying the rest of the operation.)

› **www.technyl.com**

Right: Tolsa launches its Protection line of silver-based antimicrobials at K



Tolsa will launch the Protection range of silver-based antimicrobials at K. Adins Protection S4 and Adins Protection S10 are said to be active against gram-positive and gram-negative bacteria and fungi. The company says its Adins technology allows the different active substances to be distributed evenly across the surface of the clay additive carrier, which itself disperses easily in the polymer matrix. It says this allows an optimal dispersion to be achieved, which translates into high antimicrobial activity at lower dosages.

› **www.tolsa.com**

Venator will launch a new titanium dioxide (TiO_2) pigment–Tioxide TR29. Offering a very low moisture content, good dispersion and high packing fraction, it is intended for production of highly technical thin films and for use in engineering polymers where moisture sensitivity is a considera-

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PHOTO: VENATOR

Above: Venator presents its Sachtolith TC additives for enhancing thermal conductivity

tion. According to the company, the TR29 grade can be used to create masterbatches with a very high TiO_2 loading while maintaining a high throughput rate and a low specific energy requirement–offering the potential to reduce production and transportation costs.

The company will also show its Sachtolith range of white pigments, which find niche applications in areas such as production of glass fibre reinforced plastics or as a metal deactivator in white cable and wire compounds. The established Sachtolith HDS and L grades have now been joined by the TC family, which is designed to improve thermal conductivity of polymer systems without increasing electrical conductivity.

› **www.venatorcorp.com**

Victrex will show the latest additions to its line of high performance PAEK polymers, including its CT200 and FG product lines and its specially optimised grades for 3D print filaments and powders. Victrex CT grades are designed for use at cryogenic temperatures (-150°C to -200°C), principally in sealing applications where they are claimed to offer a better combination of low temperature ductility and high temperature creep performance than established alternatives such as PCTFE. Victrex FG products carry the required regulatory approvals for use in food contact applications such as processing equipment. The company's PAEK materials for 3D print applications are said to achieve better mechanical properties than has been realised with PEEK in additive manufacturing processes in the past.

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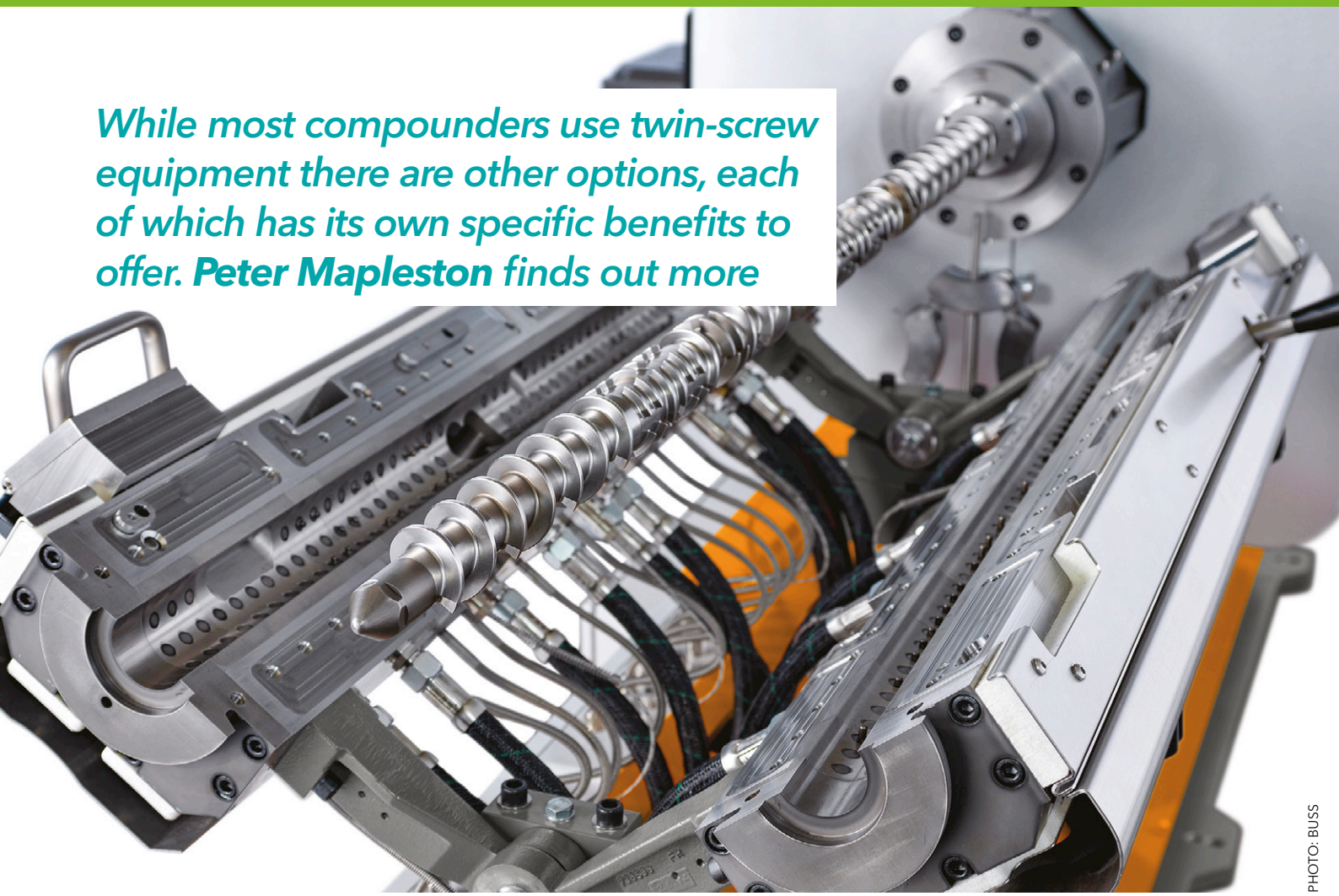


PHOTO: BUSS

While most compounders use twin-screw equipment there are other options, each of which has its own specific benefits to offer. Peter Mapleston finds out more

Compounders with a real difference

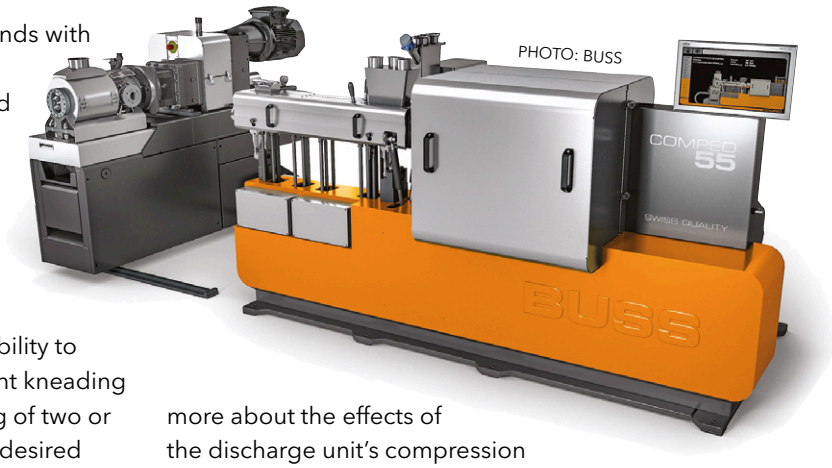
The twin-screw extruder is the de-facto choice of equipment for most plastics compounding operations. But it is not the only option and compounding companies should – and do – certainly consider alternatives such as kneaders, continuous mixers, and multi-screw systems before laying down their hard-earned cash. There is a lot to be said for sticking with a technology your company and staff are familiar with, but there is also truth in the argument that one technology can not always be the best for every situation. This article takes a look at what is going on outside of the twin-screw world.

Swiss company **Buss** is the big name in kneader extruders and it will show two new additions to its Compeo line at K2019 in Düsseldorf later this month. The Compeo 88 and Compeo 110 join the smaller Compeo 55, which was debuted last year. All three models are available with process lengths from 13 to 25 L/D, the model size indicating the screw diameter in millimetres. Typical throughputs for processing thermoplastics are 150-300 kg/h for the Compeo 55, 600-1200 kg/h for the Compeo 88, and 1,200-2400 kg/h for the Compeo 110.

The Compeo 110 on view at K will be configured with an 18 L/D processing unit and a downstream side feeder alongside the company's new conical twin-screw discharge unit. In this configuration the system is suitable, among other things, for compounding filled and reinforced thermoplastics, including natural fibre-reinforced and bio-based plastics as well as HFFR cable compounds. The 25 L/D Compeo 88, meanwhile, is optimised for compounding black or coloured masterbatches. It can be fitted with one or two additional side feeders.

Advantages cited by Buss for Compeo compounders include their ability to carry out high-

Main image: The processing section of the Buss Compeo kneader extruder can combine two, three, four and six flight elements



Right: The conical twin-screw discharge unit is a new option for the Buss Compeo kneader range

intensity mixing and to handle compounds with high filler contents while maintaining precise temperature control. Assembled from standardised modules, they are claimed to enable cost-effective configuration of specifically-optimised compounding lines for a wide range of processing tasks and temperatures.

The company says one of the great flexibilities of the Compeo series is its ability to combine conventional three or four-flight kneading elements with new elements comprising of two or six flights and to put them to use in any desired position within the process section. "Combined with an increase in specific torque, this permits longer mixing zones without any additional increase in energy input," it says.

Dino Kudrass is a Design & Development Engineer at Buss. He says the company has run a variety of compounds on the Compeo 55, including highly filled engineering plastics, masterbatches, natural fibre filled polymers, elastomers and PVC. "The machine proved to have an extremely wide application spectrum and set a new standard for data acquisition and operating simplicity," he says.

Learning curve

"We have experienced a steep learning curve with higher processing temperatures (400°C), the new powerful heating/cooling system, and a larger variety of screw elements to choose from," Kudrass adds. "We have also gained new insights into the advantages of our newly-developed conical twin-screw discharge extruder. We are developing different screw geometries and continuing to learn more about the effects of the discharge unit's compression ratio, control system and pelletiser feed characteristics. We have seen more stable pressure output and gentle melt processing due to low shaft speeds, resulting in lower shear velocities."

Kudrass says the new conical twin-screw discharge unit aims to provide a wide application spectrum for pressurising the finished compound as it exits the kneader. "Previously we have mostly worked with either melt pumps, which have closed gear chambers, or single screw extruders, which have an open helical chamber. One provides higher pressures and is more compact, while the latter is gentler on the compound and can be a low complexity solution, especially for PVC processing. The conical twin screw is in some ways the best of both worlds while introducing new advantages, such as being able to gelate PVC during start-up."

The conical design allows for a greater screw diameter in the gearbox, which means more torque, and provides a larger volume in the intake zone. It features active de-gassing, reduces the shear velocity in the stressed discharge zone due to its lower screw diameter, makes disassembling the screws easier, and allows for both screws to be heated/cooled, Kudrass says.

X-Compound's Continuous Kneader CK225 for recycling of flooring products

Success on the tiles

Another Swiss company making kneaders is **X-Compound**. It points to successes for its equipment in production of Luxury Vinyl Tiles (LVTs), including systems that use recyclate. "Demand for good looking, easy to maintain floors is constantly growing," says Karsten Kretschmer, responsible for new machinery sales at the firm. "The market for LVTs as well as SPC (Stone Plastic Tiles) is developing exceptionally well."

One of the key features of these tiles is the application of a click-down system, which makes for quick and easy installation. Kretschmer says that during the production of the several layers of the floor tiles – as well as during the manufacturing of the click-down profiles – various amounts of

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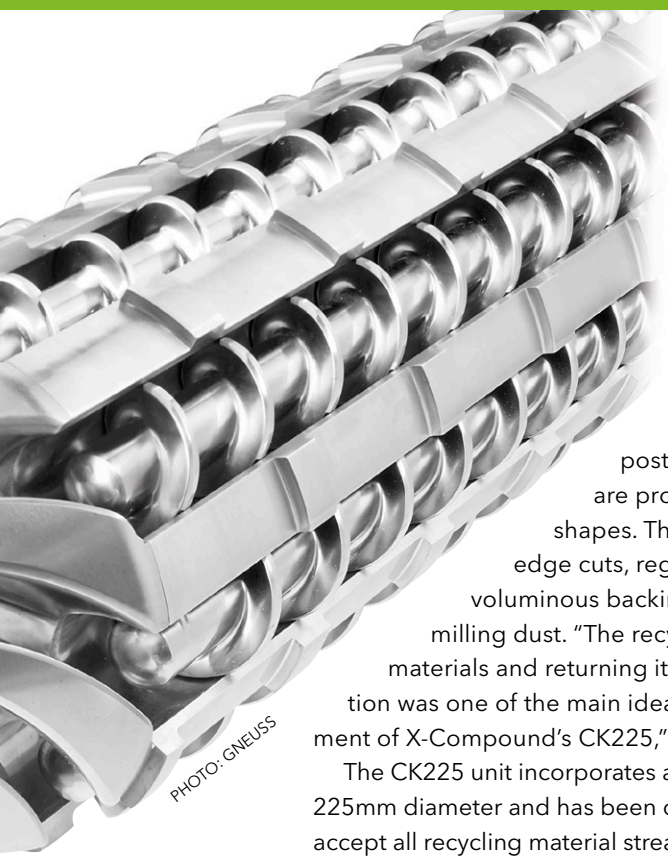

PHOTO: GNEUSS

Left: The satellite-screw configuration of the Gneuss MRS extruder makes it well suited to processing nanoparticle suspensions

post-production waste are produced in different shapes. These include film edge cuts, regrind from more voluminous backing layers and milling dust. "The recycling of these materials and returning it into the production was one of the main ideas in the development of X-Compound's CK225," he says.

The CK225 unit incorporates a kneader screw of 225mm diameter and has been designed to accept all recycling material stream types (both internally and externally recycled materials) and to convert them all into material that can be used for further production of flooring products.

"Due to the very gentle mixing principle, a degradation of the sensitive PVC materials is avoided at high capacities – up to 8,000 kg/h," Kretschmer says. "The experience shows that the machine is capable to process an extremely broad range of materials. This makes the machine well suited for current and future challenges to produce sustainable floors."

The CK225 first arrived on the market in 2017. Since then X-Compound has delivered some eight lines. "Some of these lines are already used for LVT recycling," says Kretschmer. "Currently our customers mainly use post-industrial sources while having a view on the market for all kinds of post-consumer sources."

Nano opportunity

The MRS multi-screw devolatilising extruder from **Gneuss** was also developed to rival twin-screw equipment. Available in various sizes, it was originally aimed at reprocessing post-consumer and industrial PET waste without the need for pre-drying. Close to 40 units are now being used for this application around the world and a handful of units are processing other polymers. Since its introduction, however, the company has seen opportunities in other diverse applications and nanocomposites is one of them.

Incorporating fillers with at least one dimension under 100nm – nanofillers – into polymer melts is not a task for the faint-hearted. The powders frequently contain agglomerates that need to be broken up and handling requires more extensive safety measures than are used with "regular" powders.

One of the reasons for using nanofillers is the much higher surface area-to-volume (SA:V) ratios than regular fillers, but that advantage is not fully realised if there is a high proportion of agglomerates – something that does happen frequently. Gneuss says that after six years of development work, it can now offer an industrial scale process that allows the introduction of nanofillers into polymers, without agglomerates and with "completely safe handling" of the nanoparticles.

Gneuss Nano Compounding Technology makes use of the company's MRS extruder in combination with a twin-screw extruder. Gneuss says nanoparticles are extremely difficult to integrate into compounds using conventional technologies. "They stick together like crazy" is how Gneuss Executive Andrew Prangnell puts it. So the best way to mix them into a polymer melt is by introducing them, not in powder form, but as an aqueous dispersion. Creating dispersions of nanoparticles such as carbon nanotubes is already a well-established practice. "The particles are contained safely in the suspension and cannot get into the environment," the company says.

Managing dispersion

It is not simply a matter of pouring the dispersion into a hopper, however. In the Gneuss equipment the dispersion is introduced into the melt via a special injection and mixing chamber part-way down a purpose-built twin extruder, which operates at very high pressure of around 100 bar. The extruder is manufactured by a third-party company and the quality of the dispersion achieved using it is said to be very good.

This compound then passes directly to the MRS, which drives the water out of the melt. The MRS is extremely effective at this because its configuration of eight satellite screws rotating around a central screw means the water is provided with a much greater melt surface to escape from than is available in either single- or twin-screw extruders. In addition, the MRS provides useful secondary distributive mixing.

The version of the MRS used for this application is different from "standard" units as it is taking a polymer melt rather than a solid, so the feed zone does not need to be as long. The extruder is designed so that, with a mixture of at least 70% polymer and suspension, the liquid holding the nanoparticles in suspension is removed within five

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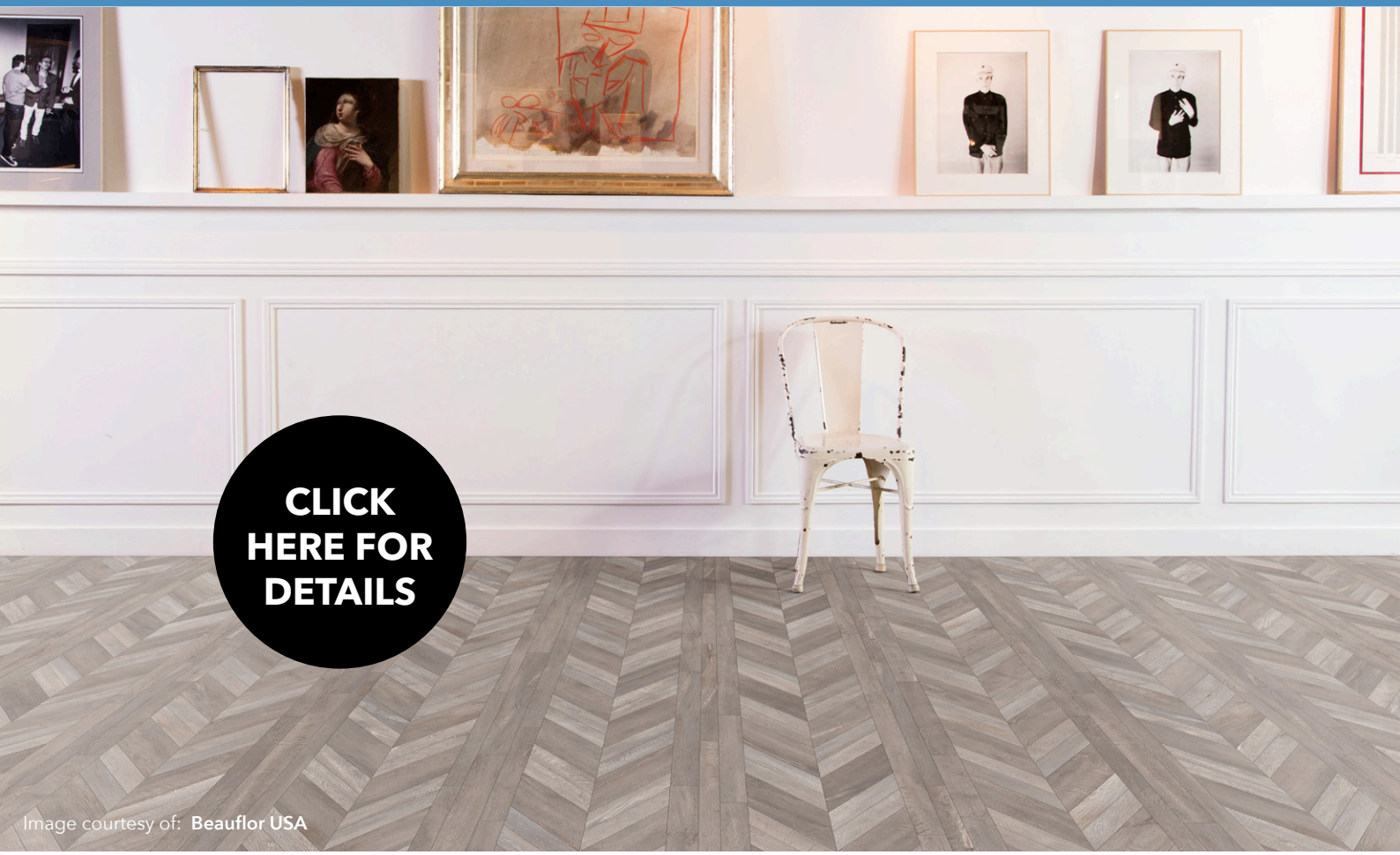

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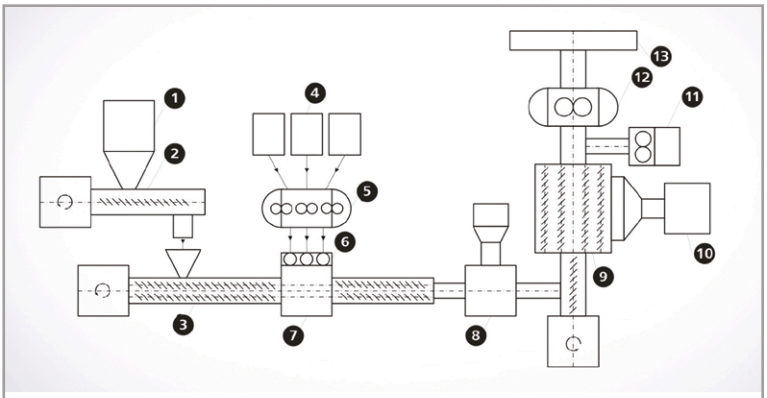


Schematic of the Gneuss Nano Compounding Technology
Image: Gneuss

seconds to leave the nanoparticles completely embedded in the polymer. Gneuss says that, due to the extremely fast extraction of the liquid suspension carrier, there is practically no damage to the polymer.

Property changes

With their very high SA:V ratios, nanoparticles can impart significant changes to the properties of the finished compound, even at low addition rates. Examples cited by Gneuss include: change of the crystallisation temperature (for faster cooling, for example) through nucleation; improved heat transfer; improved conductivity; improved mechanical properties; improved surface finish; and antibacterial properties.

"With the Gneuss Nano Compounding Technology, significantly better dispersion is possible compared with conventional processes," says Prangnell. "Therefore, it is possible to achieve the same material properties with a major reduction in the quantity of additive needed. By weight, the amount of additive required to achieve the same result is between 50% and 80% lower with our new process, depending on the application."

The lower additions required have a benefit in that the impact on other material characteristics is often much reduced. "In many cases, the required results are achievable with such a small quantity of additive that unwanted side-effects, such as colouration of the polymer due to the additive, are negligible. With the Gneuss process, it is for example possible to use carbon nanotubes to achieve conductivity in the polymer without the need for the polymer to be completely black. A coloured, conductive polymer is possible," he says.

Gneuss has been collaborating with SKZ, the South German Plastics Centre located at Würzburg, as well as Huntsman and several other companies on development of the Gneuss Nano Compounding Technology. Most of the work has involved nanocomposites based on carbon nanotubes (CNTs), although nanocellulose, barium sulphate, titanium dioxide and other additives have also been used, as well as a special additive that is incorporated into PET for production of preforms in order to make them heat up more quickly in stretch-blow moulding equipment infrared ovens. Gneuss says the equipment and process is also suitable for reactive extrusion operations. The company hopes to have at least one unit operating at a customer soon.

Recycling applications

The ability to be able to handle nanoparticles also has a benefit in recycling applications, where functional fillers are used to lift performance. The effect of any functional additive, Gneuss says, is related to the active surface area of the particles, which means that the amount of additive needed should not be considered only in terms of its weight percentage in the compound. If the size of the additive particles can be reduced, so can the quantity by weight. This reduces cost but also eases restrictions when it comes to cost-effective recycling into products with more than token value.

Gneuss says when nanoparticle additives are introduced into plastics compounds in powder form, "around 20% of the powder (by weight)

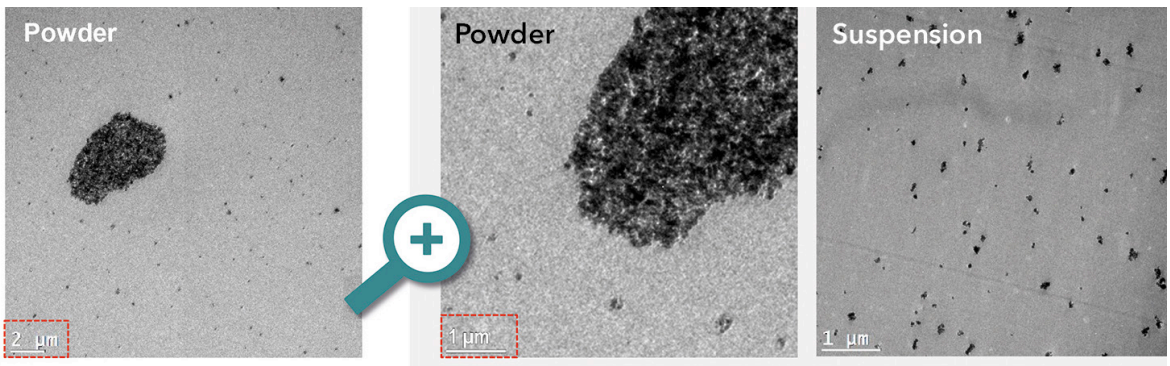
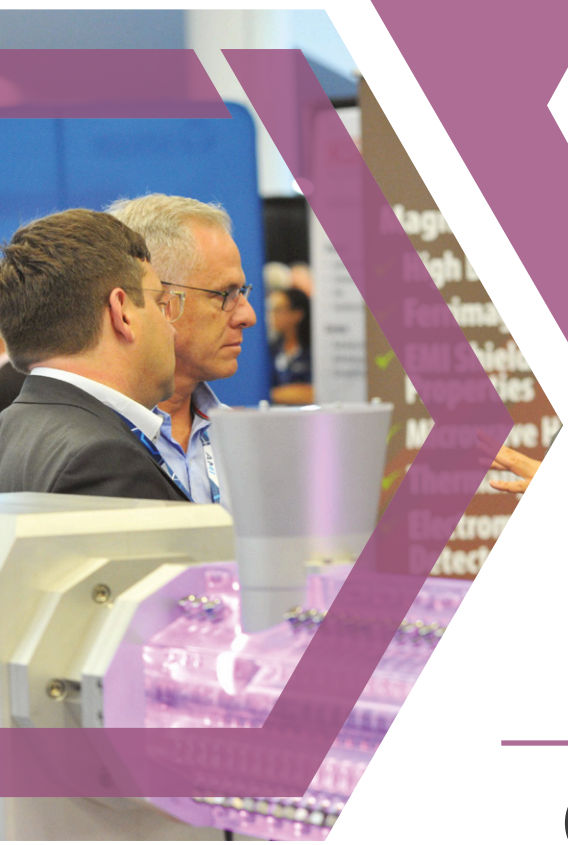


PHOTO: GNEUSS

Right: Image showing the difference in dispersion of $BaSo_4$ nanoparticles in powder form and as a 0.5% suspension in water



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Comparison of available surface area in a 1cm³ space for fillers with a range of particle sizes

Particle size, nm (approx)	Surface area, cm² (approx)	Quality
30	6	Agglomerate-free. Introduction in suspension.
500	2	Agglomerate-free. Introduction in suspension.
500	1	Low proportion of agglomerates. Introduction in powder form.
500	< 0.5	Usual proportion of agglomerates. Introduction in powder form.

Source: Gneuss

consists of agglomerates, thereby reducing the active surface area." In addition, powders with particles finer than 300nm are no longer free flowing and present the additional problem that, where the finest particles are smaller than 100nm, they are not permitted for health reasons. Within the EU, handling of nanoparticles is not permitted unless as agglomerates or in a suspension.

"In order to use additives with extremely small size, it is necessary to include them in a liquid suspension before working them into the polymer," Gneuss claims. "Only in this way can agglomerates be avoided. The combined surface area of all the particles can be drastically increased and the quantity of particles necessary for the required effect can consequently be drastically reduced."

Currently, powders are processed to give a particle size of typically around 500nm. Nanoparticles on the other hand are normally processed with an assumed average size of 30nm. "By introducing an additive with a smaller particle size into the polymer in a suspension, it is possible to increase the total surface area of the particles by a factor of three. Compared with introducing the particles in powder form, a 12-times total surface area increase is possible. By introducing smaller particles in a suspension into the polymer, it is possible to make major reductions in the quantity of additive needed to achieve the required result. This has the additional advantage of making the polymer easier to recycle," Gneuss says.

Alternative options

Another variant on the multi-screw extruder concept is the planetary roller extruder. **Entex** is well-known for its range, which has been used in PVC compounding for over 50 years. The company says that since the 1980s, the mechanical design and process control of the equipment has been further developed, opening up many new fields of application. "In particular, the improvement of the tempering performance due to the use of modern manufacturing processes, system structures with several modules, and the development of lateral feeding and degassing mechanisms enable processes today that were not conceivable on this type of machine for a long time," it says. "This allows to question the traditional processing methodology of PVC with the result that it can also be realised in a direct extrusion process without dry blends as an intermediate product."

At K2019, Entex will be showing a new addition to the product line. The L-WE 30 laboratory

Finding the right compounding solution

As competition intensifies, making sure the compounding process is fully optimised is becoming ever more important and tools to do that are in increasing demand. "More and more I'm getting confronted with a battery of questions about the 'right' compounding system for a certain application," says **Hans-Ulrich Siegenthaler**, formerly with Buss and now an independent consultant.

"Smaller and bigger players in the compounding industry are researching methodologies to evaluate and accelerate these processes. Following these requests, we have developed instruments and tools or are using them with a novel approach," he says.

Siegenthaler calls this tool kit "Compounding Analytics." He says it covers process technology aspects as well as manufacturing and economical demands and he discussed the development at this year's ANTEC conference in the US.

Siegenthaler says process technology aspects have been evaluated and analysed over the past 10 years "with a prestigious panel of experts" for the seven most important compounding systems, based on 20 criteria. "The scrutinised results have, meanwhile, attained general validity due to the broad data base and the reputation of the parties who contributed," he says. Typical criteria include mixing behaviour, throughput rates, degassing rates, dosing options, process length and torque or drive power of a compounding system.

"The production-relevant aspects play a very important role," Siegenthaler says.

"If, for example, a broad formulation portfolio is to be produced on a plant, not all systems are equally well-suited; flexibility often has to be bought with additional equipment at higher cost. The respective aspects should be carefully and thoroughly weighed up and evaluated," he says.

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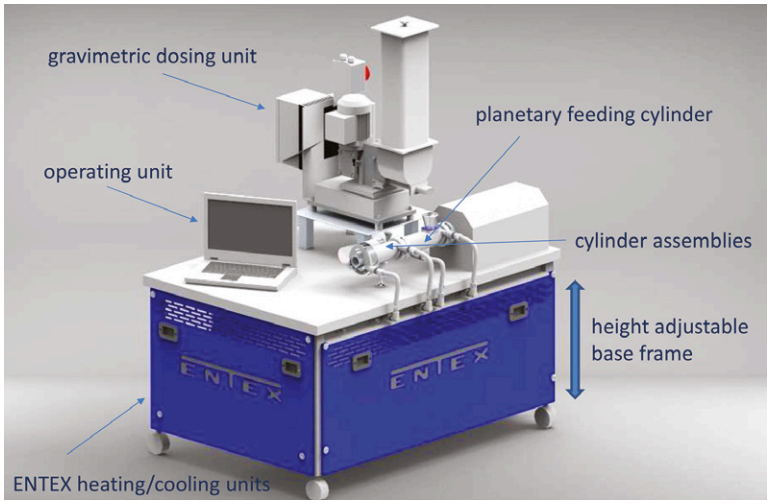

Above: The L-WE 30 laboratory extruder from Entex is supplied complete with dosing and heating/ cooling units

extruder has an output of between 0.5 and 10 kg/h (compared to around 8 tonnes/h for the company's largest TP-WE 400 machine). Both, however, are built using the same modular approach, which allows for spindles of various designs to be used in the planetary sections. There are three cylinder assemblies (one planetary feeding cylinder and two others), with six standard planetary spindles per cylinder rotating around a central spindle. Modularity extends to the plug-and-play heating and cooling units, which fit under the processing system support table and provide highly precise temperature control.

Side-by-side

Japanese equipment company **Technovel** has a stable of extrusion systems that go from single-screw, through twin-screw (co-and counter-rotating), to quad and octa-screw units. In all cases, the screws are arranged side-by-side, rather than in a circle. Screw diameters start at 5mm and go up to 134mm. Francis Lai, who works out of the company's newly opened US sales operation in Boston in Massachussetts in the US says all products are custom-made to meet the demands and the specifications of the customer.

In the multi-screw series, says Lai, the WDR MFU KZW ZRO series can compound a wide range of raw materials, ranging from general-purpose resin through super engineering plastics to fluoropolymers. The company can configure the units for applications ranging from new materials development to recycling and reactive extrusion.

"In general, the task of compounding using a twin-screw extruder is challenging to improve the kneading and compounding performance, especially in reducing the self-heating, the residence time, the size of equipment, the L/D, and the torque," Lai says.

"Our WDR fully meshed, co-rotating parallel quad-axis and octa-axis compounding extruder series is based on our experiences and know-how and verified by the process data of the fully meshed co-rotating twin-screws compounding extruder accumulated over many years," he says. The company claims the WDR series is the first to exceed the performance of a high L/D, high rotational speed, and high torque density twin-screw extruder.

Lai says quad- and octa-screw compounding units reduce shear heating and significantly extend the residence time. They can also

Right: Technovel's testing lab has four-axis and eight-axis kneading and compounding extruders. Unusally, the screws are arranged side-by-side

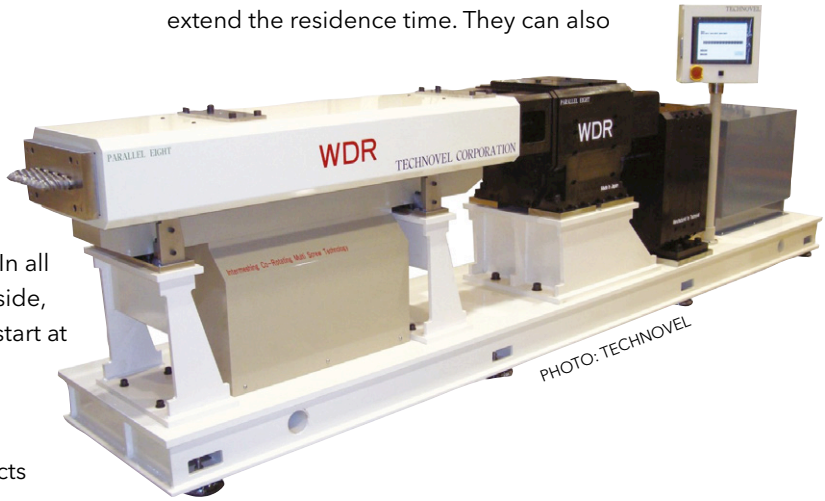

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PHOTO: B&P LITTLEFORD

Right: B&P Littleford's TriVolution system is said to offer good dispersive and distributive mixing

improve the venting and material feeding function and reduce energy consumption and space requirements. "Most importantly, it can produce a better dispersion and mixing and provide stability and precision extrusion," he says.

Working in triplicate

KMD Plastifizierungstechnik, which changed its name from Keimei a few months ago, offers a triple-screw extruder. "Our current interest is in polyolefin production, material reaction and most importantly, material property modification and nanomaterial production," says Project Manager Kevin Duan. He says the company has obtained "excellent" results in degassing, thanks to the much greater gas exchange area than available from twin-screw extruders. He says the "kneading frequency" (degassing frequency) is triple that of twin-screw extruders with three starts with the same cross section.

However, Duan claims the triple-screw extruder is as convenient to use as a twin-screw. "You can change material as quickly, you can replace a screw as easily, and the screw adjustment is as convenient," he says.

B&P Littleford's TriVolution Compounder is something of a hybrid, being essentially a kneader with three screws. The company says it "offers excellent dispersive and distributive mixing without damaging critical ingredients by its innovative mixing mechanism. Its controlled shear with enhanced material exposure is also well adapted for devolatilisation and reactive processing."

Below: Farrel Pomini's US Process Laboratory and Customer Demonstration Center at Ansonia

Minimising shear

Farrel Pomini's Continuous Mixing Technology (FCM) is said to offer several standard equipment features that address key concerns when processing flame retardant materials including ATH, MDH and brominated based formulations. The FCM utilises two non-intermeshing, counter rotating rotors, which apply controlled levels of shear to the polymer. The company says this makes it an ideal technology for shear and temperature-sensitive materials. Among these are flame-retardant compounds.

PHOTO: FARREL POMINI

The FCM is based on a mixer with high free volume. This enhances the quantity of flame-retardant filler materials that can be incorporated into the polymer matrix. Quantities of 75-80% have been routinely processed, a company representative says.

When processing ATH, for example, Farrel Pomini has found that by using a hard surface chamber liner and a combination of rotor styles, which it classifies as #15 and #7, it has been able to increase production rates by as much as 30% compared to a twin-screw machine but at process temperatures below 190°C. In addition, in the same study, melt temperature was found to be further decreased when rotor cooling was activated.

In another scenario processing MDH, use of a PTFE orifice resulted in a 15% lower melt temperature. And in a separate study processing LLDPE & MDH (60%), and using the rotor styles #15 and #7 in combination with and a hard surface chamber liner, it proved possible to achieve a 30% increase in productivity with only a 17 °C process temperature rise, the company says.

CLICK ON THE LINKS FOR MORE INFORMATION:

- **www.busscorp.com**
- **www.x-compound.ch**
- **www.gneuss.com**
- **www.entex.de**
- **www.technovel.co.jp**
- **www.keimei.de**
- **www.bplittleford.com**
- **www.farrel-pomini.com**

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Cologne / 2020

Responding to new and future regulatory developments that will impact on the plastics supply chain

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December 10-11, 2019
Pittsburgh Marriott City Center, Pittsburgh, PA, USA

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PHOTO: SHUTTERSTOCK

AMI's sixth Conductive Plastics conference takes place in Vienna in November, providing the latest insight into formulation and application of electrically and thermally conductive compounds

Exploring opportunities for conductive plastics

New technologies such as electric vehicles, energy efficient LED luminaires and the increasing penetration of electronics into all sorts of devices to add "smart" capabilities are placing new demands on plastics materials. AMI's Conductive Plastics conference provides the opportunity to learn what end users require, to understand what can be achieved, to manage the formulation and processing challenges, and to gain insight into performance prediction.

The fourth European edition of this established international event – and the sixth globally – takes place in Vienna in Austria on 5-6 November and will bring together a line-up of expert speakers to cover the full range of additive technologies available to manage static charge, provide EMI and RFI shielding, and control heat build-up in plastic parts. Importantly, presentations will explain how to optimise the design and production of conductive plastic components and address the critical influence of processing on the properties of finished parts.

Conductive Plastics 2019 will be opened by **Chris Smith**, Editor-in-Chief at ***Compounding World*** publisher AMI Magazines in the UK, who will provide an update on current and potential markets for conductive plastics, identifying some of the key growth opportunity areas. He will be followed by **Dr Frans Mercx** and **Dr Norberto Silvi**, Chief Scientist and Staff Scientist respectively at **LNP Compounds and Copolymers** within SABIC in the Netherlands. They will speak about some current polymer-based solutions for e-mobility applications requiring characteristics such as radar absorption, thermal conductivity and EMI shielding.

Turning attention to some of the additive options, **Roland Mittelhammer**, Senior Manager Technical Sales Expanded Graphite at **SGL Carbon** in Germany, will look at the use of graphite to enhance electrical and thermal conductivity in plastics. **Jérôme Crépin-Leblond**, R&D Leader Conductive Polymers at **Imerys Graphite and Carbon** in France, will explain how high aspect ratio graphites can be used to formulate easily processed thermally conductive compounds. Then **Dr Hans Miltner**, Senior Consultant and Business

Main image: Battery packs for electric vehicles are just one of the potential application areas for thermally conductive plastic compounds

Development Manager at **Procotex** in Belgium, will explore the use of recycled carbon fibre in formulation of sustainable conductive polymer compounds.

Processing is one of the big challenges in the realisation of conductive plastics materials. **Marco Grundler**, Group Leader Compound Technology at the **ZBT** fuel cell research centre in Germany, will speak about some of the challenges in processing highly filled thermally conductive compounds. **Michael Schaefer**, Program Specialist Powertrain at **Celanese Services** in Germany, will explore the effect of part design and part thickness on achieved conductivity. And **Luca Posca**, Technical Assistance and Marketing Director at **LATI** in Italy, will explain how moulding parameters can influence the performance of thermally conductive plastic compounds.

The relationship between polymer blend morphology and manufacturing process on thermal and electrical properties of compounds containing carbon black and zinc oxide will be detailed by **Dr Frank Schoenberger**, Group Manager Functional Polymers at **Fraunhofer LBF** in Germany. And **Dr Zoltan Gombos** and **Dr Luke Savage**, Research Fellow and Senior Research Fellow respectively at the **University of Exeter** in the UK, will speak about how 3D fibre networks can improve thermal conductivity in polymer composite structures. The first day of the conference will be closed with a panel discussion session.

The second day of Conductive Plastics 2019 opens with a look at additives for enhancing thermal conductivity of electrically insulating polymers. **Katsuhiro Takashi**, R&D Department at **Kyowa Chemical Industry** in Japan, will explain how magnesium hydroxide can be used to enhance thermal conductivity. Then Péter Sebö, Head of Marketing and Market Development at Quarzwerke in Germany, will examine the use of custom inorganic fillers to create thermally conductive compounds.

The focus will then turn to some conductive novelties. **Jean-Michel Poncelet**, Business Development Manager at **Cabot Plastics** in Belgium, will explore opportunities to utilise graphenes and other nano-structures in conductive plastics applications. **Leonoardo Comperatore**, R&D Manager at **Domo Engineering Plastics** in Germany, will look at formulation of carbon filled polyamides with an optimised ecological profile. And **Dr Zhen Liu**, Head of Thermoplastic Unit at **CarbonX** in the Netherlands, will detail how its nano carbon materials can be used to create lightweight electromagnetic shielding materials.

Static dissipation is one of the longest established conductive polymer applications. **Anja Oltmanns**, Key Account Sales Manager at **BASF Polyurethanes** in Germany, will discuss development of anti-static masterbatches based on TPUs. She will review their performance, processing and application. **Dr Clio Cocquet**, Market Development Manager Antistatic, Breathable and Industrial Applications at **Arkema** in France, will detail the application of its bio-based additive to provide permanent anti-static performance.

The final session of the conference will address the challenging area of thermal conductivity measurement. **Jarett Nickerson**, Commercial Director at **C-Therm Technologies** in Canada, will explore the selection of test methods for characterising thermally conductive compounds and compare the results obtained. Then **Jochen Gaiser**, a PhD Student at the **University of Applied Sciences Karlsruhe** in Germany, will present some research into measurement and methods for simulation of thermal behaviour in conductive plastics.

Expert speakers at Conductive Plastics 2019 include (from top) Imerys Graphite and Carbon R&D Leader Conductive Polymers Jérôme Crépin-Leblond, LATI Technical Assistance and Marketing Director Luca Posca, Fraunhofer LBF Group Manager Functional Polymers Dr Frank Schoenberger, Domo Engineering Plastics R&D Manager Leonoardo Comperatore, and BASF Polyurethanes Key Account Sales Manager Anja Oltmanns

About Conductive Plastics 2019

Conductive Plastics 2019 is AMI's sixth conference focused on this fast developing market sector and the fourth to be held in Europe. It takes place on 5-6 November 2019 at the Austria Trend Hotel Savoyen in Vienna, Austria.

The conference will bring together a selection of expert speakers to detail the latest additive and process developments available for enhancing the electrical and/or thermal conductivity of plastic compounds. Aside from the formal presentations, Conductive Plastics 2019 will include a mini-exhibition and will provide extensive networking opportunities during the break-out sessions and complimentary cocktail reception.

To find out more about attending, sponsoring or exhibiting at Conductive Plastics 2019, contact the conference coordinator, Emily Renshaw. Email: **emily.renshaw@ami.international** Tel: +44 (0) 117 314 8111. Or visit the **conference website**

Download these new product brochures

Simply click on the brochure cover or link to download a PDF to your PC or smartphone

KK KOMPOUNDING: COMPOUNDS

This 16-page brochure details the compounding capabilities of India's KK Kompounding Tech Giant (Technovinyl Polymers), which produces a variety of TPEs and TPVs, TPU alloys, engineered PP compounds and halogen-free cable compounds.

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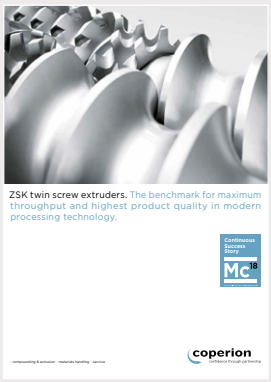
COPERION: ZSK EXTRUDERS



Described as the benchmark for maximum throughput and product quality, the ZSK is Coperion's most flexible and highest performance twin screw extruder series. This 26-page brochure explains the design features and options.

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CPM EXTRUSION: SYSTEMS AND PARTS

This new brochure from CPM Group details the extended range of compounding extruders, production lines and replacement parts available from the company following its recent acquisition of Germany-based Extricom.

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LEISTRITZ: MASTERBATCH SYSTEMS

Additive and colour masterbatch production places specific demands on compounding equipment. This 16-page brochure from Leistritz explains how its ZSE 35 iMAXX masterbatch twin screw extruder rises to the challenge.

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POLIMER TEKNIK: POEX EXTRUDERS

Polimer Teknik's POEX range of co-rotating twin screw extruders are versatile machines suitable for processing compounds ranging from ETPs to TPEs, as well as colour and additive masterbatches. This brochure details the key features.

❯ CLICK HERE TO DOWNLOAD

ARKEMA: RECYCLING SOLUTIONS

This brochure from Arkema introduces the Lotryl, Lotader and Orevac materials, which improve the mechanical recycling performance of post-consumer waste when used in plastic compounds, meeting sustainability requirements.

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If you would like your brochure to be included on this page, please contact Claire Bishop claire.bishop@ami.international. Tel: +44 (0)1732 682948

Learn more about AMI's upcoming conferences

Click on the relevant brochure cover or link to download a PDF of the full conference programme

CONDUCTIVE PLASTICS 2019

AMI's Conductive Plastics conference takes place for the fourth time in Europe on 5-6 November 2019. It is the place to learn about formulation, processing and application of both electrically and thermally conductive thermoplastics. The event takes place in Vienna.

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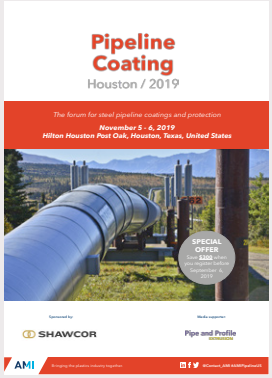
PIPELINE COATING HOUSTON 2019



AMI's fourth Pipeline Coating Houston conference takes place on 5-6 November 2019. It will bring together North American pipeline operators, contractors, pipe coaters, researchers and specifiers to discuss the latest sector trends and technologies.

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MEDICAL TUBING USA 2019

Taking place in Minneapolis, MN, USA, on 5-6 November 2019, AMI's North American Medical Tubing conference is the place to learn about the latest regulatory, material and processing developments for this demanding market.

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POLYOLEFIN ADDITIVES 2019

Taking place in Vienna in Austria on 12-14 November, attendees at Polyolefin Additives will learn more about the latest additive technology trends in the polyolefin resins market, including vital steps to implementing the circular economy.

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PROFILES

Taking place in Cologne in Germany on 12-13 November 2019, AMI's Profiles conference brings together the entire industry value chain to discuss the latest developments in construction standards, materials and production technologies.

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AGRICULTURAL FILM

Now in its 12th edition, the popular Agricultural Film conference will take place on 18-20 November 2019 in Barcelona, Spain. The three-day programme will bring together agricultural and horticultural cover specifiers, raw material and film manufacturers with agriculture stakeholders.

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To see our full line-up of more than 50 plastics industry events over the next 12 months, please visit www.ami.international/events

Learn more about AMI's upcoming conferences

Click on the relevant brochure cover or link to download a PDF of the full conference programme

POLYMERS IN FOOTWEAR

The third edition of Polymers in Footwear will be held in Berlin in Germany on 19-20 November 2019. The event brings brand owners together with designers and manufacturers to explore the latest developments in footwear innovation.

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POLYMER FOAM 2019

The seventh Polymer Foam conference will be held in Hamburg in Germany on 26-27 November, bringing together an international audience to learn more about the latest chemical, physical and particle foaming technologies.

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FIRE RESISTANCE IN PLASTICS

Now in its 14th year, AMI's Fire Resistance in Plastics conference is the place to discuss the latest regulatory developments and technical innovations in the area of polymer flame retardants. It runs in Cologne in Germany on 3-5 December.

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POLYMERS IN FLOORING EU

Now in its fourth edition, AMI's European Polymers in Flooring conference is the place to learn about the latest market, material, technology and processing developments. The event takes place in Berlin in Germany on 3-4 December 2019.

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THIN WALL PACKAGING

Get your annual update on the global thin wall packaging industry at AMI's Thin Wall Packaging conference on 2-4 December 2019 in Dusseldorf, Germany. The event gathers leading brand owners, retailers, packaging manufacturers, researchers and suppliers.

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TECHNICAL COMPOUNDS FORUM

After six successful years, AMI's Compounding World Forum returns with a new identity – Technical Compounds Forum - to Tampa, Florida, USA, on 3-4 December 2019. This year's focus includes EVs, conductive plastics, wear-resistant compounds and 3D printing.

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To see our full line-up of more than 50 plastics industry events over the next 12 months, please visit www.ami.international/events

Silvergate Plastics Ltd

Head office location:	Wrexham, United Kingdom
CEO	Tony Bestall
Ownership:	AWB Plastics (private limited company)
No. of employees:	30
Sales 2018:	€11m (AMI estimate)
Plant locations:	Wrexham, United Kingdom
Profile:	Silvergate is an independent colour and masterbatch manufacturer with more than 30 years of experience. The company produces custom colour match solutions to exact customer specifications, supplying a globally competitive masterbatch formulation and supply service that extends from short bespoke runs up to large volume commodity orders.
Product line:	The company produces bespoke colour, white, black, special effect and additive masterbatch products. It can supply polymer-specific masterbatches, as well as multi-component products containing processing or performance enhancing additives. Its Optiblow colour/additive product, for example, is said to eliminate die lines and improve productivity by up to 20% in extrusion and blow moulding applications.
Product strengths:	Aside from its high quality, fast turnaround on- and off-site colour matching for standard applications, Silvergate has invested heavily in servicing the recycling sector. The company offers specific colour match solutions that allow adjustment to meet any variation in feedstock colour. It also recently launched a prime performance masterbatch with more than 30% recycled content suitable for food contact projects.

To be considered for 'Compounder of the Month' contact Elizabeth Carroll: elizabeth.carroll@ami.international

Compounding WORLD FORTHCOMING FEATURES

The next issues of Compounding World magazine will have special reports on the following subjects:

November

Carbon black ● Active additives
Polymer reinforcements
Continuous/batch mixers
K2019 show news

December

Flame retardants ● Nanocomposites
Laboratory compounders
Accelerated testing
K2019 show review

Editorial submissions should be sent to Chris Smith: chris.smith@ami.international

For information on advertising in these issues, please contact:
Claire Bishop: claire.bishop@ami.international Tel: +44 (0)1732 682948
Levent Tounjer: levent.tounjer@ami.international Tel: +44 (0)117 314 8183

Keep informed: read our latest editions

AMI publishes five process-specific FREE plastics industry magazines. Simply click on the cover below to read each magazine. Or download the issue in the relevant Apple or Android app

Compounding World September 2019
The September issue of Compounding World discusses how to get more from pigments and also covers bioplastics, stabilisation and purging. Plus a preview of K2019 materials and additives exhibitors.

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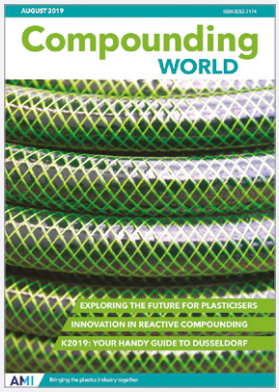

Compounding World August 2019
The August edition of Compounding World looks at the latest technical and regulatory developments in PVC plasticisers. Other technologies in this month's spotlight include reactive compounding, wear resistant machine parts and WPCs.

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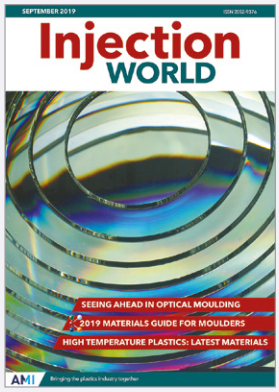

Injection World September 2019
The September edition of Injection World magazine takes a look at the latest in optical and medical moulding. It also reviews developments in high temperature plastics, plus a preview of the material innovations that will feature at K2019.

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Plastics Recycling World September/October 2019
The September/October edition of Plastics Recycling World explores a new sorting technology that uses watermarks to identify polymers. Plus, a look at the latest initiatives in rigids recycling and a preview of K's innovations.

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Pipe and Profile October 2019
The October edition of Pipe and Profile Extrusion magazine looks at the latest developments in materials handling equipment. It also details some innovations in pipe inspection and PVC-O technology, as well as previewing the K2019 show.

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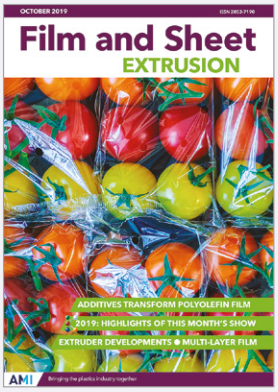

Film and Sheet October 2019
The October edition of Film and Sheet Extrusion explores the latest additive introductions for polyolefin film production. It also takes a look at the role of mineral fillers and previews some of the machinery innovations on show at K2019.

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Take out your own FREE subscriptions to any of the magazines. Click on the logos below to simply register on-line.

Compounding WORLD
Film and Sheet EXTRUSION
Pipe and Profile EXTRUSION
Injection WORLD
Plastics Recycling WORLD

GLOBAL EXHIBITION GUIDE

2019	**16-23 October**	K 2019, Dusseldorf, Germany	www.k-online.com
	17-19 October	Plastics, Printing & Packaging, Dar-es-Salaam, Tanzania	www.expogr.com/tanzania/pppexpo
	25-28 November	Plastivision Arabia, Sharjah	www.plastivision.ae
	27-29 November	Plastics & Rubber Vietnam	www.plasticsvietnam.com
2020	**13-16 January**	Saudi Plastics & Petrochem, Riyadh	www.saudipp.com
	16-20 January	Plastivision India, Mumbai, India	www.plastivision.org
	21-23 January	Swiss Plastics, Lucerne, Switzerland	www.swissplastics-expo.ch
	28-31 January	Interplastica, Moscow, Russia	www.interplastica.de
	9-11 March	Plast Alger, Algiers, Algeria	www.plastalger.com
	11-13 March	Expo Plasticos, Guadalajara, Mexico	www.expoplasticos.com.mx
	21-24 April	Chinaplas, Shanghai, China	www.chinaplasonline.com
	7-13 May	Interpack, Dusseldorf, Germany	www.interpack.com
	3-4 June	Compounding World Expo Europe, Essen, Germany	www.compoundingworldexpo.com/eu/
	8-11 June	Argenplas, Buenos Aires, Argentina	www.argenplas.com.ar
	29 Sep-1 Oct	Interplas, Birmingham, UK	www.interplasuk.com
	13-17 October	Fakuma, Friedrichshafen, Germany	www.fakuma-messe.de
	4-5 November	Compounding World Expo USA, Cleveland, USA	www.compoundingworldexpo.com/na/

AMI CONFERENCES

5-6 November 2019	Medical Tubing, Minneapolis, MN, USA
5-6 November 2019	Conductive Plastics, Vienna, Austria
12-13 November	Profiles, Cologne, Germany
12-14 November	Polyolefin Additives, Vienna, Austria
26-27 November	Polymer Foam, Hamburg, Germany
3-4 December 2019	Fire Resistance in Plastics, Cologne, Germany
3-4 December 2019	Polymers in Flooring, Berlin, Germany
3-4 December 2019	Technical Compounds Forum, Tampa, FL, USA
4-5 December 2019	Long-Fibre Thermoplastics, Dusseldorf, Germany

For information on all these events and other conferences on film, sheet, pipe and packaging applications, see

www.ami.international

PLASTICS RECYCLING WORLD EXPO

POLYMER TESTING WORLD EXPO

PLASTICS EXTRUSION WORLD EXPO

COMPOUNDING WORLD EXPO

3 - 4 June, 2020
ESSEN, GERMANY

4 - 5 November, 2020
CLEVELAND, OHIO

www.ami.international/exhibitions

Technical Compounds Forum

2019

Exploring new ways to add functionality and value to plastics

December 3-4, 2019
Renaissance Tampa International Plaza Hotel, Tampa, FL, United States

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Technical Compounds Forum 2019

After six successful years, AMI's Compounding World Forum is returning with a new name and a new location. The Technical Compounds Forum 2019 will take place on December 3-4, 2019 at the Renaissance Tampa International Plaza in Tampa, Florida, USA.

The event's new identity more accurately reflects the focus of the conference program, which has always been about adding functionality and value to high-performance polymers, including engineering plastics, TPOs and TPEs. Target end-use markets include the transport, electrical & electronic, medical, industrial and consumer goods sectors.

This year's program features sessions focused on hot topics such as polymers for the car of the future, conductive compounds, wear-resistant plastics, and materials for 3D printing.

In addition, the Technical Compounds Forum 2019 will deliver insightful market analysis from AMI, cover new developments in a wide range of additives, and deliver practical tips for getting the most from your compounding lines.

You can also expect the same excellent networking opportunities in the dedicated exhibition area. The extended refreshment breaks, lunches and evening drinks reception all provide plenty of opportunities to build new contacts and reinforce old friendships over two days in a relaxing but focused business environment.

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>
> *Todd Waddle, Market Manager, Compounding and Color*
> *M. Holland*

Headline Sponsor

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Five good reasons to attend:

- **Hear leading experts discuss key trends in technical compounding**
- **Discover new additive and materials technologies**
- **Learn practical tips for getting the most from compounding lines**
- **Gain insights into global market trends and business strategies**
- **Network with other professionals in the compounding industry**

Ways to get involved:

ATTEND

Register before October 11, 2019 and pay $1190 saving $300 on the full price of $1490. There are additional discounts for group bookings. The registration fee includes attendance at all conference sessions, the Networking Cocktail Reception, lunch and refreshment breaks on both days and a set of conference proceedings.

SPONSOR

A variety of sponsorship opportunities are available at this conference to help to promote your company's products and services to this highly targeted international audience. Contact the Conference Hotline for further information.

EXHIBIT

Make it easy to engage with the audience at this busy event with your own highly visible exhibition space. Bring your own display stand and / or banners and use the space to showcase your company's products and services and make a lasting impact. The exhibition runs throughout the conference by the main meeting room and is host to the networking functions.

Space is limited so to avoid disappointment please register for this service as soon as possible.

CONFERENCE HOTLINE

Contact: Kelly DeFino, Conference Team Manager USA
Tel: +1 610 478 0800
Email: kelly.defino@ami.international

SAVE $300
Register before October 11, 2019

AMI | Technical Compounds Forum 2019 | MHolland

Tuesday, December 3, 2019

8:00 Registration and welcome coffee
9:00 Opening announcements

SESSION 1: IDENTIFYING MARKET TRENDS AND EMERGING OPPORTUNITIES

9:10 **Analyzing global market trends for thermoplastic compounds**
Mr. Andy Beevers, Director, Events and Magazines,
AMI, United Kingdom

9:40 **Assessing polymer requirements for the home appliances of the future**
Mr. Maurizio Longhi, Materials Technology Principal Engineer – Resins GSME,
WHIRLPOOL, United States

10:10 **Formulating sustainable thermoplastic solutions in the 21st century**
Mr. Roger Avakian, Owner,
AVAKIAN POLYCHEM CONSULTING LLC, United States, and
Ms. Maggie Baumann, President,
G.H.ASSOCIATES/PERFORMANCE POLYMERS AND ADDITIVES LLC, United States

10:40 - 11:20 Coffee break

SESSION 2: DEVELOPING POLYMERS FOR THE CAR OF THE FUTURE

11:20 **Assessing the rise of electric and hybrid vehicles – what are the implications for engineering plastics?**
Dr. James Mitchell, Gloal Market Director,
SOLVAY ENGINEERING PLASTICS, France

11:50 **Leading into new horizons: novel additive formulations for the new mobility, including autonomous driving, shared mobility and electrification**
Mr. Sebastian Heitkamp, Global Marketing Manager,
CABOT CORPORATION, United States

12:20 **Developing liquid crystal polymers for producing high-performance antennae by laser direct structuring for automotive and 5G applications**
Dr. Young Kim, New Product Development Leader,
CELANESE, United States

12:50 - 2:20 Lunch

SESSION 3: MEETING THE DYNAMIC DEMANDS OF 3D PRINTING

2:20 **Examining the rise of 3D printing and the implications for plastics compounds**
Ms. Hayleyanne Freedman, Market Manager, 3D Printing,
M. HOLLAND COMPANY, United States

2:50 **3D printing and developing mechanisms to accelerate the adoption of 3D printed parts**
Dr. Thomas Fabian, Research Manager, Retail & Industry,
UL LLC, United States

3:20 - 4:00 Coffee break sponsored by: Budenheim

SESSION 4: ADDING FUNCTIONALITY AND VALUE WITH THE LATEST ADDITIVES

4:00 **Improving fire resistance with innovative halogen-free intumescent systems**
Mrs. Carolyn Pressley, National Sales Manager Business Unit Material Ingredients,
BUDENHEIM NORTH AMERICA, United States

4:30 **Advances in additives for tailoring toughness, density, dispersion and scratch resistance in performance compounds**
Mr. Don Beuke, Technical Development Leader,
MITSUI PLASTICS INC., United States

5:00 **High-performance stabilization solutions for challenging technical compounds applications**
Ms. Emilie Meddah, Technical Marketing Manager BL Performance Additives,
CLARIANT BU ADDITIVES, United States

5:30 - 7:00 Cocktail reception

Wednesday, December 4, 2019

9:00 Opening announcements

SESSION 5: EXAMINING ADVANCES IN WEAR-RESISTANT PLASTICS

9:10 **Modifying the wear and friction properties of plastics to deliver fuel economy improvements in the cars of tomorrow**
Mr. Jippe van Ruiten, Advanced Development Manager - ICE Efficiency and Emissions,
DSM ENGINEERING PLASTICS INC., United States

9:40 **Advances in carbon fillers for modifying the wear and friction properties of thermoplastic compounds**
Mr. Rijo Jacob Robin, Technical Product Manager,
SUPERIOR GRAPHITE, United States

SESSION 6: OPTIMIZING CONDUCTIVE COMPOUNDS

10:10 **Challenges and techniques for successfully compounding conductive polymer compounds**
Dr. Paul Andersen, Process Technology Consultant,
COPERION, United Sates

10:40 - 11:20 Coffee break

11:20 **Investigating high-aspect-ratio graphites for high-performance thermally-conductive compounds**
Dr. Anna Ellett, Field Application Engineer Polymers,
IMERYS GRAPHITE & CARBON, Belgium

SESSION 7: MAKING THE MOST OF INNOVATIVE COMPOUNDING TECHNOLOGIES

11:50 **Exploiting a fully configurable process zone to optimize the production of engineering plastics**
Mr. Dana Pulvino, Vice President Sales – North America,
BUSS INC., USA., United States

12:15 **New technologies for compounding heat- and shear-sensitive materials**
Mr. Alan Malott, Global Product Manager, Mixing Systems,
B&P LITTLEFORD, United States

12:40 - 2:00 Lunch

2:00 **Enhancing product quality to enable the circular economy**
Dr. Jeff Galloway, Director of Process Technology, Extrusion Division,
KRAUSS-MAFFEI CORPORATION, United States

2:25 **Top tips for compounding nano-additives in engineering resins using continuous mixers**
Mr. Slayton Altenburg, Application Specialist,
TECHNICAL PROCESS & ENGINEERING, INC., United States

2:50 **Optimizing screw geometries for maximizing dispersion, retaining fiber length, achieving high loadings and handling shear-sensitive materials**
Mr. Prasanna Kumar, Business Development & Process Technology Manager,
STEER AMERICA, INC., United States

3:15 Closing remarks

3:30 Conference ends

AMI reserves the right to alter the program without notice.
The latest program, including any new speakers, changes to the schedule, and any amendments to pricing and terms and conditions can be viewed on our website: www.ami.international

REGISTRATION FORM

Register online

PLEASE COMPLETE IN BLOCK CAPITALS

Company: _____

Address: _____

_____

Country: _____

Tel: _____ Fax: _____

Company activity: _____

Purchase order no. *(if applicable)*: _____

Invoice address *(if different from above)*: _____

_____

_____

_____

DELEGATE/EXHIBITOR DETAILS

Title: Mr/Mrs/Dr/Other: _____

First name: _____

Surname: _____

Position: _____

Email: _____

Special dietary requirements: _____

Signature: _____ Date: _____

Please confirm that you agree to your name being published alongside your company name and job title on the delegate list.

❑ *Yes* ❑ *No*

By registering for this event (please tick these boxes);

❑ *I agree to AMI's Privacy Policy (www.ami.international/about/legal)*

❑ *I agree to AMI's Terms & Conditions (www.ami.international/about/tac)*

PARTICIPATION

	Price
❑ Early Booking Delegate Admission Fee: (Until October 11, 2019)	$1190.00
❑ Delegate Admission Fee:	$1490.00
❑ Exhibition Space:	$2490.00

Total: _____

METHOD OF PAYMENT

You will be sent an invoice in 7-14 working days.

❑ ***Pay by Credit Card by registering online:***

Alternatively, please provide your contact details and we will send you a link to a secure payment gateway via email.

Name: _____

Email: _____

❑ ***Bank transfer quoting:*** 'Your invoice and A/C No.'

Account number: **2000030701584**

Routing number: **121000248** SWIFT: **WFBIUS6S**

Note: You are responsible for any bank charges involved with the transaction

❑ ***By Check:*** Made payable to "Applied Market Information LLC"

TECHNICAL COMPOUNDS FORUM 2019 CONFERENCE INFORMATION

December 3-4, 2019
Renaissance Tampa International Plaza Hotel,
4200 Jim Walter Boulevard
Tampa, FL 33607 USA
Tel: +1 813 877 9200

HOTEL ACCOMMODATION

Delegates are responsible for booking their own accommodation. We have negotiated a room rate of $189 plus tax per night at the Renaissance Tampa International Plaza Hotel in Tampa, Florida until November 8, 2019. To make a reservation, please contact the hotel's reservation department at +1 813 877 9200 and indicate that you will be attending "AMI's Technical Compounds Forum 2019 conference" to qualify for the special room rate. The hotel is guaranteed for a limited number of rooms so do not delay in making your reservation for a room at the conference location.

Please make your reservation using the direct hyperlink which can be found on our website www.ami.international/events (click on 'Technical Compounds Forum' followed by Accommodation).

PARTICIPATION OPPORTUNITIES

Delegate registration: includes attendance at all conference sessions, a set of conference proceedings, entrance into the Networking Cocktail Reception, lunch and coffee breaks.

Sponsor this event: maximize your company profile before, during and after the event by becoming a sponsor. For further information, please contact the Conference Coordinator.

Exhibition space: an excellent way to enhance your business opportunities and make it easy for delegates to find you! Includes:

- entry for one representative from your company
- one exhibition space in the networking area
- your company profile in the conference proceedings
- new and existing product display
- handing out brochures and promotional items from your stand

Spaces are allocated on a first-come, first-served basis and sell quickly.

Group discounts: when registering as a group you may be entitled to discounts. Contact the Conference Organizer for more information.

Networking Cocktail Reception

A networking cocktail reception will be held on the first evening. This offers an excellent opportunity for delegates to meet with speakers and other colleagues. All delegates are invited to attend and admission is included in the delegate fee.

CANCELLATIONS

Full refunds, less a cancellation charge of $300 will be made on cancellations received prior to October 4, 2019. Thereafter we regret that no refunds can be made. Delegates may be substituted at any time. Please note that refunds will not be given on exhibition spaces or sponsorship packages at any time.

CONFERENCE HOTLINE

KELLY DEFINO, CONFERENCE TEAM MANAGER USA
AMI
96 Commerce Drive, PMB173,
Wyomissing, PA 19610, USA
Tel: +1 610 478 0800
Email: kelly.defino@ami.international

The latest program, including any new speakers, changes to the schedule, and any amendments to pricing and terms and conditions can be viewed on our website: www.ami.international